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International Flagship Seminar on Currency Management Issues: Environment and Sustainability of Banknotes

Bali, Indonesia
30th-31st May 2022

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BANK INDONESIA INSTITUTE
2023

International Flagship Seminar on Currency Management Issues: Environment and Sustainability of Banknotes

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FOREWORD

Bismillahirrahmanirrahim

Assalamu'alaikum Warahmatullahi Wabarakaatuh

Climate change has garnered global attention, prompting widespread discussions. The challenge lies in balancing swift development while ensuring nature's preservation. Central banks worldwide are now adopting green banking practices, such as climate-related financial disclosures, given that banks play a significant role in emissions from debtors, classified as bank emissions .

One of the tasks of the Central Bank is related to cash management, which necessitates a sustainable green transition. The carbon emissions from this process add to the environmental problem. To support environmental and climate efforts in currency management, the Central Bank must incorporate several policies and strategies at each stage, from currency production to its eventual disposal.

In 2022, the Bank Indonesia Institute organized an international seminar titled "International Flagship Seminar on Currency Management Issues: Environment and Sustainability of Banknotes 2022" in Bali. Esteemed speakers from institutions like the International Monetary Fund, European Central Bank, Reserve Bank of Australia, Bank Indonesia, SICPA SA, Giesecke & Devrient, De La Rue, and Louisenthal shared their insights. Attendees included representatives from the Asia Pacific's central banks, the cash processing industries, and the banking industry.

The two-day seminar featured sessions from the International Monetary Fund discussing Indonesia's policy pathways towards a green economy, emphasizing the elimination of fuel subsidies, adopting carbon pricing mechanisms, and increasing green investments. The European Central Bank shared insights on climate change's tangible effects and their green initiatives. SICPA SA emphasized their commitment to sustainability in tech innovation, prioritizing environmental health and safety in banknote security.

Day two began with the Reserve Bank of Australia focusing on eco-friendly banknotes, highlighting the carbon footprint of banknote production. They also spoke

about their journey towards achieving "net zero" emissions by 2050. Giesecke & Devrient discussed their environmental initiatives as a money processing equipment provider. De La Rue and Louisenthal shared their sustainable practices, such as using eco-friendly substrates for banknotes. The final session by Bank Indonesia highlighted their efforts toward sustainable cash management, emphasizing energy efficiency, emission reduction, and eco-friendly waste management.

This book, a transcript of the seminar, serves as a valuable reference for academics and the general public interested in eco-friendly cash management. We hope it not only enlightens readers but also inspires environmentally-conscious actions. Acknowledging the climate crisis is pivotal for future sustainable ventures.

We extend our gratitude to all contributors, especially the Bank Indonesia Institute's writing team, for bringing this proceedings book, "Currency Management Issues: Environment and Sustainability of Banknotes," to fruition. We truly value the collaboration behind this endeavor. Enjoy the read, and may this work benefit everyone.

Wassalamualaikum Warahmatullahi Wabarakatuh

Jakarta, November 2023

Yoga Affandi

Head of Bank Indonesia Institute

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Arlyana Abubakar
Director of Bank Indonesia Institute

Honorable speakers, James Walsh from the International Monetary Fund (IMF), Fabio Tamburrini from the ECB, Victoria Pymm from the Reserve Bank of Australia, Eva Aderia from Bank Indonesia, Zeina Abdo and Christopher Schaller from SIPCA SA, Switzerland, David Eric Burke from SIPCA Peruri Securink, Matthias Roehrich and Peter Schemaul from Giesecke and Devrient Indonesia, Mark Spencer from De La Rue and Andrew Forbes from Louisenthal. My fellow central bankers from Asia-Pacific countries, my colleagues from Bank Indonesia, the committee members, distinguished guests, and participants.

Assalamualaikum Warahmatullahi Wabarakatuh

Good morning. Thanks to God Almighty for his blessing that we can attend this Bank Indonesia international seminar on currency management issues, the environment, and sustainability of bank notes as part of the G20 side events. I would like to welcome both the resource persons and participants. It is a great pleasure to have this hybrid event, where some of us gather physically in Bali and others gather virtually around the globe.

The global pandemic affects all aspects of our lives, our collective future prosperity, and our ability to create the foundation for inclusive and sustainable growth. In response to these current challenges, Indonesia is hosting the G20 Presidency in 2022, with the theme Recover Together, Recover Stronger already established. The G20 agenda will focus on three major pillars: (i) global health architecture, (ii) sustainable energy transition, and (iii) digital transformation. Every developed and developing country must be part of a coordinated effort in which economic recovery is deliberately structured to be inclusive, resilient, sustainable, and low carbon in order to close the inequality gap, increase digitalization, and ensure a smoother transition process away from fossil fuel dependence. This Presidency

gives an opportunity to solve various global economic problems. The theme itself reflects our resolve in tackling issues in light of the pandemic and ensuring a strong, sustainable and inclusive recovery ahead. It will depend on our ability to empower the three main pillars of (i) promoting productivity, (ii) increasing resilience and stability, and (iii) ensuring sustainable and inclusive growth.

Massive development that does not pay attention to the environment affects global warming and climate change in various parts of the world. This is a challenge for all parties, including central banks, which must continue to develop while keeping nature in mind. For central banks that are implementing a green central bank and have begun including activities to support a central bank's role in currency management, this seminar will provide a platform to discuss the key challenges of the environment and sustainability of banknotes in currency management. The two-day seminar will cover issues such as global initiatives and policy directions for green economy and environmental impact management, frameworks, standards and best practices for an environmentally friendly central bank, environmentally friendly bank processing in central banks, and industries related to green banknote printing, processing and waste management.

Hopefully, we will see breakthroughs in the effectiveness of currency management, while also taking environmental and sustainability issues into account. For this event, we have many excellent speakers who will share their views and experiences. We would like to express our gratitude to all the guest speakers for their valuable time. We hope that this event will lead to future collaboration. We also hope that this seminar will contribute to support the G20 agenda for sustainability in the area of currency management, as well as provide insight to all participants. Please participate with questions and comments, wishing everyone a light and fruitful discussion. Thank you.

Assalamualaikum Warahmatullahi Wabarakatuh.

KEYNOTE SPEECH

CURRENCY MANAGEMENT ISSUES
ENVIRONMENT AND SUSTAINABILITY OF BANKNOTES
May 30th, 2022

Aida S. Budiman
Deputy Governor of Bank Indonesia

Assalamualaikum Warahmatullahi Wabarakatuh

May peace be upon us all. Honorable speakers, colleagues from Bank Indonesia, fellow central bankers from Asia-Pacific countries, distinguished guests, and participants, ladies and gentlemen. On behalf of Bank Indonesia, it is my pleasure to welcome everyone to the Bank Indonesia International Flagship Program to discuss currency management issues, the environment, and the sustainability of banknotes. We also want to extend our appreciation to the resource persons and participants, especially those from overseas, and the participants who are already in Bali, please enjoy the beauty of Indonesia. Bali is well known around the world as a famous tropical paradise.

Do not worry, the committee always answers the COVID-19 protocol. This international flagship program, which is held annually, is organized by the Bank Indonesia Institute and captures the latest issues facing central banks. This year, the seminar theme is **Currency Management and Green Initiatives**. We chose this topic to support the global and G20 efforts on mitigating the risk of climate change. In fact, climate change and transition risks to a carbon economy are among the priority agendas of Indonesia's G20 Presidency in 2022.

It is well argued that it is important to address climate change and build a green global economy. Climate change may have a broad-based impact not only on natural disasters but also on macroeconomic stability, hence growth sustainability. Therefore, we welcome the political movements that established the Paris Agreement on Climate Change in 2015, as well as the 2030 Agenda for Sustainable Development. Many have begun to implement the initiative. The G20, for example, not only supports the issues but also established a specific working group, the G20 Sustainable Finance Working Group. The working group is focusing on developing sustainable finance

instruments to overcome various challenges in its implementation and to support a green and sustainable economy. In ASEAN, we also consider the development of the ASEAN Green Map. The map provides a common principle-based ASEAN-wide taxonomy and ASEAN-specific green lending principles to encourage the flow of capital toward environmentally sustainable activities.

Indonesia's government has met important recent commitments by establishing the 2021 Nationally Determined Contribution (NDC), which includes an unconditional greenhouse gas emissions reduction target of 26% by 2030 and a net zero emission target by 2060 or earlier. Indonesia also launched the Indonesia Climate Change Sectoral Roadmap (ICCSR), which includes nine sectors facing climate change challenges until 2030.

In supporting the green initiative, many central banks have actively engaged in the act because climate change and central banks' mandates are highly intercorrelated. The well-known Green Swan event is an instance of this. Cost-push inflation events that cause shocks to the financial system could potentially lead to another global financial crisis. This is why the Network for Greening the Financial System (NGFS) is being established. Bank Indonesia is also developing a framework for BI Green Policy and Institution. In this regard, the framework provides guidelines for the more comprehensive and integrated implementation of Bank Indonesia's green policy initiatives. Bank Indonesia plans to implement a comprehensive green transformation by strengthening its monetary and macroprudential payment systems and implementing other supporting policies. Bank Indonesia is also continuing its institutional transformation, which includes the formulation of green performance indicators. Several studies, including those on reserves management and currency management, have been conducted and implemented. In terms of currency management, Bank Indonesia has committed to reducing carbon emissions through a variety of policy initiatives, which includes encouraging the use of renewable natural resources in the cash production process, such as increasing the use of bioenergy and organic materials, and reducing the volume of waste generated by currency management activities. While still in the early stages of development, Bank Indonesia works closely with relevant parties, such as the industry and other central banks. We commit to meeting global initiatives and implementing best practices in this area.

One of the efforts is today's seminar, which will allow more issues concerning green currency management to be discussed and shared. In closing, please allow us to thank and appreciate all the resource persons who have given their valuable

time and knowledge to this seminar. We hope that all participants will have fruitful discussions and inspirations that will help strengthen sustainability initiatives in the central bank and the economy at large. Together, let us build awareness, willingness and capacity to have a green central bank and green currency management. May God the Almighty bless us all. Thank you very much.

Assalamualaikum Warahmatullahi Wabarakatuh

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- SESSION 1 -
INITIATIVES AND POLICY DIRECTIONS IN GLOBAL PERSPECTIVE PERTAINING TO GREEN ECONOMY AND ENVIRONMENTAL IMPACT MANAGEMENT

Master of Ceremony:

The first session, on Initiatives and Policy Directions in a Global Perspective, focuses on the green economy and environmental impact management, and Speaker James Walsh, Senior Resident Representative of the International Monetary Fund for Indonesia, will present. I would like to introduce him briefly before inviting him to the stage. Before being assigned to Indonesia, Speaker James Walsh worked as an adviser in the Monetary and Capital Markets Department, where he managed the department's surveillance, program monitoring, and technical assistance activities across the Western Hemisphere. He also worked in the IMF's Policy Design Department, where he assessed the IMF's surveillance of developing economies. He earned his PhD in economics at the University of Chicago and his BSc in economics at the University of Pennsylvania. We encourage everyone in the ballroom and on the Zoom webinar to stay for the Q&A session afterwards. Please raise your hands or ask your questions in the chat box. Please join me in welcoming Speaker James Walsh, our first speaker, to the stage.

Indonesia's Policy Course and Challenges to Actualize Green Economy
Speaker: James P. Walsh, Senior Resident Representative for Indonesia, International Monetary Fund (IMF)

I do not know if I need this because I am already loud and talk too fast, but I would like to thank Bank Indonesia for the invitation to speak at this conference today, especially Deputy Governor Aida, Pak Yoga from Bank Indonesia Institute and also Ibu Arlyana from Bank Indonesia Institute. It is always wonderful to speak at Bank Indonesia's events in Bali, and it is always informative and very helpful for us at the

IMF to hear different views. It is especially nice to see that with each of these events, more and more participants are able to visit Indonesia from outside, and it is great to see that this is increasingly a world where we are able to meet in person again. And since this idea of recovering together and recovering stronger is part of Indonesia's G20 Presidency, that is a real symbol that this cooperation is underway. Thanks very much for the invitation to speak today.

Climate Change in IMF Perspective

In today's presentation, we will be talking about how the International Monetary Fund (IMF) sees the challenges of the green economy from a macroeconomic perspective, which is maybe a little higher level than what the other speakers will be talking about but it is important to see that this is just part of a general effort as Deputy Governor Aida said to try to move the global economy toward a more sustainable and inclusive model that we can use over the long run to ensure that living standards can continue to increase without putting undue strain on the global economy. That is what we will be talking about for a little while before answering any questions that people have.

As part of the United Nations system, the Fund's view on climate change is that we are tasked with talking to our near-universal membership about how the plans to achieve zero emissions and comply with COP 26 targets can be maintained within a macroeconomic and macro financial framework that is sustainable and inclusive over the long run. The IMF is already looking at a level of emissions around the world that has begun to raise world temperatures and contribute to more extreme weather. Earlier in the week, a discussion came up with some people in North Bali about rain, for example, and there seems to be this impression that the rainy season is lasting longer than it used to, and this would be the kind of weather changes seen all over the world that cannot be tied definitively to climate change but the fact that there are so many of these happening all over the world at the same time would certainly imply that something is going on. Even in Indonesia, which is somewhat insulated from some other aspects of climate change, more of these rapid changes in the climate are being seen than in the past. To try to contain this increase in global temperatures, the various members of the United Nations have issued pledges to try to bring down emissions that are consistent with keeping the global temperature increase under 2 degrees Celsius by the end of this century. Thus far, it is safe to say that we are nowhere near that path. It is quite difficult, and nothing said in this presentation should be interpreted as implying that any of these targets would be easy

to achieve. The alternative, however, is even higher costs later on. The IMF sees the following three steps as the best framework for moving forward and achieving these targets. The first step is to reduce fossil fuel subsidies and correct fossil fuel pricing, allowing market forces to begin investing in renewable energy and zero-emissions technologies that will help the world move to a lower-carbon future.

Second, the scale of green investments around the world would be facilitated by this move toward better carbon pricing. Not only will these green investments be facilitated in a way that increases green energy production, but we must also increase our investment in transmission systems and smart grids in order to use this increased supply of green and renewable energy more effectively. In terms of energy efficiency, for example, retrofitting buildings or converting Jakarta scooters from gasoline to electricity could help us improve the economy's energy efficiency and greenness. Third, and most importantly for the Fund, we must ensure that any transition to a low-carbon economy is done in a just way. This has been something that has come up in all the G20 discussions thus far. There is a need to ensure that the burden is not disproportionately borne by low-income consumers or low-income countries. One tactic to ensure that no one is left behind by this transition is to use the carbon taxes that we will discuss later in the presentation to fund compensation for those who are affected disproportionately by the transition toward a low-carbon economy. That will be particularly important in countries with a large number of people who are highly dependent on subsidized fuels. Indonesia is such a country. This kind of planning for a just transition has to be an important part of any move toward a greener economy.

Pricing Fossil Fuels Better, and Moving toward Renewables

The first step that I mentioned before is removing subsidies and pricing fossil fuels better. The maps on the left show to what extent various countries around the world price fossil fuels differently from how our economists believe that those fuels should be priced to be consistent with keeping global temperature rise below 2 degrees Celsius by the end of the century. The projection of Russia and Canada looks much bigger than it really is, and you can barely see Indonesia on there, but the darker the color is on this chart, the farther away the country's pricing of that fossil fuel is from a level that would begin to bring emissions down. One can see that while some countries are doing a decent job, such as Canada, on gasoline or many countries on natural gas, plenty of other countries have effectively subsidized a lot of these

fuels in a way that leads to overconsumption and excessive emissions. Not to pick on Russia, but they are so large. Coal is relatively underpriced in Russia, as is diesel. Indonesia is a bit difficult to see, but diesel and coal in particular are heavily subsidized in Indonesia. And what this leads to are much higher levels of emissions around the country that not only lead to more pollution and a higher overall level of carbon in the atmosphere, but it should be noted that this also leads to high levels of respiratory disease in Indonesian cities, and this is something we see a lot of in many emerging market large cities. In China and India this is also a big problem because reliance on coal fuel and other kinds of heavily polluting fuels does not only lead to global warming but also to respiratory difficulties, so moving towards cleaner fuels is not only good from a climate point of view but also from a public health point of view.

Moving Indonesia in this direction would be a challenging task. On the right, we have the energy mix that Indonesia currently uses. There is currently a proposal on the table to try to increase the share of renewables in Indonesia's energy generation to about 1/4 of renewables overall within the next few years. That will be quite challenging to reach because, at the moment, renewables make up quite a small share of Indonesia's energy mix, at about 12%. Increasing this overtime is something that should be done, but I do not mean to imply that it will be particularly easy. One advantage that Indonesia has and should be taking advantage of is the proximity of geothermal energy. The geographical situation of the country means that there is quite a lot of geothermal resources that can be used here, and figuring out a way to incentivize investment in those sectors would not only provide an important source of renewable fuel for Indonesia but also kind of a base source of energy to replace coal plants that can be quite difficult to produce in countries that do not have a lot of renewable geothermal or nuclear capacity. Indonesia does have an important advantage there and something that should make it easier to move toward renewable fuels than we would find in a lot of other countries. But still, this transition is quite complicated, challenging and expensive, and at the moment the first step should be to reduce fuel subsidies and try to bring the pricing of these fuels in Indonesia more in line with market levels and more in line with their contribution to environmental degradation.

Fiscal Allocation on Energy

Fuel subsidies in Indonesia are actually quite large, and even from an international perspective, these subsidies remain quite important around the world. What we would point out about this is that unfortunately the subsidy bill is going up quite a lot this year because we have seen this large increase globally in the prices of coal and oil, partly because of higher demand as the global economy recovers and also because of the war in Ukraine. We are sympathetic that this places the Indonesian Government in quite a challenging policy bind because the choice is either between raising gasoline prices, which is difficult from an inflationary point of view and also from a social point of view, or increasing fuel subsidies, which might help smooth over the potential social difficulties but also increases the drain on the economy from subsidizing middle-class people to use gasoline and also postpone Indonesia's reaching of its carbon goals by raising prices toward market levels. We sympathize that it was a difficult decision to make, but Indonesia is not alone in having fuel subsidies. Quite a few large countries around the world have quite large subsidies. These do tend to be smaller in the advanced economies than in emerging market and low-income countries and energy-producing countries in particular tend to have very low fuel prices. It is also worth giving credit where credit is due. Indonesia's subsidies used to be much higher than they are now. The policy was overhauled about seven years ago, and prices were raised. Since then, the amount of fiscal resources that Indonesia spends on fuel subsidies has declined a lot, though I would point out that it is still more than the Indonesian Government is able to spend on healthcare, and that is a real indication of where our priorities are, unfortunately. Before, we were spending more on subsidies than we were on education or healthcare, but even now, with this reduction, we are still spending more on fuel subsidies than on healthcare. Over the long run, reducing these subsidies would allow Indonesia to free up resources that could be spent on healthcare, education or compensating low-income households or other vulnerable households from the higher fuel prices that would come from this green transition.

As mentioned, the goal is to raise carbon prices to such a level that they are consistent with incentivizing investment in green areas. Thus, in Indonesia, raising the domestic price of coal, for example, to such a level that investing in geothermal, solar and wind power becomes economically viable. One key task in that is the carbon tax, where carbon taxes can be used to try to raise the price of carbon-emitting activities to a level that reflects their negative contribution to the environment. Quite

a few countries around the world have begun to impose carbon taxes. Not only does the Fund work with all of these countries with the goal of trying to be a forum for discussing how carbon taxes can be implemented, but it also works with countries to develop an international mechanism for trading investments around the world and making sure that carbon is priced at least at a bare minimum level around the world. The Fund would like to see a global minimum floor on carbon emissions. We are quite a way from reaching this goal so far, but there are some countries that have done this. The example of Sweden, which has relatively high carbon taxes, is a good one. The Swedes imposed a carbon tax relatively recently, but they imposed it at a level that was high enough that it generates revenue for the government, and the advantage of a high carbon tax is that it then becomes harder to cut it because you have to find resources somewhere else to compensate for it. Sweden's carbon tax is not only large enough to generate incentives for renewable energy investment, but it also generates revenue that can be used for other goals, such as compensating people who are left behind by the transition. The Tax Harmonization Law that was passed in Indonesia recently does include a carbon tax, but at the moment it only covers coal plants. It is designed in such a way that it can be built upon, but it is probably not going to have a major impact on carbon pricing yet. But the fact is, imposing it is the first step, and it has already been taken. The next step will be broadening the carbon tax to cover a wider range of carbon emissions, reducing fuel subsidies, and raising the tax to a level that makes it more effective and improves the incentives to invest in green energy. Indonesia's tax is quite low here by comparison. However, it may not be in the Fund's database here because the data set is older than Indonesia's taxes, but it would be at the lower level. It is an important first step, however, toward having a carbon tax that will encourage more investment in renewables and green fuels.

Mitigating Higher Carbon Prices for Low-Income Households

The third component of a policy mix that would result in moving toward a low-carbon economy is making sure that low-income households do not disproportionately bear the cost of the transition from high-emissions economies to low-emissions economies. These green investments mentioned before are very important in that regard. Thus, investing in clean public transportation and smart electricity grids are two areas that are quite important. Jakarta, for example, has quite a large bus rapid transit system, TransJakarta. Moving TransJakarta toward fully electric vehicles would

be an important step in this kind of system and expanding the Mass Rapid Transit Jakarta (MRT Jakarta) would be a good way to try to make it easier to take more people off the roads. Beyond public transportation, encouraging people to shift from gas-powered scooters to electric-powered scooters would also be good. All of these are quite challenging, and one reason for that is the need for smart electricity grids. For example, when you drive around any large city in Southeast Asia, but certainly in Indonesia, there are quite a few scooters, and moving those two-stroke gasoline engines toward electric scooters seems like a relatively easy thing to do. Providing subsidized loans for people to move toward electric scooters or reducing the tariffs on them in a way that would encourage people to shift are both options. But people will also have to be able to charge them, and it is not clear how these charging grids and charging stations would be funded in a country like Indonesia. Thus, this could be something that PT Perusahaan Listrik Negara (PLN), the electricity utility, could be incentivized to do, or it could be something that other private sector entities would possibly be able to be involved in, but the issue would be that this would require to some extent increasing the capacity of the local electricity grid to bear the burden of charging all these vehicles. That is something that would require investment by PLN, which would be quite expensive and probably require fiscal support. These kinds of investments are all in the background of this energy transition and managing them in an effective way is going to be quite challenging. Countries like Germany and China have already gone relatively far toward bringing renewables into the grid, but it is not a perfect system yet and it is not always easy to do this transition. Hopefully, countries can learn from one another on what has been done thus far and try to bring more vehicles into the clean category and try to improve electricity grids around the world to make it easier for renewables to be brought online and incentivize people to move toward them. That is one thing that can be done as a kind of green investment.

The second thing is taking carbon tax revenues and remitting them to households through cash transfers, especially low-income households. Indonesia's experience during the pandemic with the PEN program, the National Economic Recovery program, shows that the country has a pretty good track record and a pretty good capacity for providing direct payments to low-income households and implementing social programs through that mechanism. This is something that would be relatively practical in Indonesia. Later, carbon could be taxed at a higher level, and the money raised from that could be remitted to low-income households. That would allow

low-income households to maintain their same level of buying power despite a higher cost of living related to carbon prices.

There is the capacity to do that here, and it has been relatively successful. These capacities can always be improved. There are other countries that have really made important strides in being able to target such payments to low-income households. India has gone very far in doing that, and that is a country that really has a lot of very creative ways of managing this. There are always ways to share examples, but those kinds of transfers could be done here and have been during the pandemic. That is something that can help smooth the transition and make it more palatable to the voters.

Third, spending on clean infrastructure is not only good for the environment but can also help provide new jobs. One thing we would be likely to see from any kind of green energy transition is a shift in the kinds of jobs that are available. As we can see from how trade was liberalized across the world in the 1980s and 1990s, some people are always going to be left behind under such circumstances, and we should make sure that we are aware of who these people are, for example, people who work in repairing two-stroke gasoline engines for mopeds. There will be fewer of those jobs necessary as we shift toward electric vehicles. Trying to make sure that those people can find jobs in a new economy is important, and that is something that countries have not always been successful with. This means we really have to pay attention to the dislocations that would come from this transition and make sure that as few people as possible are left behind.

Indonesia has imposed a carbon tax, which not all countries have done yet, but it is only a first step. The important thing here is that carbon taxes have to rely on market forces to work, and in Indonesia, a great deal of electricity and other areas where we would need to see reform before being able to move toward a greener economy are not fully market determined yet—electricity prices being the main issue here. The first thing to do would be to try to bring down subsidies. It may not be the right time to be talking about bringing down subsidies two weeks after they were just raised, but we have to keep talking about it. These subsidies should be reduced over time and market pricing introduced for fuels, both at the wholesale and retail levels. This will be important not just for Pertalite and other gasoline and petroleum derivatives, but also for electricity. The way that electricity is priced could be reformed in such a way that would make it easier for renewable energy to be brought online into the grid. That is important. Also, at the retail level, market pricing of electricity,

even if it is done in a way that allows low-income households to get electricity for free, can be done in a such way that encourages conservation and green investments.

Transmission will have to be upgraded. Geothermal energy is an important area for Indonesia to invest in, but these geothermal plants are likely to be located far away from the major cities in Indonesia. That is an advantage with coal, namely that coal can be brought to the city, and the plant can be built there. Geothermal energy cannot be moved. Therefore, you must upgrade transmission lines to be able to bring this energy into the city. This is something that PT PLN cannot afford to do on its own. It will have to be done with some kind of state involvement. This is also part of the transition, and again, do not underestimate the cost or the complexity. An upgraded transmission system and more market-determined pricing for electricity and for other fuels would spark private investment in renewables and, over the long run, should necessitate fewer public resources that can go into this area. And we do see that in a lot of countries, such as Germany, where this transition has gone pretty far, there is quite a lot of investment in rooftop solar. People putting solar on their houses to try to reduce their energy bills has been quite successful. And even in the US, where there is not much of a national public policy on renewables, there are quite a lot of investments in wind and solar because of government programs that have made it easier to bring those resources into the grid. Those are some of the policies that can be implemented to support this transition.

Transition Period for Renewables

The transition period for renewables does come with some costs, and without trying to underestimate them, these costs will vary across countries. One thing that the Fund has found in its research is that advanced economies may see smaller economic costs than some of the lower-income economies. That is probably pretty clear from what we have seen thus far, where we tend to see a lot of high-income economies, especially in Europe, which have gone the furthest toward renewable energy. This is also much more of a challenge in a lot of low-income economies, especially in sub-Saharan Africa or low-income economies in Asia or the Middle East. This cost will be higher for some middle-income economies. This strengthens the case, which has come up in every UN discussion thus far, and we assume the Indonesian authorities will make a priority of this in their discussion of this agenda within the G20. There is a need to ensure that resources are transferred from high-income countries to low-income countries to bear the cost more equitably across the world. We also

find that countries that are growing more quickly will face higher economic costs from moving away from fossil fuels. On the one hand, it is good if you see incomes rising. But on the other hand, it does mean that we have to develop policies that will make it easier to bring renewable energy online as demand for energy rises. We think this is quite clear in China, where income growth has been so high for so long. Over the last 20 years, the Chinese have been able to throw quite a lot of money at renewable energy, but part of that is just because they throw a lot of money at all kinds of energy generation. China has a great deal of experience investing in solar and wind but this is also happening at the same time that they are investing a lot in coal just to be able to increase energy output to a level that is consistent with their growth targets.

We also find that a global infrastructure push to try to increase the capacity of green energy and the ability of economies to absorb it could lead to an increase in global GDP and employment. We believe that this is an important part of the recovery from the Covid-19 pandemic, but to maximize those goals and make the most of resources that may now be idle due to the pandemic but could be brought into the economy, the private sector must be incentivized to be involved in this. It cannot just be done through government rules, and again, incentivizing the private sector means getting prices right and reducing subsidies.

Finally, and maybe most relevant for central banks, is incentivizing the private sector to invest more in green energy. One important way to do this is through developing environmental and social governance regulations or guidelines, ideally ones that are similar or identical around the world, and to try to do budget tagging or other mechanisms for determining what kinds of investments are green and what kinds of investments are not. In Indonesia, the Financial Services Authority (OJK) already has a green taxonomy for investments. Indonesia is one of the few countries that has gone that far. Ideally, we want other countries to adopt these kinds of green taxonomy standards or move toward adopting other countries' standards. Therefore, it is possible that the Indonesian standard could become either a regional or even part of a global standard in these green taxonomies, which would facilitate investment around the world in these areas.

Sustainable Investment Funds

Sustainable investment funds are going to be an important part of this as well. We already see a lot of investment funds around the world trying to focus on sustainable investment and green energy. At the moment, these tend to be relatively small, but they are growing quickly. What we would hope is that as these funds grow, they are supported by an infrastructure of green taxonomies and by budget tagging and other activities that make it clear to investors which activities are supportive of a green economy. These can be important drivers of investment in a greener economy and can help improve corporate behavior and try to get more investment in this green economy. We would also think that these kinds of longer-term investments could bear some fruit in terms of supporting financial stability, as these are relatively long-term projects, and if they are designed in such a way that risk is mitigated, or at least clearly measured and insured against, then that could make some investment funds less sensitive to short-term returns, which could reduce overall financial volatility. That is a bit speculative, but it is certainly something that could be done if we helped develop the appropriate risk-sharing mechanisms.

Finally, we would also hope to be able to channel more funds into these transitions over time. This would be one way to really incentivize the private sector to be as much of a partner in this transition as possible, along with the public sector. A lot of this will have to be led by the public sector in designing these policies, coming up with green tagging, and all of these things have to be at least set by the public sector. But ideally, those rules should make it a good playing field for the private sector to be involved.

Sustainable Finance in EMs is Enjoying Rapid Growth

Sustainable finance in emerging markets is small, but growing pretty quickly. We also see it growing quickly now in emerging market financing, which is a good development. It is not certain how much our data on this reflects the last few months of capital flows out of emerging markets, but things were looking pretty good when we put this report together. We would hope that over the long run, this access to long-term focused and relatively stable funds into the green economy in emerging markets would help the transition in these markets toward a lower carbon economy. Again, emerging markets tend to be faster growing than advanced economies, and the cost could be relatively high here. It is good, therefore, that we now see more of

this sustainable finance and this long-term funding moving into emerging markets, which is important over the long run. We are not sure how much of this over time will go into various countries, but to make the most of this boom in emerging market sustainable financing investment, you really have to lay the groundwork and set up these rules. OJK's green taxonomy is a good first step, but another important step would be improving the pricing of fossil fuels. For example, we are sure there are quite a lot of funds that would be interested in investing in rooftop solar or in geothermal energy in Indonesia, but those large-scale investments in those fields would require overhauling PLN's pricing in a way that would incentivize more investment in renewables and less investment in coal. It would also require shifting PLN's contracted future electricity away from coal and into more renewable areas, though that is a more complicated discussion. The fact is that there are funds out there willing to invest in sustainable energy and sustainable finance. In EMs, it is just important to lay the groundwork and the rules to make sure that that funding comes here.

Climate and Covid-19 Recovery

Finally, we do see climate as an important part of the Covid-19 recovery. Our Managing Director has often said that we should take advantage of resources that might have been idled during the pandemic to try to shift those resources into sustainable energy and renewable fuel. We should also try to make sure that the recovery itself does not jeopardize our climate goals. And that is now doubly true with the fact that we have a situation in Ukraine that has boosted oil prices around the world and coal prices, making it more difficult politically to unwind fossil fuel subsidies around the world. We should not use this as an excuse to postpone the transition toward a green economy, even if it does make it a little more challenging in the short run. We would therefore encourage countries, and we are working with countries around the world, to outline roadmaps for mitigation strategies from climate change and to try to improve carbon pricing mechanisms to develop a global carbon price. We are working with countries to support green rather than brown activities, including renewable energy and carbon capture, ideally over the long run, which would be part this and to try to make infrastructure and construction more resilient. And finally, to make finance green, as said before, trying to channel more money into sustainable finance that can support these goals and these investments around the world.

In conclusion, that was a pretty high-level view of how the IMF sees climate change around the world and policies to support a transition toward a green economy. I am happy to answer any questions that people might have.

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Q&A SESSION

Question:

I just read the report from PwC, entitled **Code Red: Asia Pacific's Time to Go Green**. According to the report, global decarbonization in Asia-Pacific was only 2.5%, which is well below the target for 2019. What is the most difficult challenge for us in Asia-Pacific in achieving this goal? What do you believe the top priority agenda should be for us in Asia-Pacific?

James Walsh:

This is something that we talk about a lot, and in my view, the biggest challenge in Asia-Pacific is going to be getting the pricing of electricity and fossil fuels right. The three largest EMs in Asia-Pacific are China, India and Indonesia. In all three of these countries, electricity and fuels are either subsidized or the prices are administered, and it is relatively easy to move toward a green economy if these prices are market determined. In Europe, for example, and in the US, there is much more of a market determination of all these prices than there is in the big Asian emerging markets. When you already have the framework for market prices, it is relatively easy to impose a carbon tax or to subsidize renewable investment and tilt the playing field away from polluting activities and toward renewable activities. That is much harder to do in the big Asian economies because these markets just do not function as well.

The Chinese have gone the farthest of the big emerging markets in Asia in trying to do this, but even they have not been able to fully move toward market-determined prices. There is still a great deal of central control over the pricing of electricity and the allocation of electricity, and what this means is that it becomes a much heavier burden for the state to try to run this transition. You do not need as much central control over the transition if you let the market manage things. But that is much more difficult to do in countries where there is this high level of state involvement in pricing, and that is true in India and here as well as in China. China has gone the farthest, and the state grid is able to try to push investment away from coal and toward renewables, but there is still tremendous dependence on coal. To me, the

biggest challenge will be the shift toward market prices. Reducing fuel subsidies is always politically difficult. I worked on India when they eliminated their diesel subsidies, and it was very difficult to do. I am very sympathetic to the Government of Indonesia and how they think about raising the price of Pertalite today when global prices are so high. It is very challenging to do this, and I can see the consequences of it in advanced economies. In the United States, the price of gasoline has increased a lot, and Americans are quite upset about it. They get upset about a lot, but at least it happened sort of automatically, so the state does not have to be too involved in this. It is easier to some extent for Americans to shift toward electric vehicles because they see the price impact of doing that, and that price impact is hidden in countries like Indonesia, China and India. That, to me, is the biggest challenge in Asia-Pacific, namely trying to set the ground rules for a market that would encourage people and companies to move away from fossil fuels and toward renewables just because those prices and those markets do not operate yet.

Question:

You have already explained very clearly how to force the market to change the country's use of fossil fuels. Many people worked from home during the pandemic, and the use of fossil fuels was greatly reduced, but people are now returning to the office. Does the Fund have comparable research on how other countries approach this transition? How did they use mass rapid transportation to reduce their reliance on fossil fuels, and how did their government support this?

James Walsh:

I think that is quite similar to the question that was submitted online, so maybe I can answer them both.

Online Question:

You mentioned that carbon taxes are not effective without market forces. In your opinion, what kind of market forces should countries in the world implement in order to strengthen their carbon tax policies.

James Walsh:

I think the online question is the general version, and then the issue of working from home and commuting is a specific case of that. To use market forces to increase investment in a low-carbon economy, you must first get the pricing right so that fossil fuels are taxed at a level that reflects their negative contribution to the environment and energy from renewables is priced at a level that encourages people to use those sources instead of fossil fuels. The carbon tax is obviously one of the first things that you can do to do that. You also have to have a transmission system setup that makes it usable to have these sources and bring them into places where people would need them, such as charging stations around the world. Markets only work with prices. That is the only way to get around it. Otherwise, you have to have somebody telling people what to do. The only way to have market forces drive this transition is to have a price mechanism that people respond to.

When you talk about commuting, it is very true that we saw a real decline in emissions around the world when people were all working from home. I moved to Jakarta a year ago, and a few days after I moved here, you could see the volcanoes south of the city. I said, "Oh, it is great that you can see the mountains from here," and everybody said, "Well, soon the pandemic will be over, and then you will never see them again." And that is exactly what happened. Eventually we all go back to work and the skies get gray again. Ideally, what we would want is if people go back to commuting, we do not need as much commuting as perhaps we had before. A lot of people from all over the world discovered that we are able to work productively from home—at least some of the time. Maybe we can have less traffic overall that way, but we also should incentivize people to move away from gasoline. One reason we do not see very much of that in Indonesia is because gasoline, especially Pertalite, is heavily subsidized now. The subsidy is quite high because global gasoline prices have risen while the domestic price of Pertalite has not. As a result, there is not much of an incentive to shift toward electric vehicles here. And beyond that, electric vehicles are subject to very high tariffs, making them quite expensive to buy in Indonesia. I would contrast this with what you can see in a lot of advanced economies right now, which is people who buy electric vehicles in the US taking pictures of their gasoline prices and bragging that they do not have to pay for gasoline anymore. It is kind of a silly thing that people do on social media, but it is an example of how people do respond to market forces in the US and, to a lesser extent, in Europe, where there is just more efficiency overall. But in the US, there has really been a shift

toward electric vehicles as gasoline prices have risen, partly because people think that they can save money on this. As a result, electric vehicles only reduce emissions if the electricity comes from relatively green sources. You can see from those market prices in action that as gasoline prices rise, if consumers expect them to stay high, they will shift toward electric vehicles. Not only do consumers make that decision, but companies will also invest in renewable grids. One way you can see that in the US is through private companies setting up charging stations for electric vehicles. Restaurants are now doing that in the US, setting up charging stations to encourage people to park their electric vehicles in the parking lot and charge them while they eat at the restaurant. Those investments only exist because of market forces that are pushing people away from fossil fuels, and this is in a country where there is not any kind of carbon tax and there are only minimal subsidies for wind and electricity. But even that basis does not exist in a lot of emerging economies and does not really exist in Indonesia because coal and gasoline are so heavily subsidized here. If you want to make the most of this return to work, the only way to have market forces have an impact on commuting patterns is by having the prices work and by setting up what we would see as a level environmental playing field that taxes fossil fuels more than renewables.

Question:

Has the Covid-19 pandemic had a significant impact on green economy implementation since the economy has slowed?

James Walsh:

It probably has, but we do not think it should. I mean, yes, of course it does, because I mean on the one hand, the pandemic encouraged people to stay home much more for two years. That gave us a little bit of a reprieve on overall carbon emissions, but that went right back up as soon as people could go back to movie theaters, go on vacation, and even go back to the office. But a more damaging thing in the long run will be that a lot of countries have higher levels of debt now than they did before the pandemic and a lot of economies around the world were affected by this. The overall productive capacity of many economies, therefore, especially emerging markets, is probably lower than we would have forecast a few years ago because so many people stayed home during the pandemic and we see scarring effects from

companies that have higher levels of indebtedness, or kids who have stayed out of school for two years. The overall capacity of economies to deal with this challenge is probably a little less than it was before and governments in most countries almost everywhere spent quite a bit of money to try to cushion the blow of the pandemic and that means that debt burdens are a little higher. Consequently, there are maybe fewer resources to deal with this and less overall economic capacity but that does not mean that the challenge is any less, unfortunately. As people return to normal consumption patterns, we will still see high levels of emission. Unfortunately, it probably has made it a little more difficult to deal with this, but we still have to figure something out. And that also means that the benefits of shifting toward a renewable energy economy are disproportionately greater if that can help us reduce long-term damage from these higher emissions. But yes, it has an impact.

Online Question:

Since renewables are a new technology that requires time to research, and a logical output consequence is the high cost to apply, what do you believe should be prioritized first, especially for a mid-sized economy attempting to transition to a green economy? Should we prioritize green economy regulations or investments in order to achieve reasonable costs that are affordable to low-income households?

James Walsh:

A lot of these technologies are quite tested and effective now. The one that I would focus on is rooftop solar. Currently, in Germany and in some other countries (Germany has gone the farthest in doing this), the power company will buy any electricity that you produce from a solar panel installed on your roof. If you have your own solar panel on the roof, then that helps generate the electricity that you need, at least during the daytime. And then, if you have excess electricity that you do not need, you can sell it to the grid. Today, rooftop solar is quite common in a lot of countries, including the United States and plenty of other places in Europe but the Germans have gone the farthest, integrating it into their overall grid and broadening the policy the most. Rooftop solar could be quite effective in Indonesia, where there are relatively high levels of solar radiation. Indonesia is on the equator, and many people live in single-story houses where they could put solar panels on their roofs, outside of the cities at least, but even in the cities, plenty of people live

in single family houses where they could install rooftop solar. This is something that, at least theoretically, could really reduce the amount of energy that the system needs to generate from coal, and we could replace it with clean fuel. The problem is that it is very challenging to bring around these kinds of investments. The main obstacle to this are the regulations that govern Indonesia's state-owned electric company Perusahaan Listrik Negara (PLN). This is not really PLN's fault, they operate under a system of rules that makes it very difficult and uneconomical for them to buy rooftop solar. On the one hand, their grid can easily be overloaded if there is a lot of energy being generated by solar and it goes into the power grid in Java and Sumatra, then they have to turn off coal plants to keep the system from overloading. Moreover, we would have to invest in their grid to try to make that easier. They also have already signed long-term contracts with coal companies, which means that we probably are very unlikely to have blackouts in Java or Sumatra. I am not sure if Bali is in the grid-maybe I should be including Bali, but in Java and Sumatra we tend not to have blackouts that you will find in a lot of other countries because PLN has done a great job of sourcing electricity but the problem is that it comes in the form of long-term contracts with coal companies. You have already contracted to spend the money, therefore buying rooftop solar does not make a lot of economic sense when the capacity is already there.

Second, there has to be a way to offload this capacity. And third, you would have to not only improve the reliability of the grid to deal with potential overload, but also make sure that the grid is more robust around the country to be able to transmit this solar from places that are cloudy to places where it is sunny when it is being generated, or to make sure that if it is cloudy all over the archipelago, which seems to happen whenever I go on vacation, that you can shift into higher base fuels like geothermal, ideally.

It is not so much that we do not have the technologies to move into things like renewables and rooftop solar and wind, it is often that the mechanisms we have set up that govern the pricing of power and the allocation of power or the investment in the electricity grid is insufficient to really bring these things online. And I am not saying these are easy challenges, but it is not so much a question of unproven technologies as a question of just the difficulties of managing the nuts and bolts and the rupiahs of the transition.

Online Question:

I would like to ask about this carbon issue, which is well-known in all big countries, not only developed but also underdeveloped countries. Does this issue need just a campaign or special enforcement to decrease carbon? And what is the most effective mass effort that leaders can do?

James Walsh:

It is a global problem, even though the solutions have to be implemented on a local level, so the best way that we can get countries to coordinate on this is to have forums for discussing not only how we can bring about the transition, but also how we can make sure that it is handled in a just manner and that countries that are disproportionately affected by this can be compensated in some way. I would point out that Indonesia is chairing the G20 this year, and this is the most widespread ongoing forum for discussing these issues, and climate change is one of the main topics this year. It was last year, and I am sure it will be under India's Presidency next year. This is such an important issue and this is the forum for discussing it. The G20 countries are, I think, 85% of global GDP and anything that they can agree on, any minimum carbon price or any minimum set of policies would effectively be a global standard. I would say that Indonesia has the opportunity to lead the dialogue this year on climate change and we should make sure that Indonesia takes advantage of that and make sure that the transition is just and does not leave anyone behind.

Online Question:

As we know, climate change is one of the causes of tidal flooding in several countries, including Indonesia. Even Jakarta is predicted to sink in the next ten years. What is the IMF's role in responding to these conditions in various countries?

James Walsh:

The longer we wait to bring emissions under control, the higher the costs of mitigation will become, making this yet another issue in which mitigation is a part of the problem and how we deal with potential costs of climate change. I do not think the Fund has a view on when Jakarta would be sunk and since I live there, I hope it is not all that soon, but eventually there will have to be some kind of mitigation measures

all over the world to try to deal with the fact that we have not gotten this problem under control and sea levels will begin to rise. We will have more flooding and more extreme weather events. The way the Fund tries to work with countries on that is to try to first reduce the long-term mitigation costs by working with countries to bring emissions under control, but second to try to work with countries on how to think about climate mitigation strategies. We are not experts in mitigation or how to protect a low-lying city like Jakarta from rising sea levels or increased flooding, but we do talk to governments about how to set up disaster relief funds, how to finance long-term investments in infrastructure that could be used to protect cities and protect residents from the effects of climate change. That tends to be how we are involved in it. Trying to think about how we estimate these costs over the long run and how we prioritize fiscal resources to go into these areas.

Online Question:

In your opinion, will the sustainable finance taxonomy have a significant impact on the transition risk associated with climate change?

James Walsh:

There is a lot of components that have to go into climate change and sustainable financing has to be an important part of it. I mentioned before that if you want to have market forces to be employed to reduce the effects of climate change, then you need to have prices that work and part of pricing is about making sure that people know what they are buying, and these green taxonomies are making it clearer for people to know what they are investing in. It is important for countries to have this because, when it comes to sustainable investment funds and other climate funds, people need to know what kind of projects they are investing in, and there needs to be some kind of impartial observer who has established an agreed-upon definition of what constitutes green finance and what does not. The European Union and Indonesia and a few other places have come up with these taxonomies and what is helpful for those is that they can tell us what kind of investments are green out there. In some ways, this is an important part of improving the pricing mechanism to incentivize investment because it clearly explains what these projects are and where green investments can go. It is just one more part of a long and not always easy set of reforms that have to be undertaken to try to get this under control.

- SESSION 2 -
FRAMEWORK, STANDARD AND BEST PRACTICES TOWARD ENVIRONMENTALLY FRIENDLY CENTRAL BANKS

Master of Ceremony:

Fabio Tamburrini is an economist for the Climate Change Centre of the European Central Bank, working primarily on European and international policy issues on climate change and sustainable finance. He advises the European Commission on the development of its sustainable finance agenda and the implementation of the EU Taxonomy. He is also the European Central Bank's (ECB) representative in the European Union's Energy Centre and Climate Change Working Group of the European Union Council on Economic and Financial Affairs. He previously worked in the European and International Department of the ECB, the Organization for Economic Co-operation and Development, and the Italian Presidency of the Council of Ministers. He holds degrees in economics and public policy from Bocconi University, the Hertie School of Governance in Berlin, and the University of Bologna

The ECB and Environmental Sustainability
Speaker*:* Fabio Tamburrini, Economist, Climate Change Centre, Council to the Executive Board, ECB

The topic of this presentation is a little broader than some of the presentations that will follow, but it is meant to set the stage and give a bit of insight into how the European Central Bank (ECB) has been dealing with the topic of climate change, which is ultimately the key topic of this event.

1. Climate Change and Central Banking

Scientific Evidence on Climate Change: CO2 Emissions Over Time

This probably does not need to be stated again because everyone is aware of it, but it is worth reiterating the challenge that this coming and this change posed to us all. It is well known that our planet's climate has changed over time due to a variety of factors and natural trends that regularly occur, but the increase in CO2 concentration that occurred over the last 200 to 250 years is unprecedented, according to the Intergovernmental Panel on Climate Change (IPCC). CO2 emissions have risen at the fastest rate in at least 800,000 years as a result. The latest IPCC report provides conclusive evidence that this is due to human activities, and it is widely known that the observed increase in CO2 emissions is statistically correlated with the increase in temperature due to the greenhouse effect of CO2 and other greenhouse gases.

Scientific Evidence on Climate Change: Temperatures and Emissions

The key insight from the scientific evidence is that the trajectory of this temperature increase will be critically dependent on how quickly humans reduce CO2 emissions and mitigate climate change. The economic damage caused by rising temperatures will also be determined by how quickly we adapt to the changes that are irreversible or must be contained but cannot be completely reversed, at least in the short term. This translates to risks for the economy as a whole, and has a feedback effect. Now is the time for central banks to think about these issues.

Climate Risk: Definitions

The conventional classification of these risks is familiar to everyone. Physical risks include the economic and financial impact of climate change, which includes not only more frequent extreme weather events and environmental degradation, but also more gradual changes in climate. As a result, the physical risk can be divided into two categories: chronic and steadily rising temperature levels and biodiversity loss or resource scarcity. There are also more acute events, which are more about extreme weather events, such as droughts or storms, that can cause very localized but extremely severe financial losses. There is also transitional risk, which is a catch-all term for all the economic costs and financial losses associated with the transition to a low-carbon, carbon-neutral economy, including both the potential risks resulting from public policies, such as regulation, the introduction of carbon taxes, and the

impact on businesses profitability and viability, for example. But it also captures the idea of technological disruption, which may render certain technologies obsolete, replaced by newer, more efficient technologies. Everyone should be familiar with the two main risk categories.

Why Does Climate Change Matter for the ECB?

What does this mean and why do they matter for central banks? In a bit of an intuitive sense, why it impacts financial stability is shown on the left side of this slide. There is an element where physical risk on the one hand has led over time to an increasing number of nature-led events that have created financial losses. This is something that the insurance sector has been dealing with, and they are very keenly aware of because they have to insure against events that have become more frequent, and the financial impact of nature-related events has increased over time.

On the one hand, this reflects the fact that with a growing human population and population density, of course there is an issue there, that humans are more concentrated and therefore more exposed but this is only one pillar of the story. The other element of the story is that this also reflects the increased frequency and intensity of these events. And the second element on the financial stability side is the idea of transition risks. The ECB began analyzing the exposure of the financial sector, particularly the banking sector, to transition risks a few years ago, and saw that there was a significant concentration of carbon-intensive sectors across a relatively small pool of banks, making them particularly exposed in the event of a transition to a carbon neutral economy. As a result, both arguments call for careful monitoring of what climate change means for financial stability. On the right-hand side of the slide, there is a bit more of a narrative sense of how the ECB came to realize the importance of climate change for its monetary policy approach due to the impact on prices and output. The photograph (please excuse the Eurocentric perspective) is of a small city in Germany called Bingham next to the Rhine, which has a major European waterway used for transportation from north to south in Northern Europe and vice versa. Normally, this small area is traversed by barges and ferries that travel from one side to the other. In 2018, however, there was a major drought that reduced the amount of rain to the point where people could walk from one side to the other. This anecdote is relevant because the Rhine transports distillate fuel from Rotterdam on the North Sea all the way down into the Rhine Basin. When there was a record level decline in 2018, the prices of barge freight rates on the Rhine increased, and barges

could no longer afford to travel across the Rhine all the way to Basel, which is also on the Rhine Basin. That created a spike in oil prices, which was completely unexpected, and the ECB had to fix the models that they had back then to predict how energy prices would develop. That turned out to be a key determinant of inflation in that quarter. This is just one example. But, of course, the Russian war in Ukraine and its impact on energy prices is a clearer example of how the green transition will likely affect energy prices. As such, central banks must pay close attention to the impact of climate change and the green transition on prices and output.

Why is Climate Change Relevant for the ECB?

If one takes a monetary policy perspective, this translates into two elements. On the one hand, we needs to look at climate change because it effects the outlook for price stability as well as the impact on macroeconomic indicators, especially inflation figures, but also financial stability and the transmission of monetary policy output more generally. The financial side, however, is not only an issue of financial stability; it is also an issue of the assets that central banks hold on their balance sheets, which can be exposed to climate risk themselves. These two factors call for the ECB to pay close attention to this issue.

Why Climate Risks are Special

Climate risks are also special and different from what has been dealt with for a very long time. There is a very strong global dimension, which is strong in general given the economy's interrelationship, but it is even more global when it comes to climate because the policies made in one jurisdiction affect the climate in all jurisdictions. Furthermore, there are strong amplification mechanisms, non-linearities and tipping points, which is everyone's main concern because nobody knows for sure whether we have reached a tipping point of climate change. This may cause an irreversible acceleration, which cannot be modeled at the moment—it may actually overshoot our worst expectations. A classic example is that with the rising temperatures in the Arctic, the permafrost might release large amounts of methane, which is stored under the Earth, and that could create a huge increase in greenhouse gases in the atmosphere. There is also a large amount of uncertainty, which makes modeling and forecasting especially difficult. There are very complex interactions because the policies of today affect outcomes in the future, and these are very complex interactions due

both to the complexity of the economic system and the complexity of the natural system, which filters any output that we produce from the economy. There is also the issue of long time horizons, where the most dramatic and catastrophic effects of climate change are going to happen over the long run. We know that as humans, we have a certain short-sightedness when it comes to understanding effects over long time horizons, and we tend to underestimate what happens very far in the future. We discount it, and we might actually underestimate its costs. There is perhaps the strongest argument for taking climate change very seriously, which is its irreversibility. It is contrary to many macroeconomic impacts and shocks. Climate change is going to be to a large extent, irreversible once it happens. Without a proper mitigation, this is going to stay for a very long time and affect human civilization for the foreseeable future.

Trade-Off between Inflation vs Output

The concept of a negative supply shock is one way to imagine the impact of climate change. Although there are other impacts on demand, the most notable is the impact on aggregate supply. It is also known from basic ECON 101 that if there is a negative supply shock, which is stylized here, the price stability oriented central bank should react by raising interest rates because their primary objective is price stability, and therefore, even if this comes at the cost of output loss, that is the optimal policy response that a stability-oriented central bank should do. There are clear economic costs to this, as climate change creates a situation in which central banks may face the very uncomfortable trade-off of output stabilization versus inflation stabilization more frequently. Not a nice position for central banks to be in.

Example: Carbon Pricing

Why is it important? Normally, central banks might think, OK, what makes this shock different from, say, a carbon tax? Why is a carbon tax so important for the central bank to keep in mind? Usually, central banks consider a one-off increase in carbon taxation, but the specificity of climate change and climate change policies mean that increasing the price of carbon is the most effective tool for doing so. However, this will not be a one-off increase. Rather, it will be a permanent increase with an upward slope. Here in light green, there is a one-off increase in the price level due to a tax and usually central banks look through such an increase. This is the price level,

not the inflation level, but it illustrates a bit of a static intuitive understanding of it. The central bank would look through and disregard this tax because it is a one-off and will not affect inflation expectations. But when you have a carbon tax that is increasing over time because that is what is needed to mitigate climate change, that will also affect inflation expectations and therefore might require prompt action by central banks to avoid the second-round effects. This is indeed the case because the optimal carbon price models the ECB have suggest that the price of carbon should increase significantly over time. This will extend to consumers and price setters will internalize this expectation, thus affecting wage formation and inflation expectations, feeding back into the central banks' decision-making process, which should respond proactively to avoid sustained levels of so-called greenflation, as a member of the ECB executive board recently put it. This will be the optimal way for central banks to respond to climate mitigation policies. However, this would imply a trade-off between output stabilization and inflation stabilization.

Policy Ambition to Limit Climate Change May Increase Transition Risk, but it is also a Long-Term Opportunity

There is also the short- versus long-term tradeoff to consider. Delayed mitigation action would, of course, increase the so-called physical risk, resulting in more severe, both acute and permanent, effects of climate change, while the short-term cost of the economic adjustment may be arguably lower. On the other hand, the long-term catastrophic effects of climate change would be reduced by making a very swift and rapid transition. But this of course comes at the cost of potential transition risks that must be managed. These two risks are somewhat in balance, and one must strike the optimal policy approach to it. This is not easy to model or execute in terms of optimal policy making.

ECB Mandate and Climate Change

Here are the institutional aspects of what consequences the ECB draws from all of this evidence and the status quo. The question now is what the ECB can do about climate change? This has legal implications and it is no secret that some skeptics believe the ECB has nothing to do with climate change and that its legal mandate does not allow for such a focus on climate. The ECB, on the other hand, disagrees with those skeptics. I will provide a glimpse into the legal framework. The ECB's primary

objective is to maintain price stability, and climate change influences price stability and the price outlook through its impact on macroeconomic variables and affects the value and risk profile of the assets on the Eurosystem's balance sheet. As a result, at least in this reactive sense, climate change must be factored into the framework. The ECB has a secondary objective, without prejudice to the primary objective of price stability, the European System of Central Banks (ESCB), which is made up of the ECB and all of the EU national central banks, should support the general economic policies in the Union with a view to contributing to the achievement of the objectives of the Union. Among which, the high level of protection and improvement of the quality of the environment figure prominently in the Treaty on the European Union. There is a primary mandate that calls for looking at climate change and its impact on price stability, but there is also a secondary mandate that forces the ECB to take into account this issue to support the general economic policies of the Union. Everyone is also familiar with the fact that the EU has a very ambitious green agenda, the European Green Deal, which aims to make the EU climate neutral by 2050.

Climate Change is a Priority for ECB in Several Policy Areas

This has also prompted the ECB) President, Christine Lagarde, and the Executive Board more generally to place climate change at the top of their agenda in several policy areas across all its operations. On the one hand, when it comes to economic analysis and for the complex challenges explained earlier, the ECB will have to invest heavily on making sure that climate change and mitigation policies are accounted for in the macroeconomic models, staff projections, the assessment of risk done in the context of forecasting, and make sure the impact on monetary policy transmission is understood. On the monetary policy implementation side, not much on the conduct decision of the monetary policy stance, but more on the on the concrete implementation of monetary policy, the ECB has also decided to include climate change consideration in the way it operationalizes its monetary policy framework. In addition, the ECB has been the banking supervisor since 2015, as well as the banking supervisor for the larger banks in the European Union. As part of the control, ECB supervisors aim to integrate the risks emerging from climate change and, more broadly, environmental degradation, into the current supervision of banks to ensure that banks are able to manage these risks appropriately. Furthermore, the ECB is responsible for financial stability monitoring, and they are investing heavily in advanced analytics to understand the impact of climate change on the stability of

the entire financial sector and to determine whether it poses a systemic risk to the financial stability of the European Union.

2. Climate Change in Monetary Policy Strategy View – Climate Change Action plan

Why Now?

This brings it to a whole other point, which is the ECB climate change action plan. The ECB concluded its first review of its monetary policy strategy in 13 years last year. Climate change was highlighted as one of the many key topics to discuss in this strategy review, but it was only one of the pillars.

The Governing Council is Strongly Committed

In relation to climate change, the ECB Governing Council decided to incorporate climate change considerations into its monetary policy framework and operations in order to expand its analytical capacity, as has been confirmed to be the trend, and to enhance its contribution to ongoing policies in the area of sustainable financing in the EU by adopting extensive environmental sustainability disclosures and reporting for its own operations.

ECB Balance Sheet

Why is that so? Why focus on ECB monetary policy operations? In terms of the background, following the global financial crisis and the EU follow-up, which was also the European sovereign debt crisis, the ECB launched a large quantitative easing (QE) program in 2015, which is largely focused on public sector purchases on the secondary market. As shown on the blue and red side here, but looking specifically at the violet side—the private purchases—or more specifically, the Corporate Sector Purchase Program (CSPP). As part of ECB quantitative easing, large amounts of private sector bonds are purchased to improve the financing conditions of the economy and ensure that transmission also reaches those parts of the economy, rather than using bank lending as the channel of financing. Of course, the exceptional economic conditions at the time, as well as the need to meet the monetary policy objective, drove this decision. However, public interest in this is growing, including non-governmental organizations, as well as European Parliament members, pointing out that the ECB was also purchasing the securities of large polluters as part of these purchases,

thereby improving financing conditions for companies that contribute significantly to CO2 emissions. This has increased pressure on the ECB to act and ensure that this does not happen again, because, as was claimed, the ECB as a public institution should set an example and support EU policies toward carbonization, and thus take measures to mitigate this risk that these purchases are allegedly contributing to.

ECB Action Plan on Climate Change: Focus Areas for Monetary Policy Framework

It was eventually decided to include climate change considerations in its corporate sector purchases. The Governing Council created it more broadly to reflect climate change risks, which also required a collateral framework to enhance risk assessment capabilities of how climate change risks affect its own balance sheet, thus integrating these disclosure requirements for environmental and climate information as part of the eligibility criteria for accessing those monetary policy operations.

Climate Change - ECB Action Plan

The result of this was an action plan of several measures that the ECB committed to implement between 2022 and 2024, possibly going even further. First, there will be macroeconomic projections, which will include assumptions about carbon pricing and climate mitigation policies. There will also be proposals in the corporate sector purchase program to adapt the framework to include climate change considerations, with the first announcement on this topic expected in the middle of this year. An effort was also made to improve analytical understanding of the Eurosystem's balance-sheet exposure to climate risk. As a result, we conducted a pilot climate stress test on the balance sheet. The Governing Council decided to review the valuation and risk controls of the ECB collateral framework. This is essentially a framework that ensures that the collateral the ECB accepts from its counterpart to monetary policy operations does not carry risks that could endanger our own financial soundness, thus undermining the monetary policy objective. Eventually, taking measures to avoid taking on too many credit risks and too many financial risks on the balance sheet. That is what the collateral framework typically does, and it was decided to review this system, both in terms of collateral valuation and other forms of risk controls, to ensure it reflects climate change risk to the extent that it has not already been priced in. There was also a commitment to assess how to accommodate financial

innovation, such as new financial instruments being developed in the world of sustainable finance, and to integrate those into the framework.

There are disclosures, which involves starting preparations to introduce disclosure requirements for the private sector assets purchased through the collateral framework, as well as corporate sector purchases, as previously mentioned. Finally, a work stream is dedicated to statistical data. The ECB committed to developing a set of indicators to help the organization capture a wide range of variables related to climate change risks, carbon footprint, and sustainable finance data.

Climate Change – Eurosystem Roadmap

This will all take place in 2022, and here is a stylized description of the measures, which is too detailed to present. It extends well into 2024, however the first measures are already in place. Macroeconomic projections, statistical data modeling, corporate sector purchase program, and so on. This has already been covered in the slides, so we will not go over it again. This brings the overview of monetary policy at the ECB to a close. There will be a roadmap announced in a few months in 2022. This means that the ECB will not be able to provide you with immediate results but will instead create expectations. Meanwhile, keep an eye on the ECB website for updates in the coming weeks.

3. Climate Change, Financial Stability and Prudential Framework

The next point is what the ECB does in terms of financial stability as well as monetary policy. Earlier, I mentioned why it matters for financial stability and the few elements of the analysis that are ongoing, but first, here is a brief overview of this. What is the ECB work on climate change, financial stability, and prudential policy?

ECB Work on Climate Change, Financial Stability and Prudential Policy

First, it is about risk monitoring. The ECB has invested heavily in an analytics framework to monitor and understand precisely this risk because, given the complexity outlined, the longtime horizons and their complex interactions, this risk is difficult to capture with traditional financial metrics and necessitates the development of an analytical framework. This is what the ECB has been doing, especially since climate risks are very forward-looking. In some ways, looking backward does not provide

a clear picture of how they truly are because climate change has never happened on the scale that we are experiencing now. As a result, there is no historical data to capture those types of risks, necessitating a look into the future. For this reason, scenario analysis and stress testing are particularly useful tools, and the ECB developed the climate stress test tool to test the impact of climate risk. This will be discussed further in a later slide, but the ECB is also working on the supervisory side and contributing to all regulatory work, looking into the treatment of climate risk in the prudential regulatory framework. Finally, there is the aspect of green finance, which is developing rapidly, and the ECB supports efforts to develop green finance, while also monitoring market developments.

The ECB Completed its First Economy-Wide Stress Test

What about the climate stress test? The ECB carried out a large-scale exercise, one of the most advanced, employing climate scenarios and analyzing how those scenarios affect the economy. It is a large-scale exercise because it includes both a climate module and an economic module that is transmitted at a very granular level to the financial sector. It is a very granular exercise that can track different climate scenarios over the next 30 years and how it will impact the economic system. Furthermore, for each financial institution, mapping out the impact on their counterparts and then the feedback effect that this has on the financial metrics of the financial institution. As a result, the ECB will have a better indication of how financial institutions and the financial sector as a whole would react to these different climate scenarios. The climate scenarios used were those developed by the Network for Greening the Financial System (NGFS). This, in turn, is based on the Intergovernmental Panel on Climate Change (IPCC) scenarios. It is very granular climate and financial data, which had to be collected for millions of corporations with all the interactions to euro area banks via exposures, not only through a loan book, but also through the security audit. It is an extremely sophisticated exercise. The results first point to short-term costs of the green transition, as expected. Of course, there is no such thing as a free lunch here, but the short-term costs are always more than compensated by the long-term benefits, implying the previously mentioned trade-off between short-term costs in terms of transition risks versus the benefits in terms of reduced physical risk. As a result of the model, this became very apparent. If green transition policies are not implemented in a timely manner, we would enter what the ECB calls a disorderly transition scenario, in which physical risks become increasingly

and non-linearly higher. And, due to their irreversible nature, they are constantly increasing. As a result, there may be a scramble to mitigate the last-minute effects, which would then further amplify the negative physical risks through heightened and sudden transition risk.

The impact of climate risk will increase moderately until 2050, but it is concentrated in certain areas and sectors. This exercise was also able to perform a very granular geographical analysis of the various drivers of physical risks, finding that, for example, droughts were especially concentrated in southern Europe, thus affecting certain economic sectors, including agriculture, and the banks exposed to those sectors in those countries. There is also an increased risk of flooding, particularly in central northern Europe, affecting all establishments located near waterways in northern Europe, and so on. Again, there are very concentrated pockets of risk in specific sectors and geographies.

ECB Supervisory Expectations

In addition to the climate stress test, the supervisors, as previously stated, have been working to integrate climate change risk management into banking supervision practices. As a result, the ECB issued a comprehensive Guide on Climate-Related and Environmental Risks in 2020, outlining the supervisory expectations of the ECB towards banks on how to deal with climate risks. It is what supervisors expect to see banks do. If they do not, it is a compliance approach in which banks explain why they are not doing it.

The Guide Covers Expectations Related to Four Key Elements

The Guide covers a variety of aspects of a bank's operations, such as the business model and strategy, governance and risk appetite to ensure that appropriate governance systems are in place to monitor and take responsibility for this risk. Risk management is a key aspect of it, making sure that banks have in place an analytical framework and risk management framework to deal with this specific risk. There is also a pillar of the expectations, which is about disclosures, making sure that banks disclose how they are managing this risk and how exposed they are. The ECB released this in 2020, and supervisors monitored and compared these expectations last year.

Banks' Practices are Not Yet Aligned with Supervisory Expectations

By the amount of red on the chart, the results show that most institutions were not aligned with the expectations. This is because banks, like everyone else in this topic, are catching up to this new reality. They are developing frameworks, but they are lagging behind the expectations the ECB provided. Many banks, in fact, did not have a climate risk system in place.

Banks' Risk Management Approaches are Under Development

Today, some progress is being made, and banks are starting to develop processes for determining risk appetite when it comes to climate risk. Be aware of the climate risk on your own banking book. Consider how much risk should be taken, and if more risk is taken, make sure a risk mitigation strategy is in place. Although preliminary, things are moving forward, however, there is no room for complacency. The ECB is pushing banks to continue this process urgently. Following the publication of the Guide in 2020, there was supervisory dialogue in 2021 to determine how banks compared to the expectations. Then in 2022, the ECB conducted a thematic review of banks' best practices. The ECB is conducting dedicated pilot on-site inspections to see how the banks are dealing with these risks on the ground, as well as supervisory stress tests. This is not, however, the stress test mentioned earlier, which is an economy-wide desk-based exercise. This is a real supervisory stress test, in which banks are asked to take certain parameters and scenarios and test their own balance sheet against how the scenarios are going. This is a way to test banks' preparedness to these risks, and the ECB will take the results of this stress test into account in the context of the supervisory review, which will see climate risk as a permanent feature of the supervisory review.

4. International Cooperation
Global Cooperation for a Global Challenge

This is a global challenge, so the ECB is cooperating in large numbers to address climate change, including Indonesia's G20 Presidency.

5. ECB Climate Change Centre (CCC)

ECB Climate Change Centre: Structure

The ECB has also changed its internal structure to include a coordination center. The Climate Change Center, established last year, is intended to create a centralized steering body that allows centralized understanding and strategic management of the entire institution's climate-related workstream.

6. Corporate Sustainability

Environmental Protection at the ECB

The last five minutes will be devoted to corporate sustainability and banknotes. According to the ECB, climate change is about more than just policymaking, it is also about leading by example and contributing through actions. As a part of corporate sustainability, the ECB has a comprehensive environmental protection system in place that is in line with best practices globally. The ECB established a change-oriented environmental policy in 2007, attempting to identify areas of poor environmental performance and ensuring that organizational changes address those. This was validated in 2010 under the high-level standards of Echo Management and Audit Scheme (EMAS), as well as being ISO-14001 compliant. The internal data center has used 100% renewable electricity on the premises since 2016. The ECB began compensating in 2018, offsetting the reported carbon footprint. We also attend interinstitutional meetings with other European institutions to purchase high-quality offsets in order to compensate for what we cannot reduce. Overall, by 2019, the ECB carbon footprint was reduced by 37% compared with 2008. To be clear, this was prior to the Covid-19 pandemic restrictions. There is now a push to align the entire ECB carbon reduction targets with the Paris Agreement, which will result in even stronger measures being taken, and of course, the post-Covid return to office will take into account the lessons learned during this period to make additional efforts in that direction.

Environmental Aspects and Performance

More importantly, this covers every aspect of the ECB's environmental footprint, including not only energy use, but also policies regarding travel and commuting, waste and recycling, material efficiency, sustainable procurement, water use, greenhouse

gas emissions, biodiversity, a drastic reduction in printed paper and so on. The ECB also likes stepping up efforts for biodiversity with small initiatives on the premises.

Collaboration on Environmental Protection

ECB also collaborates with other European institutions that are also acting on the same topics, most notably through interinstitutional procurement of offsetting, but also through a variety of other interinstitutional events.

Towards More Comprehensive Sustainability Reporting

The ECB has committed to move from ad hoc to more comprehensive reporting. The ECB will conduct comprehensive sustainability reporting that will include not only the environmental aspect, which has been our primary focus thus far, but also the social and governance aspects. The ECB started issuing this comprehensive reporting in accordance with global best practices in 2021 and will conclude in 2022.

7. Banknotes

Environmental Sustainability of Euro Banknotes

Finally, banknotes. The ECB is committed to ensuring the safety and sustainability of euro currency as part of its cash strategy. There is a broad scope of actions being taken. The ECB recently released its Cash 2020 strategy, which includes explicit objectives for the long-term viability of banknotes. Sustainability was already incorporated into how the ECB handled the life cycle assessment of banknotes. Since 2011, all manufacturers of banknotes procured by the ECB have been required to use raw materials that meet the ISO-14001 standards and to be certified in accordance with that, as well as to report their consumption and emissions to ECB on an annual basis. This was already part of the ECB framework, but their goal now is to significantly improve the environmental performance over time. In 2021, the ECB was the first to report specifically on the environmental sustainability of Eurosystem banknote activities. The ECB will have the first ever product environmental footprint of the second series of euro banknotes in 2022 and is redesigning future euro banknotes. For this, the first ex-ante environmental performance assessment of banknotes will be conducted. The environment will be a key determinant of the final design of future euro banknotes.

Impact of Environmental Sustainability Initiatives

The ECB has looked into this, but we are significantly improving it over time. The use of raw materials proves this. In 2022, 75% of the cotton used for euro banknotes was made from sustainable cotton. It was first introduced in 2014, with the goal of using 100% cotton farmed sustainably by 2023. The ECB has also looked into waste disposal. We are monitoring the waste generated by banknotes, both during production and disposal, and the Eurosystem has not only prohibited the use of landfill and combustion as disposal methods for both production and the banknotes themselves. Thank you for your attention.

Q&A SESSION

Question:

Regarding the most recent information presented about the disposal of the banknotes themselves. It is very interesting because the ECB does not allow banknote waste to be disposed of in landfill or through combustion. Would you please elaborate on how you manage the waste of your banknotes?

Fabio Tamburrini:

I am afraid I cannot go into too much detail because I am not a banknote expert, so I can only report to you a summary of what my colleagues in banknotes have instructed me to tell you. Essentially, the ECB does not produce banknotes. Instead, we outsource banknote production to third-party manufacturers. The ECB is responsible for the overall inspection and compliance of how this manufacturing is performed, and waste disposal is part of this agreement. Essentially, the manufacturers and third-party companies that handle the process are asked to meet certain production requirements in terms of the raw materials that they use, as well as how they plan to handle waste disposal—fulfilling certain waste disposal requirements. That is all I can say. It is a high-level commitment in a concrete way. If necessary, I would be happy to provide follow-up after the meeting.

Question:

How does the ECB effectively implement the Guide, while minimizing the act of greenwashing?

Fabio Tamburrini:

This is a difficult question to answer. I am assuming you are referring to the supervisory guide. I must say that we are conducting onsite inspections and establishing very clear and grounded expectations, as well as disclosure expectations, in order to avoid a situation in which supervised banks claim to have a Paris aligned strategy

without providing any evidence for it. In my opinion, it is a three-pillar approach. The first is more specific about what is required rather than broad commitments. Several chapters in the guide go into detail about the need for banks to have a risk management framework, a risk appetite strategy, a clear business strategy, and a variety of other requirements. When you are so granular, expecting banks to explain each of these points, you are already creating a barrier to greenwashing because you are asking them to do real change. The second item is disclosures, which are pretty detailed discussions. As a result, some supervisory expectations will be based on new legislation, but others will be created, such as Pillar 3, which requires banks to capture specific granular climate and environmental risks, as well as to provide information on the share of loans made to companies in sectors at risk, as well as detailed information on physical and transitional risks. There are numerous indicators that allow supervisors to assess clearly whether banks are walking their talk.

Finally, we have onsite inspections, also known as the litmus test, when supervisors visit banks to inspect internal arrangements. When something is seriously wrong and only superficial window dressing is used, you know the institution lacks true expertise or a real strategy in place. I would say the whole thing has been built from scratch, with greenwashing as the big fear in the first place. We cannot say whether this will prove a complete success, but I would also not assume opportunism in every case, especially in Europe. Perhaps not everywhere in the world, but in Europe, particularly, there is a relatively good understanding, including from the private sector, that the green transition is both a collective responsibility and an opportunity. If you look at the large investment needs of the green transition, you will see a large need for funding, and I am sure banks see this as a business opportunity. As a result, I believe they see this as more than just a compliance exercise and recognize its value in assisting them in transitioning and preparing for what is to come.

Online Question:

The Eurosystem roadmap slide mentioned that the focus area in 2021 for the climate stress test concerning the system balance sheet was preparing the data and methodology. What is the methodology used by the ECB for the climate stress test?

Fabio Tamburrini:

Yes, very good. I touched on some of the technicalities of it during my presentation. Essentially, it is used in combination. We have regular stress testing infrastructure that models economic transmission channels and links this to the financial sector through the probabilities of default of counterparties and how this translates to the credit risk of financial institutions. There is also a channel for market risk and how securities react to economic shocks. This is the standard structure of our stress testing infrastructure. This has been expanded in two ways to accommodate the climate dimension. First, it necessitates the creation of climate scenarios. The economic shock is determined by a climate module, which has climate scenarios, namely the NGFS climate scenarios. Those translate into certain macroeconomic outcomes, which provide the input to the macroeconomic module. This is the first and relatively high-level extension that comes from NGFS. The carbon price is used as a proxy for transition risk and captures a large portion of it because this is the most likely to be the most effective and impactful mitigation policy. Next, the physical risk requires a further geographical extension in terms of geographical scope. There would not normally be a geographical differentiation of the economic shock. Typically, it would be across the board. However, a geographical dimension is required for physical risk, which entails linking each of the counterparts of the banks or financial institutions to a geographic location and then assigning a physical risk score to that geographic location. For example, exposure to floods and droughts. This is a tricky exercise because it requires very granular information and counterpart linking. Everything must be anonymized, so this may entail some data protection issues. When you get this granular, you must be careful to balance the various objectives. Collecting geographical data on physical risk exposure is difficult. Fortunately, in Europe we have excellent providers, and we were able to locate someone who provides very granular data and associates it with their geographic location. In general, this is how it works. It includes the standard stress testing infrastructure as well as a high-level scenario module and an extension that accounts for physical and transitional risks.

Online Question:

What kind of transition risk policy is implemented by the ECB to support the green transition and mitigate climate change risk? Also, with which organizations does the ECB collaborate?

Fabio Tamburrini:

When it comes to transition, the ECB is always mindful of the fact that we are an independent central bank, and we are not in the driving seat of the transition, which is primarily the responsibility of the elected government. The ECB understands its role here as first and foremost to manage risk. It is this fundamental understanding that underpins all the work on financial stability and prudential supervision, as well as a large portion of our work on macroeconomic modeling based on this idea of risk and how it impacts ECB variables or a set of policy objectives. The secondary objective of the ECB is to support EU policies. This means that the ECB will play a secondary role in supporting legislators and EU policymakers in their transition decisions. This is where you can see the greening of the ECB monetary policy framework. The greening of the monetary policy framework, particularly the corporate sector purchase program, is justified not only in terms of managing climate risks, but also in terms of contributing to the EU decarbonization trajectory, as decided by EU legislators.

What does it mean? This is the big question. What role will finance play in the transition? I believe finance has a supportive role to play, but we should not overestimate the impact of adjusting our corporate sector purchases because it may affect the cost of capital of companies differently and create a slightly higher cost of capital for companies that are not transitioning quickly enough. It sends an important signal to the market, however. Basically, ECB actions and commitments send a very strong signal to the market that we are serious about this, that there is no turning back, and that they need to start making contingency plans because that is where the financial sector of the EU is heading. Finally, there is an important disclosure component. The ECB will introduce disclosure requirements as an eligibility criterion to access its monetary policy operations, acting as a catalyst for market participants to adopt climate-related disclosures. Disclosure is critical to making informed decisions because it provides investors with the information they need to allocate capital efficiently. By catalyzing this change, the ECB sees itself as a contributor to the transition.

Question:

If I understand your presentation correctly, climate change and its impact can be regarded as risk, and when we talk about risk, we usually cannot separate it from the risk management and audit functions. How do these two functions contribute to the ECB management of climate risk?

Fabio Tamburrini:

The risk management function is one of the drivers of the reflections on how to adjust the ECB monetary policy framework. Through the financial risk channel, it has an impact on the valuation of the assets we hold on our balance sheet as collateral. Thus, the risk management function is actually quite key here, and our risk management function has worked closely with the operations department to ensure that we have a solid system in place that is resilient to climate risks. Furthermore, there has been a significant amount of analytical work done to determine how much climate risk is already correctly priced and accounted for in our framework, and if not, how to best address this. All these reflections have been led by the ECB risk management function. I cannot go into too much detail because everything is still being finalized, but you will see the announcement soon, and there will be measures that will cover the collateral framework as well as the haircuts and valuation measures that the ECB applies. Finally, the ECB relies heavily on external rating agencies for risk management. When it comes to credit risk assessment, we make use of external rating agencies. The role of risk management has been very important in establishing intense dialogue with these agencies to ensure that climate risk is appropriately considered. The ECB serves as a catalyst, interacting with market players to ensure that climate becomes a factor in their decision making.

Closing Statement:

I would like to stress that I believe we have come a long, long way. I began working on this topic in 2018, and the issue of climate change seemed very alien to the world of central banking at that time. Having a discussion like this at such a high-level event, I believe, points to the gravitas of the problem and its importance at every public institution, which must play a public role. They have a responsibility to contribute to solving societal challenges. One must be mindful of institutional peculiarities and independence, as well as avoid conflating the roles of independent institutions and policymakers. This is not a justification for avoiding responsibility, however. We all need to play a role. I believe it is critical that central banks do so through their functions, whether through banknotes, policy portfolios, or other means. This is just a word of encouragement to the central banking community to keep going on this very important topic, and events like this are proof that we are on the right track.

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- SESSION 3 -
GREEN BANKNOTE PRNTING AND WASTE MANAGEMENT: INK IN BANKNOTES

Master of Ceremony:

Our first speaker is Zeina Abdo, who is the head of the Marketing Department for Currency and Services Solutions. Prior to joining SICPA, Zeina Abdo carried out various managerial roles internationally, spearheading marketing, communication strategies, and projects for world-leading companies of diverse backgrounds across several countries, including the United Arab Emirates, Switzerland, and the United States. Zeina Abdo also holds a Bachelor of Science in international hospitality management from the Ecole Hotelière de la Santé. The next speaker is Christophe Schaller, Director of the R&D Department, SICPA SA Security Inks. Christophe Schaller is a Swiss national who studied chemistry in Switzerland and completed a PhD in organic chemistry at the University of Lausanne, with intermittent research periods in the US and Germany. Christophe Schaller joined SICPA as an ink chemist in 2000, mainly working on oxidative intaglio formulation, and he is now responsible for R&D activities for both high viscosity and liquid security ink. Last but not least, we have our third speaker, David Eric Burke. He is the Regional Managing Director for Asia-Pacific SICPA SA and also President Director of SICPA Peruri Securink. Prior to joining SICPA, David Eric Burke was the managing director of PT Visi Media Asia, TBK (IDX: VIVA), a leading media convergence company, and Chief Operating Officer of TVONE, the number one news and sports channel in Indonesia. He is also a member of the British Chamber of Commerce Consultative World in Indonesia and has been a member of the Chamber since 2008. Ladies and gentlemen, please welcome our speakers to the stage.

Speaker 1*:* Zeina Abdo, SICPA SA/ Switzerland

Assalamualaikum Warahmatullahi Wabarakatuh

My name is Zeina, and I am the new head of CSS Marketing at SICPA. On behalf of my colleagues and the entire SICPA team, allow me to start by thanking the Bank Indonesia Institute for organizing this much-needed seminar at such a critical time for humanity. It is a real privilege to be standing in front of you. I am incredibly honored and humbled to be speaking about sustainability at SICPA. Not only am I incredibly passionate about this topic, but it has also shaped my life decisions to date. Being in Bali adds a magical touch because my sons were accepted to the Green School four years ago as the three of us planned to settle on the Island of the Gods, but life decided differently.

> "We don't inherit our planet from our ancestors, but we borrow it from our children"

That Native American proverb beautifully sums up how I have steered my life in the current reality. Indeed, we do not inherit the earth from our ancestors, we borrow it from our children. From the moment I read this quote, I knew this deep-rooted wisdom should and would be humanity's North Star. The proverb is a potent reminder of the responsibility that awaits us, namely to be mindful of our impact on the environment and taking steps to preserve it for future generations. We must ensure that the world we leave behind for our children is a habitable one, and now is the time to make the right changes for them to enjoy a healthy, sustainable planet. I grew up in the United Arab Emirates, and it is no secret that back in the 1980s it was a wild and deserted country. Yet in the span of a generation, I witnessed and contributed to an incredible fast-paced real estate megadevelopment that changed the local ecosystem, which triggered many questions that led me to embark twice on environmental expeditions to Antarctica. This land of peace, science, and universality that we all own but can barely inhabit taught me firsthand what interconnectivity means. Mesmerized by the beauty and power that emanate from this frozen landmass larger than Europe, an innate drive to preserve the world and its habitability sparked in me, and what struck me the most when being there was witnessing that even the

remotest corner of our planet is not immune to the impact of our human activity. We are seeing increased evidence that climate change affects every corner of the Earth, including Antarctica. When I was last there in March 2019, we had three days in a row of 15 degrees Celsius in Antarctica, which was warmer than back home in Switzerland. The glaciers are melting at an alarming rate, causing sea levels to rise. Ocean acidification makes it harder for marine life to thrive and invasive species threaten the delicate ecosystem balance, to name just a few threats. Now is the time to act and stand up for our children and their children to be able to experience these awe-inspiring places too. We owe the next generation our conscious leadership in preserving the habitability of the world they are born into. The Intergovernmental Panel on Climate Change (IPCC) released its third and final report last spring, warning that humanity is facing its biggest collective challenge. The report outlined the severe consequences of climate change if we do not take immediate action to reduce our greenhouse emissions. We all need to do our part to address this issue. We have a clear responsibility to drive substantial change that will come from businesses like ours. It is time to choose a higher ambition than just economic growth. Time is running out. Humanity's 21st century challenge is clear, meet the needs of all people within the means of this extraordinary, unique living planet.

As we all know, following the pandemic, the last few months have seen dramatic heatwaves, droughts, and fires worldwide, not to mention conflict and unprecedented supply shocks. Here in Indonesia, Jakarta is both one of the most densely populated cities globally and one of the most threatened by climate change. Jakarta regularly suffers flooding and is also one of the fastest sinking cities globally. The situation has been exacerbated by rising sea levels caused by climate change, and it is time for action. But where to start? Like Seneca said, "if one does not know to which port one is sailing, no wind is favorable." I like to refer to the Donut economics model from Oxford University, which I see as an excellent tool for understanding what we need to do in order to foster a sustainable and preferable future for all. The idea of planetary and social boundaries helps us stay within safe and just limits, while allowing for humanity's growth in many vital areas. The Donut economics model is an excellent way to visualize the challenges institutions and businesses face in creating a sustainable future. The model proposes two boundaries not to be trespassed: the social boundary and the environmental boundary, so that we and the rest of nature can thrive together. The social boundary represents the level of tolerable inequality in society, whereas the environmental boundary represents how much we can use

natural resources before they are depleted. We, as businesses and banknote industry actors, tend to focus on core competencies. Yet it is of paramount importance for our leaders not to lose sight of the end users. We have worked so hard on our engineering and industrial excellence that we have lost touch with the people who actually use our currencies on a daily basis. We need to find a way to reconnect with them and understand their needs to continue to be future relevant.

The Covid pandemic has also revealed how our global economy, initially designed for efficiency, was deeply lacking resilience and at risk of more future shocks. One cannot deny that organizations faced different development paths over the centuries caused by changes in the competitive environment and the ability to respond to these changes. Such changes and choices can be analyzed from the perspective of innovation waves responsible for changing the current competition structure and presenting a new competitive format for organizations. By observing the existing five ways of innovation, we can see a significant jump in development for companies that well understood the context of the new wave and competitive problems. Some other companies, even leaders in their markets, were swept off this landscape if not responsive enough. The sixth wave of innovation has started and is guided by sustainability since the depletion of resources can cause many companies and countries to conquer high competitive performance and seek innovative solutions to problems, and those that fail to do so may have a loss of competitiveness. Today, there is an urgent need for a healthy tension between efficiency and resilience. A need for economies that make us thrive as humanity. Using an approach like the Donut model opens to the promise of helping you provide a cash system solution that remains open, inclusive, sustainable, secure and trusted. Talking about the tension between efficiency and resilience, for example, today the US Army is having to airlift baby formula using military cargo from Europe to provide mothers with one of the most essential products in society. On the other hand, mothers are also pumping their milk, and donating it to Millbank for distribution to other mothers. Basically, the world has definitely changed, and what we knew as normal in 2019 is no longer there. Therefore, it is time to think again and reimagine the shape and meaning of progress.

At SICPA, we are constantly innovating to improve our solutions. Today, a banknote is the most advanced intersection between paper and printing technology. After joining the United Nations Global Compact in 2016, we have since successfully phased out 18 raw materials from our security technology. If we are currently working

on becoming climate neutral by 2035, a particular area of impact that is close to our heart is the durability of our products. Depending on circulation conditions, cash cycle factors, and the industrial design of the currency, our varnishing technology can extend the lifetime of a banknote anywhere from 20 to 60%.

In conclusion, I strongly believe and advocate that when confronted with severe and complex challenges in our lives, a simple two-millimeter modification in our daily routine is a secure first step towards an emerging answer. However, as other changes occur elsewhere in our environment, the effect gets amplified and magnified. It is common knowledge that change happens through repetition and habit in tiny, consistent increments, and I would also like to add collaborative effort coupled with a profound shift in mindset that we as a humanity need to make together to thrive. Kaizen is a term used in Japanese culture to describe the process of continuous improvement. Minor improvements every day will build up to significant positive outcomes over time.

Here is my invitation to you. Collaboration is the new competition. Are we ready to thrive together? Before I pass on to my colleague Christoph Schaller, who will take you through a deep dive of what actually happens in the labs, allow me to give you a quick overview of SICPA. Founded in 1927, SICPA is a leading global provider of secured authentication, identification, and traceability solutions and services, and the long-trusted advisor to government, central banks, and high-security printers. Based on its core expertise in high-security inks, the company protects the majority of the world's banknote security and value documents from the threat of counterfeiting and fraud. SICPA also integrates material cover features and cutting-edge technology to offer sophisticated traceability and supply chain protection solutions and services, enabling governments to optimize tax revenue and enforce regulations. Headquartered in Lausanne and operating globally with technologies and services provided in more than 180 countries, we are certified ISO-14001 for the environment and ISO-45001 for health and safety, including the consultation and participation of workers and their well-being. SICPA obtained its first environmental certification, ISO-14001, in 2003.

Sustainability Frameworks

The main external framework guiding and framing our initiatives will be depicted in the following slides. SICPA, as I mentioned earlier, has been a member of the UN Global Compact since 2016. We also adopted the Sustainable Development Goals (SDGs) in 2019 as a generic framework that we rely on to design our strategy. And last but not least, the International Currency Association (ICA) Sustainability Charter sets up our principles for the currency sector. SICPA participated in the development of this charter and is committed to its principles and goals, such as the promotion of a circular economy, the reduction of environmental footprints, and the decrease of emissions. SICPA is also a member of the International Currency Association (ICA) and was part of the sustainability workstream team.

Corporate Social Responsibility (CSR)

Based on these frameworks, we at SICPA have developed an internal one to deploy the best practices and increase sustainability for our operations, technologies, and solutions. In 2017, we came up with the first materiality analysis to ensure that we align the topics of sustainability with the preoccupations of our partners and customers. This tool allows us to start building our CSR program, which consists of four key pillars covering the three dimensions of sustainability: economic, our market, social, our people, and the environment. A new materiality assessment is currently taking place this year to assess new trends and identify new challenges, risks and opportunities in terms of sustainable development for the company.

Speaker 2*:* Christophe Schaller, SICPA SA/ Switzerland

Good afternoon, ladies and gentlemen. I am very pleased to be among you today. I will not be able to speak your language, unfortunately, since it is my first time in Indonesia—I arrived late last night. But what I have been able to see until now is a beautiful country with very nice people, and I look forward to discovering more over the next few days. Today's presentation is about the link between SICPA's commitments, sustainability, and its products and solutions. How do our products and solutions contribute to maintaining cash as a sustainable infrastructure, and what can be done to make a positive and sustainable impact at a company level, an industry level (banknote industry), and at a societal level? Help is needed from

all participants by giving their feedback on general questions on today's topic. Once you have navigated to the poll, please scan the 2D-barcode and begin by answering the first question, which is related to the banknote life cycle. Here, participants will select between the two elements they believe have the most environmental impact. The choice is between the raw materials (ink, substrate), manufacturing (banknote printing), distribution and circulation of cash, and banknote use (banknote lifetime) or waste management (paper, ink and banknotes). Online participants are also encouraged to participate because the more answers we get, the more ideas we will also get. Please take a few more seconds to answer the question, and please note that there will be more questions later. It is important to join now, but if not, anyone can join later. Looking at the results, they seem to show that both raw materials and distribution and the circulation of cash are the most prominent. OK, please continue to vote. Perhaps go to the next slide to get the answer.

Cash Life Cycle Assessment - Trends

In fact, the environmental impact of cash has many contributing factors, which may and will depend on the specificities of the market in which cash is deployed. That said, and from the figures seen thus far through life cycle assessments, some of which SICPA has contributed to over the last 20 years, banknote production is rarely the main contributor as compared to the circulation and use phases, such as cash transportation and ATMs. Within the manufacturing process, the impact associated with ink production is also not preponderant, despite the use of chemicals that might have suggested different results and which we have also been able to see from the results. Does it mean SICPA should stop the presentation here? Clearly no. SICPA believes that as an actor in the cash cycle, we have the same responsibilities as all the other actors to make it as sustainable as possible for the benefit of the planet and the population. On the lower scale, making sure cash remains as sustainable as possible should be a goal, to avoid being replaced by alternative ways of payment due to a possible negative impact.

SICPA's Contribution to Sustainability

Specifically, there are different ways in which we can act to make a concrete contribution to the entire life cycle. Indeed, even though it is clearly a key point of impact as primarily an ink manufacturer, SICPA as a whole cannot be limited to only

the raw materials side; we can and must act on all different levels through solutions, products, design, and collaboration with the relevant actors to contribute or influence even in domains we have not yet fully mastered. This is a critical point that will be revisited later in the presentation to explain further how SICPA can contribute to the development and maintenance of cash with an impact as low as possible. Starting with our core impact, ink manufacturing.

Material-Based Products

By definition, ink manufacturing is based on materials. It is, therefore, a fact to be accepted that on the environmental and product safety dimensions zero impact is not possible, especially if the nature of the raw materials must be exclusive and of high security. It is possible to work on sustainability, but this should not be done at the expense of the security of the banknote value chain. Our goal will be to select raw materials with an impact as low as possible, while maintaining the required properties for banknote security as the common objective for the banknote industry, which is to provide safe means of payment.

Knowing thew Exact Composition

Looking more in detail on the ink composition, one can see that an ink is composed of a limited number of types of raw materials, each with a specific function, such as color, security, drying, resistance and adhesion. Our understanding of ink composition is much more detailed, so SICPA has a complete understanding of all the chemical substances in all of its products. This is possible thanks to a module in the enterprise resource planning (ERP) system dedicated to raw material and recipe management.

R&D

Design and development must integrate these elements at an early stage, ideally from the birth of the technologies. This is why SICPA chose to integrate the evaluation and promotion of the safety and sustainability of their products and solutions in the R&D department, even if this dimension is then globally integrated in all the different manufacturing, delivering, sourcing, and other processes. Security ink development is organized either by process, with dedicated labs for each printing process, such as intaglio, offset, screen, and so on, or by security features. Product compliance, which is fully integrated within this organization, brings its various activities and

competencies to the service of formulators. It is aided by the analytical laboratory, which can complement data with specific measurements. Meanwhile, the technical assistance team will help the customer improve efficiency and, thus, sustainability by improving the ink, press and local conditions interface. Despite the fact that the core competencies are based in Switzerland, SICPA maintains a close relationship with its SICPA Peruri colleagues in Indonesia.

Security Inks Evolution Drivers

The main driving forces are depicted here behind the development or evolution of SICPA products. Several of these drivers contribute to a more sustainable banknote in the broader term: cost efficiency, customer value, and regulatory performance. Even if SICPA takes the common shortcut of viewing sustainability as a synonym for environmental impact, we truly believe that several dimensions must be addressed. On the performance side, our goal is typically to support customer production efficiency and reduce their print waste. This is possible by improving product performance. Meanwhile, SICPA continues to monitor technological trends and promotes the adoption of promising technologies, such as the transition from oxidative inks to ultraviolet (UV) curing inks. SICPA is also looking at new printing processes that have not yet been used in the banknote industry. Of course, sustainability and regulation are very important to these aspects; thus, SICPA manages change and ensures supply chain continuity. One important driver is the value for our customers and partners by adopting our technology to local requirements or local regulations. Cost efficiency is also very important in any industry.

Product Safety: Assessing New Substances and Raw Materials

SICPA has spent decades investing in product safety, with a robust process in place to integrate these elements into an ink's life cycle. Through development, versioning, and possible phase out if there are no suitable alternatives, SICPA sees product safety and interrelated human health protection as a key component of sustainability in addition to commonly accepted environmental aspects. Our main approach to product safety is currently hazard-based—checking classification from the supplier, mostly for health and safety thus far as this is the industry standard—but SICPA is also moving towards more exclusive criteria for environmental aspects. There are two levels of checks and qualification: one is compulsory and includes internal and

external selection criteria, which is an effective method for filtering problematic raw materials from the start and limiting the hazards associated with SICPA products. The second level is voluntary, anticipative, and proactive. We are constantly looking for trends from NGOs, regulatory agencies or industry trends with contacts with SICPA suppliers to anticipate innovation and/or shift away from existing technologies.

Steps Toward Product Compliance

The initial selection process is part of a larger process designed to integrate the evaluation and promotion of safety and sustainability of SICPA products and solutions. It is associated with a significant effort to collect, manage and update data, while managing thousands of different inks, references, and hundreds of raw materials to satisfy the needs of the banknote industry. It is a dynamic process, and the change that is happening must be managed for a variety of reasons, including regulatory changes, innovational changes, and extra requirements from customer, and supply chain issues. Communication is key for SICPA, as is customer collaboration to help in integrating improved solutions whenever SICPA is able to develop them.

Banknote Production

Looking at banknote production, it can be seen as a complex process that includes not only substrate production, but also offset intaglio screen printing, application of applied features, numbering, varnishing, and other more specific ones.

SICPA Measures to Reduce Environmental Footprint - Key Milestones

The industry had already worked to improve sustainability during the banknote production cycle, beginning with a switch from a toxic trichloroethylene intaglio to a water-based delivery system. In the 1970s, intaglio inks were also developed to remove interleaves, which is where blank sheets were placed between each printed sheet to prevent printing waste. SICPA banned lead from its oxidative inks in the 1980s. The lead was used to accelerate drying. Since then, it has been based on cobalt, which is also under pressure, but SICPA has found a new solution. Furthermore, in 1993, a contribution from the press manufacturer resulted in optimized ink mileage—less ink equates to a lower environmental impact. Intaglio ink formulations were also modified for wastewater management systems, which included recycling the wiping solution and separating the solid waste from the liquid being replaced.

There has also been a lot of developments from the substrate suppliers, developing more environmentally friendly substrate, more durable and, of course, SICPA has to improve their product portfolio also to cope with these developments. SICPA now has a dedicated series for whatever type of substrate, polymer coated substrate or even hybrid systems.

Intaglio Waste Management System

SICPA has also seen that intaglio is a key printing process in the banknote industry. With the optimized use of intaglio, the waste produced by intaglio process can be consequently reduced, and this optimization can be achieved by significant improvements on the type of press, the Orlof printing machine, the use of polychablone, and specific design guidelines. Furthermore, waste from fresh inks and waste from post-printing treated solid inks can be valued by transforming them into energy without polluting the environment. They can be mixed with special materials and burned to produce inert ashes in cement plants equipped for the purpose.

Recent Product Innovation

Here is a summary of a few raw material replacements that will be discussed in greater detail later in the presentation by an ink specialist. There is the replacement of some organotin catalysts used for the synthesis of alkyd polyesters, which is our main binder and brings the ink to the substrate and gives it resistance. Also, the substitution of UV-stabilizing agent in the SICPAPROTECT® post-printing varnishing system and the development of more environmentally friendly SPARK® inks by reusing low VOC content (volatile organic compound) and having nickel-free based pigments. It is also worth noting that the replacement of anti-drying agents in offset inks was strictly adhered to here in Indonesia at the Perum Peruri and De La Rue printing plants.

Moving on to the next three questions, which will be asked sequentially, followed by comments. What makes an ink more sustainable? Is it because it is water-based? Because it is based on nonhazardous ingredients or renewable raw materials? Or, because of the low emission of volatile organic compounds (VOC)? The world is yours. Okay, it appears that there is a trend in the type of ingredients SICPA are introducing into our inks, followed by the renewability of raw materials. On to the third question. What are the main benefits of switching from Mercury UV lamps to LED UV lamps, in your opinion? SICPA has found that inks are either oxidative or UV curing. There

are two UV curing versions: the standard methods based on mercury lamps, and a new trend that uses LED lamps. The possibilities include energy savings and LED generating less heat. Is there improved productivity with LED or a better industrial safety profile? (zero ozone emission or no mercury). The trends seem to point to energy savings and zero ozone emissions as the main trigger, and both are correct. Before returning to the presentation, here is one more question. This is more related to the varnishing concept and the protection of post-printing varnish. During her speech, Zeina provided the answer. How long does SICPAPROTECT® post-printing varnish extend the life of a banknote in circulation? 10-20%? 30-40%? Or 50-60%? Depending on the country, all answers are correct.

Extending the Framework – Multidimensional Approach

Product safety was mentioned as one of the main focuses, but it is far from the only one. SICPA believes that several dimensions must be addressed, even within sustainability reflections, in order to have a clear picture and sound assessment of the impact, be it positive or negative. SICPA has been working on other improvements axes in collaboration with various partners, particularly for the reduction of volatile organic compounds (VOC), limitation of emissions in the air during ink and banknote manufacture and increasing the bio-renewability of raw materials to reduce dependency on fossil-based materials. These are challenging aspects taken individually, but it becomes a headache if all dimensions are optimized at once. It is important for SICPA to define the most important points to consider for the desired product or solution among customers and stakeholders as we do not believe in the perfect product on all axes.

UV LED Lamps - Advantages

UV LED has been mentioned, and this is a trend in the banknote industry. It is still in the early stages of research, but it allows for the assessment of environmental aspects. There is no more ozone production to reduce energy consumption, which is clearly beneficial to printers. The lamps also have a longer lifespan. In terms of technology, it is a well-established technology, lower frequency of maintenance, selective lamp maintenance, and SICPA must adapt their formulation accordingly. In addition, there is also less heat transfer to the printed sheets.

Extending Banknote Lifetime with SICPAPROTECT®

Varnishing has a proven effect and a major influence in life cycle studies. It is an effective way of reducing environmental impact. By extending the life of the banknote, the need for raw materials, manufacturing, and distribution is reduced. The results of various circulation trials have shown that lifetime enhancement can vary but is always significant. This lifetime enhancement ranged from 20%, in England, with the former series on paper, and a country with inherently easy circulation conditions, but up to nearly 60%, as demonstrated in Colombia. Other trials, such as the one conducted by the ECB, yielded similar results.

Cash Cycle Trends

The conceptual design of the new cash center will not only have a new cash center, but it is also integrated with the BI business resumption site (BRS) and the second data center. This will be a very important facility for Bank Indonesia's future.

Efficient Cash Cycle Management

Banknote automation will be required to keep cash handling and logistics viable, while also lowering costs and environmental impact. SICPA will provide a solution for automated cash handling and processing with reliable detection for an optimized cash cycle. This is done by staying cleaner by using SICPAPROTECT® varnish, but also by making inks specific to become readable by all banknote handling machines in the infrared part of the spectrum or by bringing specific magnetic properties to the inks.

Life Cycle Assessment – A Tool to Measure and Improve Sustainability
Different Approaches to Address Environmental Impacts

The next topic is life cycle assessment. SICPA is providing data and support to central banks in order for them to perform life cycle assessments on cash, which is a product-wide approach. And again, as a companywide approach, SICPA is assessing their own environmental impact to understand where the hotspots are in the value chain. The third methodology explored by SICPA in recent years has been the assessment of new technologies with different value chain actors.

Comparative Life Cycle Assessment (LCA) as a Measuring Tool

SICPA typically explores the impact not only at the ink manufacturing level but from a broader perspective. Does a change that seems to make sense at one point of the value chain alter the overall impact of the value chain? As a result, SICPA has performed, as a pilot project, comparative LCA studies of two different aspects of the same printing process, based on the offset printing process. Thus, comparing oxidative versus UV LED printing of settings, which was done with the help of a sustainability consultant. The opportunities seen in that exercise are a collaborative effort through the industry—the ink manufacturer, the machine manufacturer, the printers, and the central banks. Eventually, it may become a standard methodology for eco-design when introducing new technologies. SICPA has also faced challenges, including difficulties in collecting reliable and accurate data across several stakeholders. An important question remains: how to prioritize the environmental aspect against other factors?

"Small streams make a big river."

Even if the ink manufacturers have limited impact compared to the global banknote life cycle, SICPA keeps striving to evaluate environmental, health and safety (EHS) impact with the goal of improving or at least controlling the impact of inks. In other words, SICPA needs to accept that for material-based products, zero impact does not exist. Focusing on areas where action can be taken. SICPA is willing to contribute to all initiatives where we can have an impact or an influence, and welcomes partnership with other actors as well, in the spirit of the ICA Sustainability Charter.

Collaboration Between All Industry Actors is the Key to Improve the Environmental Footprint of our Products

To conclude, SICPA truly believes in collaboration within the whole banknote value chain to achieve tangible and long-lasting improvements in the efficiency of cash in the different dimensions of sustainability and we are convinced that this will help maintain the existence of cash in the future. This is a very significant contributor to the sustainability of society.

Sustainability – A Key Pillar of SICPA Business and Operations

SICPA aims to integrate the world's best practices in sustainability into its business and operations by constantly monitoring its environmental footprint. This is also made possible by the integration of the sustainability dimension at the R&D level. SICPA is continuously contributing to optimize, shorten, and modernize the cash cycle in order to reduce the environmental impact and lower the carbon footprint of banknote printing. Substitution programs are ongoing for certain chemicals and continue to contribute to the management and reduction of risks for humans. There are also different corporate social responsibility (CSR) actions, such as reducing electricity consumption, using solar energy, waste recycling, and stimulating individual eco-friendly practices.

Speaker 3*:* David Eric Burke, President Director PT SICPA Peruri Securink

PT SICPA-PERURI SECURINK Contribution to Sustainability
Four Operational KPIs

On the ground SICPA has a range of things we are working on, including waste management, energy conversation, fossil energy, and water consumption, these are all day-to-day actions taken to protect our business and the future for the central bank and Peruri. Just to give everyone a bit of a backstory, we have been working with Bank Indonesia since 1957, that is 65 years, and in production in Indonesia manufacturing since 1971. Peruri had to learn how to ensure that we could do this in the most efficient manner.

Waste Management

Talking about waste management, we have a stack of methodology and tools in hand, working very closely with the Department of the Environment in order to manage the waste management.

Energy Conservation

With energy conservation, we have already started the first phase of our solar panels and this year we will reduce by 10%. Over the next five years we will also reduce by an equal amount of 700 metric tons of CO2, which will be reduced on our platform

by the next five years. That has taken us down from about 1,200 to about 500 in the next five years. That is a 700 metric ton reduction.

Fossil Energy

Fossil energy, everyone knows that we actually started bringing in corporate policies for gasoline for vehicles. We actually purchased our first hybrid vehicles this year to ensure we are following what we preach. Also things like gas, even simple things like cooking in the kitchens, how all are being changed to compensate and ensure we qualify. In Indonesia, the Swiss head office got it before us but we also just got our ISO-14001 certification as well.

Water Consumption

Water consumption is also a very key issue for us and we have started making sure that as the company progresses, we do not lose control over the water. Hence, we have actually started saving water. We control water usage in the factory and vehicles are not washed there anymore. These are little things, but every step is all part of the greater picture and we are taking little steps to make sure we can achieve the overall objectives.

VIDEO

SICPA is committed to operating in an environmentally responsible and efficient manner. We continually work to improve our processes while respecting the environment and complying with safety standards. For example, with our sophisticated waste recycling systems, we reuse about 90% of the liquids we process. Water involved in production is carefully treated, and solid wastes are collected for recycling. SICPA facilitates innovation and new technologies consistently with low carbon requirements. We increased the use of renewable energy and resources to promote their efficiency and sustainability. In 2020, SICPA decided to achieve carbon neutrality by 2035. Aligning itself with the UN Sustainable Development Goals (SDGs), we evaluated our environmental impact, taking into consideration the following objectives to positively transform the world we live in: good health and well-being, clean water and sanitation, affordable and clean energy, responsible consumption and production, climate action, life below water and on land—SICPA is dedicated

to making sustainable decisions. We reduce water consumption undertaking the recovery of water. We prevent harm to society and biodiversity by limiting our environmental impact. We developed an ecologically friendly carton liner, compact waste, and recyclable cardboard packaging, which reduce environmental impact and disposal costs. We use safe and sustainable raw materials.

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Q&A SESSION

Question:

I have two questions. First, given that SICPA is always improving its technology for safe environmental products, especially ink, how does it manage the costs and end results of operating in line with the green banknote principles? Second, we know that older banknotes are still in circulation in Indonesia, these are the old banknotes from previous issues that used SICPA ink. I believe this was before the green environment became a hot topic, and before the eco-friendly ink was produced. Is the ink in old or used banknotes harmful to the environment and the people who handle it, in your opinion? And, if so, do you have any suggestions for how we should manage the banknotes?

Christophe Schaller:

Thank you for the question. In terms of cost, of course, this is part of our requirements when we first develop the inks. An ink has to answer many different requirements. First is the technical. The ink has to be printed on specific substrate with a specific machine with the requirements of the printers and that is the main trigger to develop new products. We are now integrated. Also, there are health and safety and sustainability aspects to that. As an industry, we will of course select raw materials, which are the most cost effective. In our selection criteria, cost is not coming first. We have strict rules to be able to validate raw materials and this is mainly the compliance group. It is not the ink formulator which is able to validate the raw material, it is the compliance group. Once validated, it is up to the formulator to use it at the best ratio. We have various types of raw materials for the same function depending on the function of the raw materials, and we will try to keep the cost as low as possible because we believe also for our customer, the pressure is here, and this is a very important aspect. But we are not neglecting the efficiency of the inks. For us, it is very important that the printer be very efficient in its productivity. It is all linked with the specificities of ink formulation. There are a lot of different requirements, and

we need to be the best as a sum of all these requirements, being health and safety, technicalities of the mixture, and cost.

In terms of older notes, this is still our current ink series, and as such everything that could be done in terms of sustainability has been done. The oxidative inks are one aspect that has been improved and used in recent weeks. The drier system was based on cobalt and other salts, such as manganese or even zirconium, but cobalt has come under pressure after being reclassified as carcinogenic. It is not the cobalt salt used in inks. The consortium that decided on the new toxicological profile did not distinguish between the different types of cobalt salt. As a result, we needed to find a solution for the new series and the oxidative inks and cobalt free. SPARK® is also in accordance with the most recent developments, which means it uses lower VOC compounds and nickel-free pigments.

David Eric Burke:

I wanted to say something about the existing notes printed from the last two series. Most of the evolution of health and safety had already been implemented. One of the standing jokes among the people in the lab in Switzerland was that you could eat a banknote and be perfectly healthy because it would not kill you. I would not advise you to do that. Banknotes are something that you hold and keep in your hands for a number of years with no ill effects on individuals or people. That means that even older series are very safe.

Question:

To begin, I would like to thank all of today's speakers for not only their comprehensive presentations, but also for teaching us about diversity. The first presentation was deep, touching on the human side of our being through aesthetic visualization. Collaboration is the new competition, was one phrase I noted. Thank you, Christoph, for the lengthy and technical presentations, and David, for the quick but effective presentation and for staying firmly grounded in Indonesia. I am new to this industry, please accept my apologies in advance if my question is unclear. I am concerned about the long-term sustainability of your ink in various climates around the world, particularly in tropical and subtropical zones. Do you produce the same type of ink for each zone or do you vary it?

Christophe Schaller:

As an industry, we strive to develop the most universal inks that can be deployed in any country. In order to do so, we must ensure that all the ingredients in our formula can enter the country where the inks are delivered. This is one of the activities of the compliance group before we begin developing new products. This ensures that once the product has been developed, it can be shipped to any country. We have national lists and know which countries we can deliver inks to when we validate new raw materials. We are then able to deliver inks to a wide range of countries. It is really an activity of our compliance group to ensure that we will be able to deliver these inks. This is more on the raw material validation side. Considering the formulation of inks, we do not currently develop inks for specific regions, but SICPA can address local requirements in terms of regulation, and also in terms of printer productivity. This is done by changing a little bit these core formulas by adding specific additives. This typically involves changing the type of dryer system or having specific additives added onsite. This can help. We are focusing more on the productivity needs of the printer. In terms of sustainability, we are now entering a new phase. In the future, we will take more into consideration, such as local needs. The most important parameters for sustainability to define are VOC reduction, bio-renewability, carbon footprint, and other parameters. I believe this is a discussion we should have with all our customers, and I am confident that in the future, we will have much more specific dedicated ink series to meet all of these requirements, which will differ from country to country.

Closing Statement from SICPA: David Eric Burke

The underlying comment we would like to leave with the audience is that we have been doing this for a significant period of time. We understand the local issues at hand, and it is something that is extremely serious to us, and we maintain constant communication with Peruri and Bank Indonesia to ensure that as we go through this process, especially since it is a learning curve for us as well, that we are addressing the key concerns that the central bank, printers and consumers have. Thank you very much for listening to us. I am sure we will be around for the next day or so, so please feel free to approach any of the three of us and ask us any questions you have, especially me about the local water, fuel, and other stuff like that.

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- SESSION 4 -
ENVIRONMENTALLY FRIENDLY BANKNOTES IMPROVING THE ENVIRONMENTAL IMPACT OF AUSTRALIAN BANKNOTES

Master of Ceremony:

Victoria is a highly experienced public policy professional with a range of government experience in both Australia and the United Kingdom. Victoria is currently responsible for developing the future strategic approach to banknotes, managing banknote production orders, and formulating the strategic approach to data management.

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This presentation is titled Environmentally Friendly Banknotes. One of the points to make in this space is that the Reserve Bank of Australia (RBA) is very much, like a lot of the initiatives that other speakers have talked about, at the beginning of this process. Throughout this presentation, there will be a variety of initiatives, some of which we are right at the start of, while others are reasonably well advanced. Overall, it will give a good picture of the kinds of things the RBA is doing. First off, to acknowledge the Bank of Indonesia Institute, this is an incredibly important topic, and the speakers selected for the agenda have been really interesting, and I hope to contribute to that as well. I would also like to acknowledge the hybrid forum, which is incredibly important for issues like this. The RBA is as inclusive as possible, and having the online webinar function means that a huge variety of people can attend outside of those that are in this room. It is absolutely wonderful to be here and do this presentation face-to-face. Colleagues and I have done a couple of these in the past over webinars, and it is just nice to be in a room with such a great, interesting collection of people. This presentation will focus on a wide range of initiatives, giving a good idea of the position of the RBA in this space

Outline

First, I will introduce the context of the presentation and talk about our commitment to sustainability, followed by sustainability throughout the banknote life cycle. The RBA's interpretation of banknote processing is broad, and that is because there are quite a lot of interesting initiatives in the banknote design phase, which is early in the process, through the supply chain, banknote production, banknote distribution, and recycling at the end of that process. For information and context, the RBA has polymer banknotes that can be recycled, which I will talk about towards the end of the presentation.

Commitment to Sustainability

The RBA has made a public commitment to improving the performance of our operations to minimize the impact of activities on the environment. An environmental statement was published by the RBA in 2019, and it outlines our commitment to implementing initiatives to enhance sustainability, including the increasing use of renewable energy, improving waste management and other initiatives. Internally, RBA has documented sustainability principles, which ensure that sustainability and environmental management are central to all the RBA's operational activities and are embedded in the RBA's processes and culture. That is an incredibly important point, namely the idea that sustainability considerations are inherent in all the work that the RBA does.

Interestingly, Fabio Tamburrini was speaking yesterday about how to apply sustainability considerations to monetary policy, and they have obviously developed a framework to implement that. Similarly, the RBA has a framework, which I will provide in the context of banknote operations. That means the RBA is thinking about sustainability outcomes in our day-to-day work. For additional context for this presentation, Note Printing Australia (NPA) is a subsidiary of the Bank. They are the people that produce our banknotes, and I will talk about them and their commitment to sustainability and the work that they are doing because there is a significant program there.

Banknote Life Cycle

The banknote life cycle covers a broad range of initiatives. In terms of banknote design, the RBA is focused on how we can make the design of our banknotes more sustainable by improving durability and reducing spoilage, which come up quite a bit in the design phase but also in some of the other elements that will be discussed too. In terms of reviewing RBA's supply chain, our suppliers of the raw materials obviously do contribute significantly to carbon emissions, and that is something that has to be taken into account when looking at improving our own outcomes. In terms of banknote production, this is a space where there is obviously a lot of potential. I will go through some of the initiatives that NPA is in the process of working through. Banknote distribution is challenging for Australia in particular. The RBA has outsourced most of our banknote distribution processes and we have a national banknote distribution site. Once banknotes are taken from there by cash-in-transit (CIT) companies, they are then delivered entirely by the private sector. As Christoph Schaller noted yesterday in his presentation, cash distribution is one of the biggest emitters of carbon emissions, particularly in a country like Australia where there is an enormous land mass and a lot of road and air transport is used. It is a real challenge for the RBA to influence better outcomes in this space. Finally, there is recycling. This is a very well-established enterprise for RBA, and it is something that has been very effective and has been implemented for the long term. The RBA recycles all our banknote waste. That includes production waste that occurs throughout the production process, but also unfit banknotes as they return to the Bank.

Banknote Design

Banknote design is the focus of this first part of the session and is included here because it is where there are some interesting considerations, and it comes back to that point about including sustainability in our day-to-day operations. RBA banknotes are made of polymer. This has some significant sustainability objectives that might not be obvious given that it is made of plastic. One of the key things is durability, namely the improvements in durability and the reduction in spoilage. Those are two things that are big contributors to a reduction in carbon emissions. Those two images are the older series of banknote. Many of them are still in circulation, however, and one of the reasons that recycling and other elements of the polymer program are so well advanced is because Australia introduced polymer very early on with the release of the RBA's first banknote series in 1992, and that is the picture of the

AU$5 there, concluding with the release of the AU$100 in 1996. This is a very well-developed program. The impact in terms of durability is significant. In the table on the left, there is a comparison between paper and polymer in terms of lifetime. This is obviously contextualized to Australia, but our paper notes lasted 6 months to 2.5 years, whereas the polymer banknotes last almost 7 to just over 20 years. That is a significant increase. In that table, the RBA has not included the AU$100 because it is not a transactional banknote. People keep it as a store of value, and it therefore does not show the same transactional wear as other banknotes. Although this is not related to sustainability, it is worth noting that there are also significant cost savings to RBA from this introduction of polymer, particularly with the lower denominations. Overtime, the AU$5, AU$10 and AU$20 have made significant savings in this space, both through increased durability and a reduction in the number of banknotes we have been producing. That analysis shows RBA saved roughly a billion dollars over the last 25 years, which is significant. Being explicit about the environmental benefits, there is the increased life span and time in circulation. That obviously reduces the production emissions associated with the actual printing of the banknotes. It also reduces the emissions associated with transport processing and the destruction of unfit banknotes. Having that broader perspective obviously contributes to that space as well. There are clearly the recycling benefits as well. It is a significant reduction in terms of the material going to landfills.

Design: R&D

Moving on from polymer, I will talk about the day-to-day thinking that RBA does in this space. Much of this work sits with the Research and Development team, which is based in Melbourne. The team has been looking at the two key elements: durability and spoilage. Durability implies that RBA is looking at an improved lifespan, a reduction in destroyed notes, and a reduction in production waste. Similarly, with a reduced amount of spoilage, RBA is looking at a reduction in waste in raw material requirements and in production.

Set-Off is one of the projects in this space. Intaglio Set-Off is a significant issue for the production of Australian banknotes and Note Printing Australia (NPA) does experience quite a lot of spoilage in that space. In terms of design, RBA has been looking at a couple of things. One of them is looking at where the banknote has relatively light areas in the offset, or the background color, opposing very heavy intaglio on the other side. That means when the notes are stacked during

the production process, there is an almost inevitable poor aesthetic outcome that results in high spoilage. RBA has been investigating how we might better design that background color so that it is not so pale where the intaglio opposes it to make sure we are getting an improved aesthetic outcome. NPA has also been looking at ways to improve the production processes as well as how to better handle the material. This prevents materials from being clumped together in large blocks, which causes a lot of spoilage on the outside of banknote sheets.

In terms of improving durability, it is tricky but it is interesting with a lot of potential. The RBA's Research and Development team has been investigating which areas of the banknote experienced significant circulation wear. In addition, where there are specific security features, the RBA has looked at different alternative materials or different security features, replacement security features, to improve banknote durability. There is a real tension here between banknote security and durability. What the RBA does not want to do in terms of seeking good durability outcomes is compromise banknote security. As a result, the RBA has been focusing on lower denominations that experience a lot of circulation wear because they are highly transactional but much less prone to counterfeiting. These potential substitutions would not be appropriate for higher denominations due to the risk of counterfeiting.

Principles of Banknote R&D Program

In the design space, I wanted to discuss some of the work RBA has been doing behind the principles of that R&D program, particularly in the area of quality assurance. RBA has sought to understand the circulation wear outcomes of Australian banknotes as well as assess when banknotes are returned unfit for circulation. The RBA has been collecting a large amount of data on those banknotes to understand why they are being returned as unfit, with the goal of better identifying which features or elements of the banknote are weakest. RBA has also reviewed aspects of the quality testing program to ensure that it mimics the type of circulation wear seen once banknotes are issued. The idea is to ensure that RBA has a good upfront understanding of which features are likely to be impacted by circulation.

Banknote Production

Banknote production is one of the more challenging areas in terms of how NPA operates in this space. Nonetheless, RBA is launching a number of exciting initiatives

that we are just at the start of. Australian banknotes are produced by NPA, a subsidiary of the RBA. Banknote production contributes significantly to the Bank's overall carbon emissions at approximately 60%, which is much higher than one would expect given the large number of RBA offices. The Bank is committed to the Commonwealth Government's target of achieving net-zero carbon emissions by 2050. NPA is also committed to those targets, and therefore this work fits under that program. NPA is committed to the same sustainability goals as RBA as well as the UN Sustainable Development Goals, which SICPA also mentioned. NPA has categorized their emissions reduction program of work into three key areas: renewable energy, facility/system upgrades, and infrastructure solutions. The facility upgrades and infrastructure solutions are significant projects that will take time to develop and implement.

Renewable Energy

When it comes to renewable energy, only 20% of grid electricity is currently sourced from renewable energy sources. That is one of the targets for which the NPA is collaborating closely with the RBA to improve. The RBA is responsible for the NPA site more broadly and is thus heavily involved in some of these larger projects. The intention is to transfer to 100% renewable energy, which is a short-term ambition but a challenge in this space. The RBA is also conducting a feasibility study for the installation of a 1-megawatt solar installation with batteries at the NPA site, which is expected to have a significant impact on carbon emissions and save up to 40%. There is a lot of potential there, as there is for a number of these projects. That is how we hope the NPA will look in the future. It is a photograph of the banknote resumption site in a different location, but the same principle applies.

Facility and Infrastructure Upgrades

Here are some of the long-term initiatives. In the near term, however, the lighting audit is currently underway and will include the installation of LED lighting throughout the entire site. The temperature and humidity control on the press at NPA is an interesting project. Unlike many printing facilities, NPA is housed in a building designed from the 1970s, and it is basically an enormous hall. The print hall houses all nine printing presses with no distinction between them, and they are not in individual rooms. The hall itself is high enough to stretch across all floors of

the building, thus the ceiling is far away, representing a massive amount of space that must be temperature controlled, thus causing a lot of emissions. Some of the ideas that NPA is considering are practical solutions for this space, such as creating a false ceiling to reduce the amount of volume required to heat and control the humidity in that area. Finally, a program is currently underway to install new energy-efficient chillers for the water system and cooling towers. This is essentially a more environmentally friendly air conditioning solution that will be integrated across the entire site, not just NPA.

Waste Reduction

In terms of waste reduction, which SICPA also mentioned, we are actively removing chemicals from the process. RBA is also looking into recycling. Waste reduction is obviously a key commitment in this space, and NPA has been working with a number of partners to deliver on it. NPA currently diverts approximately 60% of its waste from landfills. However, they are working with a key partner to increase that. It should be very close to 100% by the end of the next financial year. NPA is also reviewing the chemicals used on site with the goal of removing the most toxic chemicals, such as the plan to remove chromic acid from the current plate-making process. All the chemicals involved, particularly the chromic acid, will be replaced with less hazardous alternatives. SICPA mentioned cobalt-free ink, which RBA is also developing. In fact, the RBA trialed cobalt-free ink across the new generation banknote series with reasonable success. Future production orders will use cobalt-free ink to reduce some of that chemical waste. Finally, e-waste, which requires collaboration with a partner and is a relatively simple but important task of collecting batteries, computers, and other everyday electronic waste and recycling it rather than diverting it to landfills. This project is hoped to be completed by the end of next month.

Supply Chain

Sustainable procurement is one of the RBA's sustainability principles. This requires the Bank to consider the environmental performance of all suppliers and the environmental attributes of products and services when making purchasing decisions. This also applies to NPA, though the unique raw materials required make this a bit more difficult. Nonetheless, NPA purchases of goods and services are the largest contributor to its emissions. Working with suppliers in this space is critical, and

hearing from other colleagues that they are committed to the same objectives as RBA is encouraging. The RBA is constantly looking for efficient and sustainable supply chain options, which is becoming increasingly critical.

Banknote Materials Supplier Transition to Carbon Neutral

The RBA's key banknote material suppliers are transitioning to carbon-neutral operations. CCL Secure, RBA's substrate supplier, and Koenig and Bauer Banknote Solutions (KBBS), a printing press manufacturer, are both transitioning their Australian plants by 2030. SICPA is there in 2035, and Kurz, who produce the banknote foil, is there in 2040. These ambitions are really important because they demonstrate that everyone is working toward the same targets and goals.

Co-Location of Banknote Site

This is another element worth mentioning because it is quite unique to Australia. Many of our suppliers are co-located on the banknote site, with the exception of SICPA and KURZ. INNOVIA, which produces the polymer for the substrate, along with CCL Secure, which manufactures the substrate for NPA to print on, and finally the National Banknote Site (NBS), which is the RBA's storage and distribution center are co-located in one secure precinct in Craigieburn, Melbourne. These photographs of the site show INNOVIA in the upper left-hand corner, with the tower in the center. The polymer bubble is blown up and stretched here before it becomes the film on which CCL Secure prints. The NPA is difficult to see in that picture because it is obscured by gum trees. However, it does give you a good sense of the site's Australian quality. The National Banknote Site (NBS) is in the lower left corner, which is a highly secure and very large site that serves all our storage and distribution needs. We previously had sites in Sydney and other states, but they have since been closed, with the private sector handling distribution

Banknote Distribution

Banknote distribution is a significant challenge for the RBA because we do not specifically maintain any of this function ourselves. There is much that can be done, however, in this area because it is a significant carbon emissions producer. Cash distribution is an enormous component of banknote-related carbon emissions. In this

context, cash distribution refers to the circulation process of transporting banknotes to and from the RBA, and to commercial banks and then to retailers by cash-in-transit (CIT) companies. This occurs in Australia via both road and air transportation. This figure also includes the CIT depots themselves, where banknotes are sorted and assessed either for destruction or reintroduction into circulation. Somewhat interestingly, ATMs generate the second highest carbon emissions in this process, and that is just the electricity that ATMs use to function. Third, the banknote production process accounts for 23% of carbon emissions in this assessment, which also includes our suppliers' carbon emissions. Finally, vaulting and destruction. Unsurprisingly, activities on the NBS site contribute to banknote carbon emissions to a small degree. The goal of banknote distribution in this context is broad. Not only does it include providing banknotes to the public, it also includes banknote storage, transportation and fitness sorting, and banknote destruction. It is an end-to-end process in terms of accessibility. Distribution is conducted by the private sector. The issue of fitness standards is interesting, and it presents a challenge for the RBA given that banknote distribution is governed by the private sector. Fitness standards are developed by the Bank and apply to the private sector to ensure that the quality of banknotes is as the RBA wants it. There is real tension here between the time a banknote spends in circulation and the durability impact of banknote security. We must make sure that banknotes do not remain in circulation for too long before their security features wear off or experience a catastrophic failure. This tension is very real, and it is one of the issues that the RBA is currently engaged with, namely how the RBA strikes a good balance between a fit banknote that is secure and something that has been in circulation long enough to receive the emissions reduction consequences.

Distribution Network

Being a country with a large land mass like Australia, banknotes are often transported significant distances, perhaps up to 3,500 km from Craigieburn. The RBA has observed some interesting innovations within the industry, such as banknote recycling machines. ATMs with banknote recycling capabilities help banks and CIT companies reduce transportation emissions. A recycling ATM accepts cash deposits before validating, sorting and storing the banknotes. Those banknotes are then made available to consumers for withdrawal, effectively recycling them back into circulation. This means those machines require far fewer replenishments, resulting in a significant reduction in carbon emissions for CIT's transportation impacts. Smart

safes are another industry innovation that has emerged in recent years. Smart safes use cash management software that provides data on cash balancing and forecasting to enable efficient scheduling and forecasting of CIT pickups and cash replenishments. Smart safes are used by CIT companies in Australia to reduce the necessity for frequent cash pickups and allows the company to optimize transportation arrangements, resulting in lower emissions. Retailers can deposit money or cash in the smart safes, and the funds are immediately credited to their bank accounts. The cash will not be collected, however, until the smart safe is full and the CIT receives an alert to come and collect the cash.

Recycling

Recycling is a relatively mature process for the Bank. RBA has been recycling or sending our banknotes to a recycler for the last 30 years, but this is significant because it means we are not sending plastic waste to landfills. In terms of the process, the RBA granulates the banknotes onsite, where they are then melted into pellets. They bear no resemblance to banknotes or any of the materials used in their production, which are then recycled. The recycled products are turned into a variety of items such as coat hangers, plumbing fittings, compost bins, garden furniture and more. Even eyeglass frames are made from recycled banknotes, demonstrating the potential in this space. There are a lot of ways that the waste associated with this process is removed from landfills and turned into something useful.

I hope I have given you an idea of the broad range of thinking the RBA is doing in the sustainability space in relation to banknote processes, particularly the production elements. There is massive potential in this space, and everyone could be doing a lot more. I have referenced a lot of bank research in this presentation and will be able to provide those papers to our hosts. Finally, I would like to thank my colleagues who helped contribute and put this presentation together. Elise Lewis and Ravi Ratnayake are members of the online audience, and they did a brilliant job of looking at the broad range of activities that the RBA and NPA are working through together and summarizing how that fits into the banknote life cycle process. Thank you.

Q&A SESSION

Question (Currency Management Department, Bank Indonesia):

Thank you very much for the excellent presentation. It was very comprehensive yet enlightening. You mentioned that currency distribution is one of the most important areas that we must address for carbon emission reduction. I want to know your view on our ATM network, our CRM network, as well as the central bank's use of numerous vendor processing systems, which involve various sensors to verify the authenticity of banknotes. Would it be better for Bank Indonesia as a central bank to focus on a specific feature, such as cash handler features and central bank features, rather than having three or four security features in order to reduce the number of sensors and thus the amount of electricity used in ATM networks, CRM, and our VPS?

Victoria Pymm:

That is an interesting question, and I am not sure I know the answer. It is something RBA has thought about in terms of how to prioritize which security features are most important. The RBA is currently reviewing the note quality rewards scheme, which relates to the quality of banknotes in circulation and is conducted by the depots. While Bank Indonesia owns its depots, RBA CITs are incentivized to do this kind of quality sorting in their depots. The RBA has indeed thought about how to narrow down the requirements we have in order to use the network in a more sustainable way. The tension is around security. How does the RBA avoid dumbing it down to the point where we create a counterfeiting episode, for example?

Question (Regional Department Bank Indonesia):

Thank you for a good and concise explanation about Australia's banknote life cycle. Could you please elaborate on the considerations of RBA in the transition from paper to polymer? Was it solely based on reducing production and durability, or do you have any research on cash handling? As a developing country, the public in Indonesia does not handle banknotes all that well. You also talked about how RBA recycles banknotes into various making products. How did that come about?

Victoria Pymm:

In terms of the recycling, the RBA has a contractor, but we must first pulp the banknotes. In other words, they are shredded and formed into pellets before being transported offsite to a separate company that creates a range of different products.

This is an interesting question about the polymer transition. Back in the late 1970s and early 1980s, the RBA experienced a significant counterfeiting outbreak for what was then a relatively new paper series of notes. The Bank had not anticipated the counterfeiting outbreak, which came as a big surprise, and the governor at the time was inspired by the idea of creating a holographic security feature on the banknote. Not only did he believe it would be cutting-edge, but it would also address the counterfeiting issue as a highly effective security feature. He worked with the Australian Government's Commonwealth Scientific and Industrial Research Organization (CSIRO) to develop a holographic feature. However, they realized that it could not be effectively placed on a paper banknote. As a result, the idea of using plastic emerged. It was a byproduct of the security feature requirement. However, as evidenced by the durability outcomes, it has also made a significant difference to transactional banknotes. Polymer banknotes are extremely durable against handling wear. We see failures around security features and ink wear long before we see degradation of the actual substrate.

Question (Peruri Research Institute of Authenticity – PRIFA):

Thank you very much for your excellent presentation. The RBA uses polymer for banknotes. Given that polymers cannot be decomposed by microorganisms, why does RBA use polymers that could harm the environment? Second, is reusing polymer enough to support the environment? Will the RBA continue to use polymer in the future, or will other materials be used for banknotes?

Victoria Pymm:

Good questions. In terms of polymers, the most important environmental consideration is recycling. RBA does not generate plastic waste that needs to be degraded by microorganisms in landfills. The RBA is investigating 100% repurposed plastic waste, which includes the spoilage in the banknote production process and the return of unfit banknotes returned from circulation.

The RBA will continue to use polymer. We have seen significant cost savings as well as a significant reduction in the number of new notes required, which provides significant long-term sustainability benefits. The RBA was at the forefront of this process. However, other banks, including the Bank of England, have recently begun to adopt polymer banknotes. Their estimate was that they would cut two-thirds of their banknote production order because they would no longer require continuous reprinting of banknotes. The durability is so powerful, leading to some significant sustainability benefits in terms of the numbers of products produced.

Question (Currency Management Department, Bank Indonesia):

Regarding the current payment system environment in Australia, particularly the comparison between banknotes and digital payments, is there convergence towards cashless, implying a reduction in banknote usage or a shift in Australians' preferred method of payment?

Victoria Pymm:

It is something RBA considers a lot, particularly because part of my responsibilities is to look at how to keep giving cash to Australians that need it in the future. The Bank is committed to providing cash while it is required. The polymer element is important because it indicates that one of the potential benefits considered by the RBA is a reduction in transport emissions. Using banknote recyclers makes it a more important quality, especially given Australia's large rural and regional areas, where use cash is preferred. The note quality scheme, for example, and the continued use of banknote recyclers will be important ways of supporting cash use as the trend for transactional cash use continues to decline. Furthermore, the RBA saw an increase in banknotes issued during Covid, dominated by higher denominations. We think they were being used as store of value by people in a crisis who liked the security of having cash available on hand. Like in most countries, transactional cash use is declining, and as such, thinking about the durability of banknotes in that space is important.

Question (New Cash Center, Bank Indonesia):

We are currently building a new cash center. Through the green building initiative, everything will be built with the purpose of lowering carbon emissions, including roof solar cells and other things. In your presentation, you stated that Note Printing

Australia (NPA) accounts for 60% of carbon emissions. How did you calculate that? Is there a reference for that so that we can give similar estimates for our new building in the future?

Victoria Pymm:

That figure was not included in the presentation because it is an estimate. We have had some contractors do that work, but we need to go through it to ensure that those estimates have taken all the right elements into account. As a result, 60% is a bit of a guess at the moment. However, it is an important statistic because it shows how enormous the contribution of a manufacturing facility is in this context when compared to just the average emissions associated with running the central bank. While I cannot provide you with a reference for that, unfortunately, it is still an important factor to consider when constructing your new facility.

Question (Bank Indonesia Representative Office Solo):

It is great to see how the RBA and NPA have considered every aspect of providing effort for a greener environment. Does NPA use recycled banknotes to produce new banknotes? Second, as providing durable banknotes with security features is challenging, how does this relate to the number of banknote counterfeiting cases in seen in Australia?

Victoria Pymm:

In terms of banknote waste, there is a limit to what you can actually do with it. The polymer that INNOVIA produces in terms of the film is very pure, with no additives in it. I am not sure of the exact scientific formula, but the only product that can be recycled back into it is the film waste itself. The RBA cannot use banknote waste to make new banknotes because they need a very refined type of polymer requirement. In terms of the durability issue with security features, this is something that the RBA is actively considering. For those who are unfamiliar with the new generation banknote series, it currently has a family feel, with all banknotes having the same security features. The RBA is currently considering how that might change over time in terms of the future for banknotes because durability will become increasingly important as the use of transactional banknotes declines. We do not have a metric

that links counterfeiting to a decrease in security features. I am aware that the Bank of Mexico and the Bank of Canada have previously attempted some work in this space and have been caught a little short due to a significant reduction in security on their lower denominations, which did result in some counterfeiting incidents. They were then in a position to go back and reconfigure all the banknotes that were affected by the counterfeiting outbreak. What this means for the RBA is that they must be extremely careful when approaching this type of durability work.

Online Question:

What RBA policies should be imposed on banknote material suppliers to achieve or set a target for a transition to carbon-neutral operations over the next 20 years? Will the RBA continue to use polymer banknotes for the next 20 years?

Victoria Pymm:

I think the RBA will continue to use polymer banknotes for the next 20 years, and we will continue to evolve over time, but I suspect that polymer will remain the base substrate. It is an excellent question about the policies we have in place for raw material suppliers. NPA sets the rules and I would need to ask them to find out a bit more about what those policies are. It is important that raw material suppliers have sustainability targets in place, as all of them do.

Online Question (Currency Management Department, Bank Indonesia):

I would like to delve deeper into your materials, could you elaborate on the RBA's recycling machine policy, the banknote recycling machines, and how the RBA applies its fitness standards for banknotes to impact sustainability?

Victoria Pymm:

In terms of recycling, security is again one of the main areas of focus. RBA granulates the banknotes themselves onsite and turns them into pellets. Those then do go offsite, making sure product waste is kept secure. That is one of the key elements of the policy, and RBA has had a plastic recycler in place for a long time now and has a contract with just one provider. RBA has considered in the past as to whether we should open that up, but there has not been an enormous volume. At the moment,

it is focused on one supplier, which means that rather than having a broad policy approach in this space, it is a contract between the Bank and that supplier. In terms of the no-quality rewards scheme, this is something that is interesting and that came about roughly 15 years ago in terms of the Bank's removal from the banknote distribution function. What the RBA saw was that banks were not keeping the quality of banknotes at a high enough standard, or at the standard that we believed was required to prevent counterfeiting. As a result, the RBA introduced an incentive-based scheme that randomly assesses samples banknotes at different depots to assess their quality, and then provides the banks with a financial incentive if those quality standards are met. The RBA has found this to be reasonably successful over the past 15 or so years, but it is something we always want to keep considering because it is an important requirement for banknotes. However, it also impacts durability in the sense that it can potentially remove otherwise very high-quality banknotes from circulation for minor defects. The RBA always wants to make very pragmatic decisions in this space.

Online Question:

Are there any other factories or institutions to collaborate with in waste management, and if so, how do they deal with it?

Victoria Pymm:

There are quite a lot. From an NPA perspective, there are several organizations that help manage, specifically the reduction of waste going to landfills. There are quite a few organizations that NPA works with, including the e-waste provider and obviously the plastic recycler. They operate with them in the same way that the RBA procures things, with that sustainability lens on top of any engagement. It is important to note the security level. When talking about materials associated with banknotes, the RBA wants to be very sure that they are handled in a secure and appropriate fashion to avoid getting raw materials or input materials distributed in places they should not be.

Online Question:

To what extent is RBA devoted to mitigating its negative effect on the environment?

Victoria Pymm:

The RBA has made a public commitment to improving the performance of our operations. Our federal government target is carbon neutrality by 2050, and the Bank is obviously working towards that. RBA is very committed to sustainability, and one of the key things in terms of our sustainability principles is embedding them in our day-to-day thinking. Regardless of the type of work program we are delivering on, sustainability considerations are built into the fundamental heart of whatever is being considered.

Question (Currency Management Department, Bank Indonesia):

One simple question about your plastic recycling products: do you sell them to the public or use them internally in the Bank? If you sell them to the public, is that considered revenue?

Victoria Pymm:

We do not use it internally. It is sold publicly, and RBA has no control over where it is sold. There is a diverse range of companies that accept recycled banknote products. Therefore, yes, they just go out into the broader universe. A colleague of mine received a recycled banknote flowerpot from her son at a school fair. They are very widely available, particularly in the Melbourne area, where the plant is.

Online Question:

It is good to implement the circular economy to recycle polymers, but what about liquid waste? Do you do the same thing with liquid waste?

Victoria Pymm:

Liquid waste is much more of a challenge because here we are talking about chemical waste as well. One of the things that SICPA talked about, which was quite interesting, was removing some of the toxic chemicals from liquid waste. For RBA, that can be a bit of an issue still. Therefore, no, RBA does not have any kind of recycling or diversion from landfill operations yet in terms of liquid waste. That is something that is still an initiative, which would require RBA to do quite a bit of work to start getting better outcomes in that space.

Question:

Was a study conducted to prove that polymer is better than paper as a substrate for banknotes? Did the RBA conduct its own or a third-party study?

Victoria Pymm:

The RBA did that work ourselves. That resource can be provided after the seminar. There are a couple of papers that are publicly available that show RBA's research in this area. I will provide that to the hosts for you to read through and understand some of the analyses.

Question (Bank Indonesia):

My question is about the progress of the central bank digital currency (CBDC) implementation. As you are aware, some countries are already in the pilot project phase, while others are still in the whitepaper phase. Is the RBA already assessing, mapping, or planning the impact of CBDC implementation on the banknote life cycle with respect to the amount of production or the distribution mechanism?

Victoria Pymm:

This is not my area of expertise; however, the RBA is looking into it, as is probably Bank Indonesia. The RBA's understanding of how cash will be used in the future suggests that it will not be completely removed from its utility as a payment mechanism. It will continue to be used, perhaps not as much as it is now, and this is the trend seen in the decline of transactional cash use. The RBA, however, is still seeing an overall net increase in banknotes delivered to the public. The RBA does expect the increase to level out in the future, but when that happens is unknown. The RBA anticipates a baseline need for cash going forward. The RBA does not expect cash use to fall off a cliff and be replaced by central bank digital currency, for example, because there is a strong preference among certain groups of people to continue using cash.

Online Question:

Is there a timetable and budget allocation from the NPA and RBA for developing a sustainability strategy based on the UN Sustainable Development Goals (SDGs)?

Victoria Pymm:

Yes, there is. NPA has spent the last couple of years developing its sustainability road map. It is a big initiative, and they have spent a lot of time working through it. There are a lot of challenges around budget allocation. I do not know what that budget allocation is, but the NPA had to commit to this space as well as to the projects that the RBA is working on with them in terms of what the Bank is responsible for on a broader scale. They absolutely do have budget commitments, but I am unsure what they are.

Online Question:

In terms of recycling, does producing recycled products from banknotes themselves increase carbon emissions?

Victoria Pymm:

It does increase carbon emissions. It is a contrasting benefit, however, to sending a huge amount of product to landfills or having it burned, which is the alternative for paper banknotes, making it the lesser of two evils.

Question (Bank Indonesia):

It is interesting to understand that the RBA, in a joint effort with the NPA, is committed to improving sustainability in its operations. From a business perspective, would you mind elaborating on the costs and benefits of the current sustainable green operations versus the previous conventional operations?

Victoria Pymm:

Yes, absolutely. RBA has some specific polymer analyses that can be provided. In terms of the durability outcomes, RBA is still working through this because the long-term benefits are not yet realized, which is true for many of these programs. They are still in their infancy and are new. The RBA has conducted some high-level estimates that show what we believe to be significant cost savings. Previous speakers have also stressed the importance of investing in green initiatives upfront to transition to cost-saving initiatives in the long term. While there may be a short-term cost outlay, the long-term cost savings will be seen in addition to the environmental benefits.

Online Question (Bank Indonesia):

Is there a problem with waste management thus far, given that it is a major contributor to emissions?

Victoria Pymm:

Chemical waste is the most significant challenge in the note printing space. In terms of management, it does contribute to enormous emissions once it has left the site. It is something that both the RBA and suppliers are working on in terms of improving the chemicals we use and making them less toxic in order to reduce the chemical waste. It is one of the challenges of this area. Again, the RBA is at the start of this process, which is expected to bear fruit in the coming years.

Closing Remarks:

I would like to thank the Bank Indonesia Institute, as this is an incredibly interesting area. It is critical. I think the agenda that has been put together has also been hugely interesting.

- SESSION 5 -
GREEN BANKNOTE PROCESSING

Master of Ceremony:

Matthias Roerich is the president and director of PT Giesecke & Devrient Indonesia (G+D) as well as the Vice President of Marketing and Sales for G+D Currency Technology Solutions in Southeast Asia. Mr. Matthias Roehrich is a member of the Executive Management Team of the G+D Group as well as the Executive Management of G+D APAC Ltd. Hong Kong. He joined G+D Headquarters in Germany in 2000 as Regional Sales Director for Banknote and Security Printing in Africa, before joining G&D AOAC Ltd. in 2013. He also earned a Diplom-Kaufmann degree in business administration from the University of Erlangen-Nuernberg in Germany.

Peter Schermaul is the Sales Director for G+D Indonesia, and he oversees sales not only in Indonesia but also in Thailand and Vietnam. Prior to joining Giesecke & Devrient Indonesia, he served as Head of Customer Solutions and Services Indonesia and Head of Distribution Management for Southeast Asia. In 1996, he began his career as a Field Engineer for worldwide projects at Giesecke & Devrient's Headquarters in Germany. He also holds a degree in electrical engineering with a major in data processing technology from the Polytechnic of Berlin in Germany.

Speaker: Mathias Roehrich, President Director, PT Giesecke & Devrient Indonesia

First, I would like to thank Bank Indonesia Institute for the opportunity to deliver a speech and share some thoughts and considerations here with you. I am hoping to join my colleague Peter, who has already been introduced as a regular. This is different from previous presentations I have delivered in the past in that it was mainly about content, expertise, and know-how. When I was preparing for my presentation today, I noticed that this provided an additional aspect. Sustainability really is something close to my heart. I have three children, ages nine, thirteen, and fifteen, and I want

to set them free into an inhabitable world. It is critical for each of us, as well as every industry and player, to consider sustainability and purpose in our daily lives, business decisions, as well as future and career plans. It is a real pleasure for me to combine all these considerations with banknote processing.

Sustainable Cash Cycle

The subject originally allocated for this presentation was green banknote processing, but focusing only on processing does not serve the purpose—that is a small aspect. I extended the presentation, therefore, while staying on the subject and calling it the sustainable cash cycle. The agenda is clustered into three parts. The first part is the cash life cycle and its impact. The second section discusses the cash cycle and the key players, followed by a brief discussion of G+D products and solutions. It is not a marketing or sales presentation. This keeps it on a higher level, a little bit agnostic, in the hope that it is not too abstract in the first part, but later I will come up with two or three very pragmatic examples of how sustainability can be implemented.

Key Contributors of Sustainability in the Cash Cycle

What is the cash cycle? The cash cycle can be structured into a value chain of creation and into a value chain of distribution and circulation. In the value chain of creation, there are usually more one-time sustainability effects of decisions and production, whereas there are more recurring sustainability effects in the value chain of distribution and circulation. G+D aims to take a holistic approach to this. On the one hand, G+D is a provider in this currency technology spectrum with a holistic portfolio, and we obviously want to serve that purpose. On the other hand, G+D believes that if the goal is to create a truly green cash cycle, then all aspects must be considered end-to-end, before focusing on research and development, the target settings, and the actions on this overarching target of a green cash site.

Cash Cycle Sustainability

Though this end-to-end sustainability consideration is essential, focusing solely on one aspect does not help because making the right assessments and decisions will be difficult if only the product is considered without the rest of the value chain. And, of course, the same is true for substrate choice, transport choice, optimization, and infrastructure; it must always be considered end-to-end for an honest assessment

and making the right decisions. In the product, there is a lot of determination on sustainability in the design phase. The choice of substrate, features, durability, and serviceability of G+D machines and processing machines is important, as is how little emission they have and how little they consume. G+D should always follow that and try to minimize those negative effects.

The use case is again to strive for the highest efficiency. If the system runs quickly with few jams and as little energy consumption as possible, then the process is already sustainable. However, there is more to product efficiency. Some may have heard of XaaS, which refers to the delivery of anything as a service or offering services instead of products. Car manufacturers tried it for a while, saying they do not sell cars but rather mobility services. When transformed and applied to our industry, we have managed services across the cash cycle. It will then allow everyone in the industry to make better use of infrastructure. Collaboration and managed services may be the best path to more sustainable infrastructure and a more sustainable cash cycle because more players working together eliminates the need for spare capacity. You can see this is not a sales presentation because no selling is taking place. If the infrastructure is used more efficiently, different tools may be required to control and optimize it, which can then be sold as software that still works. After that comes recycling and recovery, as well as end-of-life treatment and management. There is no need to elaborate on recycling. It must somehow now be managed well because it generates a carbon footprint. G+D recycles used products for a purpose that makes sense and we try to recover as much as possible. Collaboration in this field can be strong leverage for sustainability and efficiency because if the players in the cash cycle collaborate and have an open mindset, they can create recirculatory models where the product is in a recycling loop before it goes to the final end of its life.

Taking a more structured theoretical approach to this topic, aside from the end-to-end value chain consideration, G+D suggests creating a pyramid to show the prerequisites for a sustainable cash cycle. The triangle shows that it is working for social responsibility and that the common goals require cooperation and innovation. It is always about collaboration, having the right perspective on social responsibility and sustainability, and innovation is key to driving this forward. G+D machines cover substrates and materials that are the best option now. However, the need for a more innovative process may help G+D overcome this hurdle and produce something far better. Nobody believes G+D will have a banknote processing machine made from bamboo, but who knows? It is best to keep an open mind.

Social Responsibility

Sustainability is not just about the environment. Cash has a social responsibility component that applies to both physical cash and digital currency. That is why central banks are investing in central bank digital currencies (CBDC), as there is a need for inclusion as well as digital cash that is equivalent to physical cash. Everyone in this room will agree that social responsibility, freedom of choice, and cash privacy are very important. This must be combined with the most environmentally friendly production and use cases.

Collaboration

When talking about collaboration and looking at G+D cash cycle models, particularly in Southeast Asia, which includes both the Indonesian and Australian cash cycles, there is a pattern that each player and each stakeholder in the cash cycle tries to optimize themselves, taking the best solution design and workflow gets the best output. The next level of optimization is achieved through collaboration, with linear optimization between the stakeholders. For instance, between a commercial bank and a CIT, or a CIT and a retail customer. Later, I will give a practical example that focuses on this collaboration option between CIT and a commercial bank through standardization of the trays to be used in the cash cycle. In the subsequent generation, which looks like a distributed ledger model, is the cash cycle 4.0. This is a highly efficient cash cycle with the best collaboration of all stakeholders, high data integration and availability to make the right decisions and forecasts in a way that is fostered by the central bank or regulator. That is the maximum, more or less industry 4.0, with high integration across the entire value chain. If this is possible in industrial production, some of the elements could be taken over in the future of the cash cycle and currency technology.

Innovation Path to Sustainability

After social responsibility and collaboration comes innovation. Having this seminar and discussion in the industry, as well as the invitation from the Bank Indonesia Institute, is exactly the right thing to do. It starts with selecting a topic, bringing it to the table, listening to presentations, finding food for thought, taking in considerations, and so on. The issue is then identified and analyzed in greater depth in order to gain a broader perspective. Finally, solutions are developed. I believe that BI and all other

central banks can and are already taking this action. The regulator has it in their own hands to help the industry and its players move in the right direction by setting the right parameters and, for example, by fostering standardization. Standardization is a perfect example of increasing efficiency. Think about the containers in sea freight. If the container was not standardized, it would be even more of a mess than it is now with all the logistical disruptions. The central bank and the regulator can play a big role in this. Once this collaborative approach to a better cash cycle has been achieved, it can be optimized further.

G+D Sustainability in a Green Cash Cycle

G+D is committed to a sustainable green cash cycle. I will now apply the theoretical framework to what we actually do as a group, along with the entities. It is important to take ownership of this, and therefore responsible individuals are needed. On a group level, G+D has a highly skilled environmental, social, and governance (ESG) manager as well as in the divisions. G+D has also further institutionalized the ESG. ESG has always been present in G+D's DNA, but this is a new dimension. G+D may have considered a solution or product development in the past when considering the acquisition of a company with a strategic fit consideration. Moving forward, G+D will have a sustainable fit consideration and determine that this is the next level of producing green and taking it seriously.

Trade-Off between Inflation vs Output

The concept of a negative supply shock is one way to imagine the impact of climate change. Although there are other impacts on demand, the most notable is the impact on aggregate supply. It is also known from basic ECON 101 that if there is a negative supply shock, which is stylized here, the price stability oriented central bank should react by raising interest rates because their primary objective is price stability, and therefore, even if this comes at the cost of output loss, that is the optimal policy response that a stability-oriented central bank should do. There are clear economic costs to this, as climate change creates a situation in which central banks may face the very uncomfortable trade-off of output stabilization versus inflation stabilization more frequently. Not a nice position for central banks to be in.

Our Solution Design Considers Sustainability of the Product and in Operations

Here are some of the measurable targets set by G+D at the board level, as well as their strategic considerations. ESG is for G+D and for everyone—environment, social, and governance. In terms of the environment, we currently say that net zero is unlikely until 2040 or earlier and reducing water consumption by 10% until 2030 compared to the baseline in 2020. Zero waste to landfills until 2030 or earlier, and 70% of revenue based on green products until 2040. Social is not as relevant for the subject here, but with quotas set at 80/20 in executive management, then improving and controlling lifelong learning, which is very important because in the disruption and transformation everyone is in, it is very important to ensure that our talent and experienced employees can continue to be trained and can keep up. In terms of governance, human rights for example, G+D assignment to the UN compact, and so on. It is a framework that will be published soon, and it is the overall guideline at the top level.

Coming back to the product level, if a manufacturer creates a product, they will, of course, investigate all relevant aspects. There is always health and economic protection, safety standards in operations, certified quality, environmental management, low power consumption, low heat emission, as well as durability and waste destruction. However, this is now being driven to the next level, such as ISO certification. This is accomplished through the use of explicit frameworks and patterns to run product development and product decisions, as well as dedicated managers who have a say, authority, and relevance for that decision.

Sustainability in Cash Processing: Lower Emissions, Reduce Waste and Intensify Cooperation

For a more practical approach, sustainability in cash processing means lower emissions, reducing waste and intensifying cooperation. Collaboration is key. On the one hand, there are scalable hardware solutions with a loose banknote logistic example, demonstrating how waste can be minimized using a container. Furthermore, efficient cash center operations are made possible by automation and robotics. G+D has built a very modern cash center in Indonesia with our customer, which is likely the most automated and modern cash center in the world. It utilizes as much automation and robotics as possible and generates a very high output of data from

the banknote process on a daily basis, reducing much of the emissions, costs, and efforts that were previously distributed. Software is key to optimization. Therefore, having forecast models with intelligent algorithms will optimize decision-making, optimize routes, and more.

Loose Banknote Handling in Intra- and Inter-CC-Logistics with Standardized Trays

Loose banknote handling intra- and inter-cash center logistics with standardized trays is maybe the most tangible example of the lowest hanging fruit. This is not rocket science. But it is likely the most complex aspect to implement due to the large number of stakeholders who must agree on something. The agreement and coordination processes are a challenge. The idea is to have a traceable and trackable tray that uses software to keep track of where the tray is at all times. The tray also has a sealable lid, eliminating the need for shrink wrap, which is then optimized for storage through palletization, minimizing storage capacity waste. As a result, loading processing systems and filling ATMs becomes easier. If such a tray can be used, and there are pilot cases to show this in Europe, for example, between commercial banks and CITs or other stakeholders, all of this can save a lot of processing capacity, resulting in less energy consumption and waste.

Waste Reduction in Intra-CC Logistics with Tray Filling

The normal process entails having the banknote processing in the system, followed by bundling, packaging (which involves shrink wrapping the bundles), storing the bundles before giving them to the next player in the value chain, who unpacks, unwraps, unbundles, and then sorts it again. There are a couple work steps here that take time, consume energy, and generate a lot of waste. In this case, NotaTracc® tray filling and collaboration among stakeholders reduces waste and reprocessing because the data are captured securely via software before being transferred to the other players. Furthermore, the trays have sealed lids, making them difficult to tamper with, and there is no need for foil, including PPT foil or something more environmentally friendly, and there is no need for paper bundles.

Benefits of Loose Banknote Handling with Trays

The trays reduce the process to one machine level, one BPS M7 system, which requires eight fewer operators, has 30% fewer process steps in ATM cassette filling, and can save 145 kilometers of banderole paper per machine per year, which is quite impressive. What does save 145 kilometers of banderole paper mean? Perhaps it can convince the regulator to introduce one type of tray that every stakeholder in Indonesia will use. The M7s machine can save 145 kilometers of banderole paper per machine per year. Bank Indonesia has around 40 M7s machines, implying massive savings each year, equivalent to a roll of paper that would start in Banda Aceh and go all the way to Papua, covering the complete distance of Indonesia (5,500 kilometers) from east to west. Essentially, we could save enough paper to stretch from Bandar Archer to Papua every year. In the second year, we could do the same from Flores, Indonesia, to Northern Australia. After ten years, we could go around the equator. Low-hanging fruit is not a big deal. All that is required is standardizing a product, reaching an agreement on it, and everyone using it. This creates a massive sustainability effect. This is only for the 40 systems but imagine doing it for the entire cash cycle. The challenge is deciding how to agree on it. Consequently, it is more likely a political process. It is difficult, but worthwhile and very tangible. That would still be a significant step if it were done in 5- or 10-years' time. How long it takes is unknown, but one thing is certain, it would be fantastic if this was implemented in more and more cash cycles. G+D had the first pilots in Austria and Scandinavia not long ago, proving that it works. It is not an illusion; it is clearly visible.

Measures to Optimize Cash Transport

Having a large, highly automated cash center with more robotics and less manual intervention, along with the associated efficiency gains, is a very simple example of standardization and the gains from that. Finally, software is the key to many things, including this one. Having the right software products and information, the right data intelligence, results in better operational work and better strategic decisions. The software products that are used should optimize things like route and transport optimization, but there is still room for implementation. Also, optimizing the cash requirement and cash as a cash point, as well as the network for the route, mass transport and locations where cars stop and collect, makes for a better overview. Assuming there is a collaboration model between the central bank, commercial banks and CITs, a common platform for coordination is needed. In this case, it would be

beneficial to have software that can cover the entire cash cycle and optimize storage, stockkeeping and cash flow, independent of stakeholders.

Compass ICO: Efficiently Distribute Banknotes Across Large Countries

This is something G+D implemented with the Bank of Canada long ago. It is called ICO, or Integrated Cache Optimization. It is a software tool designed for supervising, optimizing and managing the cash flow between the central bank, the CITs and the commercial banks. It is also extended to central banks with delegated styles or where there are notes-held-to-order (NHTO) policies. Similarly, Bank Indonesia applies NHTO policy in remote areas. All these innovative collaboration models, when combined with this smart and reliable software tool, which G+D introduced ten years ago, can lead to cash cycle optimization. Optimization in the cash cycle is sustainability in the cash cycle. It begins with the product, then moves to the use case, which is optimized within your own premises. It is optimized linearly between stakeholders to see the big picture before integrating most of the players with the right software to control and steer it to achieve the maximum sustainability effect.

A Green Cash Cycle

In summary, we all believe in the social purpose of cash. Cash must be a combination of social responsibility and sustainability. Sustainability is more than just the product. Sustainability is end-to-end, namely the company and its DNA, as well as the DNA and sustainability efforts of all players. Sustainability is an overarching guiding principle in daily operations, innovations and optimization, and strategic thinking. The sustainability fit makes a lot of sense. The next level of efficiency and sustainability lies in standardization, such as the NotaTracc® tray, which is simple but complex to operationalize and agree upon, hence the need for regulators and all stakeholders to cooperate on that. Cooperation, for a purpose like sustainability, makes a lot of sense.

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Q&A SESSION

Question (Bank Indonesia):

According to my data, G+D has supplied 142 sorting and destruction machines. Do you have any suggestions for the central bank in terms of recycling the waste from the destruction machine? For the time being, BI disposes the destroyed banknotes in landfill. I read recently that Bolivia uses waste to improve soil, whereas the Bank of England uses waste as an electricity source. Is G+D aware of any solutions for Bank Indonesia's banknote waste?

Mathias Roehrich:

Thank you for the question. It is a difficult question to answer because it falls within our scope while also being outside of it. Our scope usually ends when we discuss the secure destruction of banknotes and the handling of storage material. G+D can destroy both polymer and paper banknotes in the banknote processing process, and they must be treated differently. There were many considerations a few years ago about using shredded banknotes as insulation material for houses. In my opinion, there are many good ideas, and the only question is what can be implemented and what makes sense. I have no other good examples right now. Perhaps Peter has one.

Peter Schermaul:

Bank Indonesia could burn the waste and store the heat to generate electricity later. However, filters are required because otherwise, when burned, the toxic waste will fill the air.

Mathias Roehrich:

There is a solution for everything. I learned this from a good friend who is in charge of engine production at one of the largest producers, and we were discussing ocean liners. He told me it is easy to have an emission-free filter system on the engine of an ocean liner, but it is a commercial decision. I believe Indonesia can burn banknotes

and produce energy with an efficient filter. To truly understand this, you must have a full picture. I am pretty sure there are options, and it is probably a matter of the driver behind it in most cases, such as the regulator and what rules are set. We are all commercial entities—at least B+D is a commercial player—and we can only innovate if there is a good purpose for that and if we can afford it.

Question (Bank Indonesia):

Concerning soiled banknotes that must be destroyed by our operators, I do not see any initiative from a cash processing company to develop a machine that will assist us in managing our soiled banknotes, particularly in tropical countries with high humidity and a climate that is not conducive to cotton paper. As a result, any initiative or technology that will aid in the improvement of our soiled banknotes will be critical. Years ago, I visited a company that was developing a machine to improve soiled banknotes, but it was still on trial. Unfortunately, I never heard anything more about it. It would be interesting to see if G+D can launch a new initiative. In any case, whether in Malaysia or China, especially for small denominations, that can be easily improved by cleaning the banknote and reintroducing it into the cash processing system.

Mathias Roehrich:

OK, we are two now because I also suggested to our R&D people a couple of years ago that we should have a banknote washing system, but it never worked out. Nevertheless, I think the answer is to go back to the substrate. Earlier, Victoria presented the polyurethane and polymer substrate views. Later, my colleagues from Liebenthal will present their views on the durability of paper and hybrid substrates. I do not think, however, processing can achieve much about that. Therefore, you must make the right decision and make the right trade-off between the substrate, durability, and all the effects, as well as sorting efficiency. That way you have made a step in the right direction. The destruction and end-of-life of banknotes is also a logistical issue. Indonesia has many islands. I believe small capacity destruction equipment can help as well. I believe we have 200 kilos per hour as one of the smallest entities with the least distribution and circulation of banknotes. As a result, I do not believe you can solve the problem in the processing, and you will have to revisit it end-to-end and holistically.

Online Question:

What do you think are the most challenging issues and the most effective way to collaborate with so many stakeholders in the cash life cycle? In addition, with the extensive use of machines in cash handling, do you have any suggestions for how we can process the banknotes with lower electricity consumption?

Mathias Roehrich:

The biggest challenge of this collaboration is that each stakeholder in this industry and part of the cash cycle has its own set of targets and objectives. I think it is difficult to go to a higher level and ignore the commercial targets in favor of sustainability. The regulator is required, therefore, to foster and catalyze this. There are always options, and even if an industry trend is disruptive, innovative companies will always find ways around it. As a result, I believe stakeholders must be supported and fostered by the regulator, and there must be more than just the commercial aspect. There must also be some way to ensure that not the cheapest solution is the best, but that maybe the most sustainable and economically reasonable solution is the best. This is something that must be accomplished by bringing people together. There are a lot of good intentions, which may be difficult to implement. To answer the question, the regulator plays a key role.

Regarding energy consumption of the systems in the cash cycle, it is not only the processing systems, which are a big one; there are also small ones and ATMs, so you have plenty of machines to choose from. Again, make it as efficient as possible. Having as little infrastructure as possible will automatically minimize consumption. Good planning and good software tools, therefore, can help you achieve that target. I thought about the ATM question before. I believe many ATMs are powered by solar cells so there may or may not be a correlation between ATMs and power consumption. The subject is always complex; many aspects must be considered. Collecting all the data and information is difficult, which is why statements are always a little bit weak.

Online Question (Peruri Research Institute):

What is the most critical factor in ensuring a sustainable environment, and what benefits can be gained by working jointly with other cash cycle participants?

Mathias Roehrich:

In my opinion, you need ownership and institutionalization. There must be buy-in and ownership at the top of whatever organization it is. You have to make the organization in such a way that this can be implemented. This is not rocket science, it is rather basic. You will not make any progress unless you have a high-level owner and implement sustainability on a strategic level due to a surplus of operational items.

Concerning the second question, I believe in collaboration and its benefits, both independent of sustainability and also in terms of sustainable. If a local important player like Peruri and a supplier like Louisenthal Paper Mill can collaborate to deliver a local benefit, local content, and a locally specific, customized solution, I believe it is very worthwhile and valuable. This serves the purpose of no hard transfer for collaboration and it serves the purpose of finding the best solution for the individual local or national solution because there is no global footprint or global blueprint to serve everything. Would be great if there was a global initiative.

Question (Bank Indonesia):

I am especially interested in the standardized trays of your innovation because you have said that using NotaTracc® trays could save about 125 kilometers of banderol paper per machine per year, but that this type of logistics would need more machines. Do the machines consume a lot of energy? If so, how should the issue be addressed in order to maintain sustainability and a green environment?

Mathias Roehrich:

You might recall that I purposefully said standardized trays rather than standardized NotaTracc® feeding modules because you do not need the feeding module. Of course, I am happy to provide a NotaTracc® feeding module, but that is not the main intention. The overarching intention is that G+D believes the standardized product will be beneficial. We do not want to monopolize it. We are a commercial company looking to earn money, but that does not mean we are not open to good collaboration models, especially such an innovative logistical solution for intralogistics in a cash center. However, if you decide you want to have a feeding robot, which has many advantages, you can also bring this to an environmental aspect, which I also did not elaborate on previously. The feeding robot will be seamlessly integrated into

the system, and G+D has it for both the high-speed system and the smaller system because we must provide it for the entire cache cycle. Moreover, this connection and vacuum system eliminates a lot of noise and dust emissions. As a result, there is another positive effect and more economics. You must make a trade-off in terms of energy consumption. And then there is the question of where you get your energy from and how can you help generate it. I am not in a position to find a solution for that. I can only tell you what the benefit is, and you must weigh the tradeoff. However, I do not believe that the energy consumption of the NotaTracc® feeding robot is so significant that you would decide against it if you were truly at the decision point. The advantages of stress-free processing—less emission, less dust, higher accuracy, and efficiency—would far outweigh any negative considerations about the consumption that this causes.

Online Question:

In terms of sustainability and green cash, what innovative products, other than tray machines, does G+D offer to reduce the impact of banknotes?

Mathias Roehrich:

This question can be answered better by our colleagues later, who will deliver a presentation about green banknotes. We have already elaborated on the main points of increasing sustainability from the processing side. We are only one division of the G+D company group. There is also our paper mill, and they will have something quite impressive to present, which will answer your question. If you really implement sustainability at such a high level and with so much power behind it, as well as so much expertise and skill, there will be more and more innovations coming, and this will have increasing momentum. I cannot provide many more examples, but I am confident my colleagues can, and the innovation will occur quickly.

Online Question:

What does G+D advise its users do with the electronic waste from banknote processing systems and the end of their lifetime? Users currently sell machine parts to metal producers.

Peter Schermaul:

We could make a buyback. G+D is happy to do a buyback program where we can then offer you new machines and buy back older systems whenever your machines reach the end of their life cycle and you need to replace them. This has been very successfully implemented in the region, and we can do the same in Indonesia.

Mathias Roehrich

Another aspect is the current supply chain disruption caused by the crisis. I am not sure who in this room is suffering from a chip shortage, but considering what might happen, I would be happy to get some chips and boards and find a way to recycle and reuse them before we wait until the supplier finally provides what we need. It is highly relevant given the current situation. Therefore, please provide us with your systems, and we will come up with a good idea.

Question (Bank Indonesia):

You mentioned route and transportation optimization as one of the sustainability tips. We are unable to separate that from the note or the location of our office networks. We established a fixed number of office networks and then selected the most efficient route. Thus far, this has been the most efficient method for us. Does G+D have any frameworks or formulas for calculating the optimal number of offices or cash networks and pinpointing which locations are best?

Mathias Roehrich:

Yes, we have had those projects in the past for other central banks, and a couple of colleagues in our consulting and engineering department can offer consulting projects that analyze your distribution, demand and peak hours. They can look at the technology available and service-level agreements (SLAs) using software products to visualize and optimize before giving a proposal to support the decision-making. Even more so now, with all the data analytics, there are a lot of tools and options that you can use to make a project. It is a consulting project, but it is doable, and with these considerations, you can produce good results. I also know that you are currently looking at Indonesia's cash infrastructure in general. And with the cash center development you plan, this is also a good opportunity to review and look

at what can be done better or perhaps the result is that you are already doing it perfectly and there is no room for improvement. But it is feasible, and I will gladly connect you with my colleagues.

Online Question:

Will making banknotes more secure consume a lot of energy? What kind of green security is best for making banknotes more secure?

Mathias Roehrich:

I will answer the question, but I would like to point out that you may not get the best answer because I do not represent the banknote printing or substrate department. In general, there is a need for secure banknotes to serve a social purpose, and depending on the features you use—if you have applications, if you have threads—there is a carbon footprint associated with it, as well as energy effects and everything. This can be considered case-by-case for each feature, but there is no general answer. At the end of the day, it is a tradeoff between what you need to accomplish and how big the threat is and what the downsides are. I am pretty sure that if my colleagues go to the central bank and talk about substrate features or banknote printing, one part of their thinking could be to provide information about the energy and sustainability effects of a feature, which makes sense. Some restaurants provide all the kilocalorie information behind the food. It is a piece of information relevant for the decision-making, especially if sustainability is a major trend, which I believe it is. The Bank Indonesia Institute was digitalized last year. If you were to ask me what the most important trends are for us, I would say digitalization, sustainability and automation. And, if this truly is critical, there will undoubtedly be solutions and information provided, but you cannot provide general information. You have no idea how much energy will be expended.

Closing Statement:

I am grateful and happy that I was able to present this. I hope you noticed that I tried to be sincere and open in my approach. We have shown with the presentation that the next level is at the beginning, it has to have structure, it has to have initiatives, but we all have a couple of good ideas, and I really think it makes sense if the industry

players sit down and discuss and come up with good solutions. I have three children, and I feel responsible for what they inherit from me, even though I am only a small piece of the puzzle, but it will be good if you all have the same consideration. Thank you very much.

- SESSION 6 -
GREEN BANKNOTES, PRINTING AND WASTE MANAGEMENT: PAPER IN BANKNOTES

Master of Ceremony:

Mark Spencer is responsible for De La Rue's diverse currency portfolio spanning paper, polymer, security threads, print, and applied features. He manages all aspects of the product life cycle, supporting the identification, development, and implementation of new security features, services, sustainability and improvement projects. Within Mark's role as technical product manager, he also advises on all aspects of the specifications, design and manufacture of banknotes with focused efforts in sustainability.

Andrew Forbes received his executive MBA from CASS Business School University London. He also joined Louisenthal in 2009 where he is now responsible for global sales of banknote and security paper as well as high security threads and foils. Andrew spent twelve years in international sales and marketing positions in the data security industry.

Speaker 1*:* Mark Spencer, De La Rue

Before we start, I just wanted to say thank you to Bank Indonesia and the Bank Indonesia Institute for the opportunity to come and speak on my first trip to Indonesia in one of the most beautiful locations I have probably ever had to present. It is an honor to speak on behalf of De La Rue on a topic that is very close to everyone's hearts and something that De La Rue takes very seriously. During the session, I will talk about De La Rue's holistic approach to sustainability, our alignment with global charters and initiatives, and our transparency and auditing, which have been industry-leading and recognized.

Currency Division

De La Rue was established over 200 years ago and is headquartered in the United Kingdom. It has currency printing facilities around the world, including in Malta, Sri Lanka, Kenya, and, of course, at the Bank of England in London. De La Rue also has a security features and a polymer manufacturing site in Manchester, UK. De La Rue offers extensive global experience across all sectors and areas of the banknote life cycle, from substrate security features to design and support services to fully finished banknotes. In the last five years alone, that experience has been gained by designing more than 30% of all new banknotes and working with more than half of the issuing authorities and printing works. Some of those relationships date back many years, such as the one with Bank Indonesia, which is now over 70 years old. De La Rue understands that banknotes are more than just currency and is fully committed to ensuring that we deliver security, functionality and a sustainable solution for the future. That is the topic on which we are all gathered today.

The Climate Crisis Remains the Biggest Long-Term Threat Facing Humanity

The past two years have shown us the potential for sudden and significant global disruption. It is our belief that the climate crisis will bring further sustained disruption and devastation around the world. As everyone has heard mentioned many times over the last two days, that crisis is impacting this country in Jakarta as we speak. Therefore, De La Rue needs to do what we can to mitigate and soften these future impacts. As a business, De La Rue is taking action and is committed to playing our part in securing a sustainable future for everyone. Sustainable activities have been a focus for De La Rue for decades, but we have increased our efforts in recent years. The importance of mitigating the impact of the climate crisis is above competition or using it as a way to seek competitive advantage. It is about taking responsibility as a business and being a global citizen, thinking about our shared future. That is why today, I will not focus on a single initiative that will change the world or something that will significantly make a big difference on its own as the reality is that only a collective and holistic approach can truly move the dial and enable us to move towards this goal for a sustainable future.

Building Sustainable Confidence Over Decades

The ability to measure efforts in a structured and meaningful becomes hugely important. The ability to track the data generated by De La Rue's activities allows us to inform insights and decisions, enabling us to improve continuously. De La Rue has been able to ensure robust and credible measures that guide our progress by aligning their objectives with accredited standards and organizations that make evidence-based decisions through transparent reporting. Our journey started 20 years ago, when we began measuring and publishing scope 1 and 2 emissions. For those who are unfamiliar, scope 1 emissions are greenhouse gas emissions that De La Rue directly owns and controls, whereas scope 2 emissions are those that De La Rue cause indirectly. For example, the emissions created when generating the energy we use. This measurement is significant because the act of measuring at that early stage allowed us to identify where to focus and create a road map of initiatives that would lead us to where we are now. After all, you cannot improve what you are not willing to measure. As seen on the timeline, De La Rue has continued this philosophy of measurement and transparent reporting with early ISO-14001 certification in all of their sites, which began 15 years ago. The Carbon Disclosure Project, which supports companies and cities in disclosing their environmental impact, arrived later, followed by setting goals and aligning with the UN Global Compact in 2016. All these phrases are well-known because they have been mentioned several times as a clear industry standard. De La Rue also aligned with industry-specific charters, such as the UK Cash Industry Charter and the International Currency Association's Sustainability Charter, as well as industry colleagues such as SICPA and NPA, who were part of the formation and remain active members. However, De La Rue recently moved this alignment to a different level, and we are now on a government level and at a different stage through the Science Based Targets Initiative.

The Science Based Targets Initiative independently assesses and approves De La Rue's targets in accordance with strict criteria to limit global warming. These targets will only be approved as science based if they are aligned with the Paris Agreement to limit global warming to 1.5 degrees Celsius, accompanied by transparent annual reporting to ensure accountability. The Paris Agreement was established at the Paris COP 21 Summit and supports and aligns with the G20 objectives, which this side event is here to support today.

Through this alignment, transparent reporting, long-term objectives and initiatives that De La Rue is working on to actively reduce our environmental impact,

De La Rue has been voted as one of Europe's climate leaders for the last two years, across all manufacturing. That was awarded by the Financial Times in collaboration with Statista. It is an award that we are extremely proud of, something that De La Rue will continue to be a part of and continue to improve upon. Anyone who follows De La Rue on social media or has read some of the industry sustainability reports will notice that we have been mentioned for some of our recently implemented initiatives. Our sustainability initiatives reach across many different areas within De La Rue, whether it is purchasing more efficient hardware, improving processes, or bringing more environmentally friendly products to market. De La Rue recognizes that every decision we make has an impact on the environment. For example, in Malta, we invested in cool roof technology, which reduced the factory's overall temperature, gave us greater control over that part of the factory's process, and reduced overall energy consumption. As James mentioned yesterday and Victoria this morning, access to renewable energy is vital and access to them is becoming easier in some areas of the world. De La Rue is very fortunate in the UK that solar and wind power are things that we can have access to. As a result, the De La Rue UK sites run 100% on renewable sources. De La Rue also has solar installations at our Manchester site that produces our security features and polymer. Those solar installations are going to progress now into De La Rue's other sites, in Sri Lanka and Kenya over the next three years. Along the way, De La Rue also hit some other key milestones. One of those is using the autothermal process in the manufacturing of our security features, such as threads in paper, which started in 2001. This has meant that the solvents that were used in the process can be recycled and reused in place of gas and converted into heat. Gas use has gone down by about 80% since this was put into place. Another important milestone was the creation of a bespoke life cycle assessment tool that is customized using De La Rue data direct from production and allows De La Rue to measure our products and banknote specifications throughout the entire life cycle. That tool is used for creating initiatives and creating understanding of our products and the impact they have. It was also used to support a 2020 initiative from the Central Bank of Samoa, which launched a carbon-neutral banknote in collaboration with De La Rue in association with their Green Pacific Games. The polymer banknote showed a significant environmental improvement over the existing paper banknote. The analysis then told us about the residual carbon from that production. As a result, we were able to make that project carbon neutral for investment in green initiatives. In fact, in this instance, the investment was in geothermal power in Indonesia. Some may be aware that De La Rue is currently investing significantly in production

facilities, including more than doubling our polymer substrate capacity and making our site in Malta a state-of-the-art 29,000 square meter manufacturing site. These investments are designed to improve efficiency, reduce waste, and minimize energy usage, offering long-term environmental improvements and benefits. Individually, these initiatives are useful on their own, and they represent measurable steps toward reducing De La Rue's environmental impact. Holistically, however, each sustainable initiative is a piece of a much larger picture and a much larger goal to work towards.

Our Commitment

By taking a holistic approach to sustainability activities, De La Rue can achieve continual, measurable progress as we move toward being carbon neutral within the next eight years. A 45% reduction in scope 1, 2, and 3 emissions by 2030 is one of those initiatives that has been validated by the Science Based Targets Initiative. That way, De La Rue knows it aligns directly with the Paris Agreement's 1.5-degree trajectory and, ultimately, the end goal of being net zero by 2050. De La Rue has set up a group under the Transform Sustainability banner that is a cross-platform or cross-functional set of people to manage this process and all the different initiatives we do, away from De La Rue's CEO through our management structure in both the authentication and currency divisions. We also have specialists with degrees in environmental science and geophysics on that team to help funnel these activities. Here are some examples of how sustainability underpins all the activities of some of the key initiatives, but they also build on what has already been said about how this is more of an ethos or philosophy that must be fulfilled across all that is done by examining three distinct areas of the business: design, banknote printing, and De La Rue's products. We will look at how some of the sustainability initiatives flow through those processes.

Sustainability in Design

Starting with design, it is nice to see design has come up a few times because it influences everything De La Rue does. Design certainly has a pivotal role to play in many aspects of what a banknote will be in the end, and more importantly, on the journey to becoming more sustainable. Any product starts with design; therefore, any circular economy we want to create should also start there. The design phase will often dictate the raw materials used, the volume of those raw materials required,

the manufacturing, routing, and efficiency. Therefore, if a design is not considerate of manufacturing tolerances and capability, we could create a product that is too complex and too difficult to control, resulting in higher waste, which in turn requires more raw material or more time in production, thus consuming more energy and producing an overall negative environmental impact. Design can also dictate durability and circulation, which are fundamental to the design process, and how De La Rue thinks about the specifications we may look to set. All this ultimately drives waste levels, which can all be driven by poor design.

Design for Sustainability – Circular Design Philosophy

This is why at De La Rue, we have developed a design philosophy that considers the environmental impact of a product from its initial inception all the way through manufacturing and the end of its useful life. De La Rue's design function consists of highly experienced banknote experts—the kind of disciplines one would only expect from an industry-leading design house within this industry—creative designers, technical designers, engravers, proofers, and quality professionals. However, De La Rue also coupled that with product engineers. Those product engineers are responsible for assessing each aspect of the banknote design, the features that are used, and the functionality that is required, and they are there to challenge whether that functionality requirement and user needs can be produced in a more efficient way or with a lower environmental impact. The compact security thread, for example, the construction of that will be through several layers, with each layer having a different raw material, a different consumable required, and a different manufacturing process step. Essentially, each layer creates its own environmental impact. This team would be looking at those aspects and those products, seeing whether functionality can be combined or can be gained through other raw materials or other variations, creating opportunities for that functionality to still remain but with reduced process steps or reduced or different raw materials that will be required, therefore reducing the impact. The same principle would apply to a banknote specification that is required or a design that is being produced, and a product engineer will sit alongside that to see if there is a more efficient or more environmentally friendly way to manage that. To achieve this and provide the insights that are required, De La Rue needs to gather data by actively pulling it from our production sites on an hourly and daily level, driving down into each process step to understand the material utilization, waste levels, efficiency, energy consumption, and so on. This, combined with our

cash analytics database, allows De La Rue to then build a holistic view. This allows us at the earliest stages of design to build a predicted environmental impact and offer ways in which this could be reduced. Ultimately, we want to create more data-driven decisions and choices at the earliest stages possible for our partners and customers.

Green Banknote Printing

Moving on to manufacturing, De La Rue is in the process of expanding its Malta manufacturing site. In the undertaking of this, it was vital that this site be built with environmental impact and sustainability benefits. The Malta site expansion includes various steps. The way De La Rue has looked to achieve this is by tackling three major areas. Before giving examples, keep in mind this site is currently under construction and is looking to be finished going into the early part of the next calendar year. The site will feature heat recovery and temperature control, and all new equipment, including ancillary equipment, such as chillers and air compressors, will be equipped with heat recovery. That way, the heat can be used to heat water that is used in various processes that require it. The cool roof technology will be extended to the rest of the transformation. To give a bit of perspective, the overall size of this expansion means that the factory itself will probably have around double its current footprint, essentially creating another version of itself in the adjacent area. This cool roof technology will be moved into that area as well. This reflective material can regulate temperature in a much more controlled manner. All the way through to the very simple architectural design of all the windows being north facing, making the most efficient use of light and heat that comes from that north facing element.

Reduced electricity consumption. That same process with the north-facing windows will obviously create more light, implying less light needs to be used. The lights that will be installed will all be LED, resulting in the least amount of electrical consumption. In addition, water radiators will be used to heat the fresh air handling units. Much of the existing equipment in this area would have been electric, and only the secondary assisted heating systems will be electric, and they will be used only when necessary. The primary will be via water radiators. That heated water is returning from the recovery. All the components of the fresh air handling unit will also have three-way valves. This results in more efficient use of chilled water, which in turn reduces electricity consumption.

Reduced water consumption. De La Rue is currently building a dedicated reservoir that will sit below the factory and collect all incidental rainwater. Although Malta is a Mediterranean island with plenty of sun, which is ideal for the solar panels that will be installed, when it rains, it rains a lot. As a result, this reservoir will almost certainly be filled on a regular basis, and it will be used to chill web press rollers or the web press. Instead of using fresh chilled water, it will be used in the site's bathrooms, fire sprinklers, and other utility and cleaning areas within the site. Aside from the reservoir, there are other initiatives that are directly involved in the printing process around water, such as the wiping solution used in the intaglio process. The intaglio process is central to many sustainability efforts and much of the attention is focused on it. At this point, the intaglio machines that are already in the Malta are recycling water at a rate of around 92% reutilization, with only a small amount remaining to ensure that the harmful toxins in the solution remain at a safe level. This will be carried over into the new machinery that will be used in Malta. This is a site that will double in size and footprint. With any kind of build like that, there is a need to maintain a balanced biodiversity. It is something that De La Rue is very conscious of. For example, at our Kenya site, we have a fully maintained and protected natural habitat within the grounds. In Malta, for every tree removed, ten more will be planted on the island to compensate, ensuring that biodiversity is maintained.

Sustainable Waste Products and Waste Management

This is a three-part process: design, manufacturing and product. It is hard to give this type of presentation without mentioning polymers and waste management. I am grateful for the opportunity to speak after Victoria, who provided an excellent explanation of the entire process and the benefits of polymers, but I will touch on some of those points again. The graph represents over 12,000 data points that are held within De La Rue's analytics database, which uses direct central bank data to calculate banknote lifetimes in a standardized way. In this instance, De La Rue compares paper, coated paper, and polymer banknotes for all the notes that sit within this database. As illustrated, the lifetime has ranged from a few months to 10 years in every instance. Polymer, however, lasts on average 2.5 times longer, meaning that there really are durability and note life benefits in that transition. As polymer lasts longer, fewer notes need to be issued. With fewer banknotes being produced and transported, there is less energy used overall. When polymer finally reaches its end of life, it is 100% recyclable into further multi-use and recyclable items. On that

element of waste management, De La Rue is committed to supporting customers in this area and partners wanting to sustainably dispose of banknotes at the end of their useful lives, regardless of the substrate. De La Rue is currently exploring new partnerships and testing packaging solutions to support a more sustainable overall solution to waste and banknote handling. To support that, De La Rue wanted to try and get an understanding of where the market is now and what others may or may not already be doing in the market. To gather that information, we conducted a study across different issuing authorities and contacted them on the basis of their waste destruction, frequency of waste and end-of-life disposal methods. For the purpose of this presentation, I have pulled out the study that was around the disposal methods themselves, which are most relevant to some of the questions and some of the discussions over the last two days. The study got responses from a wide range of issuing authorities, such as state printing facilities and central banks across a wide variety of regions. The study found no demographic or regional differences in the way banknotes were disposed. The issuing authorities adopted a pragmatic route to banknote waste disposal, adopting frequencies and approaches that were appropriate to the volumes that they were handling in the regions they were in. It demonstrates that pure paper banknotes and pure polymer banknotes do have ways of being sustainable at the end of their useful lives, and recycling is used for both. That can be in multiple forms in terms of paper, including alternatives like composting, cement and building materials. Meanwhile, polymer can be fully recycled in plastic recycling facilities. It does appear, though, that more issuing authorities are recycling polymer banknotes, which may be a reflection of the fact that it is possibly easier to find recycling facilities around the world in addition to some of the support that is given to do that. Over the years, it has not been so easy to do that for paper. With that being said, the incineration element would partly be for energy or energy for waste, and although they come under the incineration banner, which is not the ideal platform, there is an environmental benefit of some type with those percentages. Overall, it does seem that there is an easier route to recycle polymer banknotes.

Our Commitment

In summary, no single initiative or company holds the key to sustainability. However, working holistically in a collaborative and transparent system with mechanisms holding De La Rue accountable will assist us in taking the necessary steps forward as an industry. De La Rue remains committed to its partners in finding sustainable

solutions for banknotes, as well as setting the highest levels of achieving those goals, now at the government level, with the goal of remaining an industry climate leader.

Speaker 2*:* Andrew Forbes, Director of Sales, Louisenthal
In Green We Trust: Sustainable Banknotes with Unmatched Security from Within

Good afternoon, everyone. It is a pleasure to be here, and we thank the Bank Indonesia Institute for the invitation. It is a pleasure to be here with everyone, both physically and online. We all have the responsibility of safeguarding the environment for future generations, and the decisions we make every day have a direct effect on the quality of life of our children and grandchildren. The banknotes that we put into circulation go into the hands of millions of people each day, sending a direct message to them. G+D has been enabling secure payment transactions for 170 years, and what we will share today is a technological innovation to help support sustainable, secure payment transactions for future generations. Our journey begins with the blowing of dandelion seeds, which take the journey through the air, and ends in a field of blooming flowers. The bee then continues the cycle of life further by flying from flower to flower to create new life. The cycle of life is also reflected in the different generations of banknotes, who pass the responsibility for the environment from one pair of hands to the next. With this in mind, we think that the sustainable banknote of the future must be based on natural, renewable fibers in order for the cycle of life to continue. Users will increasingly demand that central banks look for sustainability and an environmental footprint in the payment mechanisms that they offer if banknotes are to remain a popular payment medium. With this in mind, we have been working on developing a banknote concept platform, which will be shared today. To do that, I will briefly touch on our work concerning the life of a banknote, which we started back in 2019, as well as the study we commissioned by the Deutsche Forschungsgemeinschaft (DFG) Institute to look into the life of a banknote. I will then present this green banknote concept, which stands for reduced carbon emissions, reduced plastic content, virgin plastic content, and increased sustainability. Then, I will talk about the Green Banknote Initiative we launched this year in April at the Intergraf Conference, which is an open platform for issuers and suppliers to work together in collaboration, which is a theme that has been discussed extensively over the last two days in order to make the cash cycle greener.

The Life of a Banknote

Beginning with the life of a banknote, we produced a newspaper in 2019 to document the steps taken and the steps planned to look at the entire life cycle of a banknote through substrate production, security feature production, and so on, and we committed to presenting the most sustainable banknote concept we could generate in late 2021. Because of Corona, that was postponed to 2022, and we launched this concept at the Global Currency Forum a few weeks ago in Barcelona. In the meantime, the International Association of Commercial Administrators (IACA) recognized our work in this area and awarded us with the award for best new sustainability project in 2020. All this activity feeds into G+D's overall efforts in this area. G+D's work has a direct impact on 9 of the 17 United Nations Sustainable Development Goals (SDGs), and we have set a target of a 42% reduction in carbon emissions by 2030 in comparison to the baseline year 2020, to be net zero by 2040, to reduce water consumption by 10% by 2030, and to have 0% waste going to landfill at all G+D sites globally and across the various divisions where G+D operates through our various subsidiaries. This is nothing new. G+D has long been engaged in these activities. At Louisenthal, for example, a hydroelectric turbine generates 25% of our energy needs from the river, and we have a closed loop operation whereby the heat generated by the paper machine is diverted to offices in the winter to keep them warm. We are also using the water to keep the machine cool during the summer, and we have a bio-membrane wastewater treatment plant to work as efficiently as possible with the water to make it as clean as possible when we need to put it back. It is important to note that the Louisenthal Paper Mill (PL) is located on the main water source that feeds Munich, a city of 2 million people. Therefore, it is not in our interest to contaminate the water that serves as our drinking source where we all live. Germany has very high environmental standards in this respect, and this is something that Louisenthal has been living with for decades now. Another example is the G+D printworks in Malaysia. In 2020, G+D completed the installation of 9000 square meters of solar panels to generate renewable energy at that site as well. These are just some examples from a number of initiatives.

To take this work further, G+D commissioned the DFGE, which is the Institute for Energy, Ecology, and Economy, to look at the ecological impact of G+D's cotton-based banknote substrates. We looked at the different substrates throughout their entire life cycle, which was based on the methodology of the greenhouse gas protocol, product lifecycle, accounting and reporting standard, and relevant ISO standard. We

really looked at everything, from a complete analysis of cotton cultivation to the production of the security features, production, printing, use and circulation, and so on. Furthermore, we conducted this work based on real customer orders and completed it in 2021. We also looked at alternative natural fibers, such as hemp, flax and organic cotton rather than conventionally cultivated cotton, which offers a lot of opportunities for reducing carbon emissions and water consumption during its production. It became very clear that the more durable the banknote and the longer it lasts in circulation, the lower its carbon footprint. We identified three stages that dominated carbon emissions, namely use, printing and cotton production, and water is relevant for cotton production. It was very clear that hybrid substrates, which are a sandwich of cotton in the middle with polyester foil on each side, really had a significantly longer circulation lifespan and therefore reduced carbon emissions.

The Key Driver of Banknote Sustainability is Durability

What has G+D learned from this study? We learned that the key driver of banknote sustainability is durability. Obviously, we then looked at the studies published by Bank of Canada, Bank of England and Bank of Mexico in terms of polymer notes to get comparisons there. We discovered that while durability is a key driver, obviously a banknote also needs to fulfill other aspects. It needs to be secure, it needs to be processable in the cash cycle, it needs to be flexible to the role of an individual denomination in that cash cycle, and it needs to have an end-of-life recycling solution.

The Green Banknote

Looking at what we learned and how we interpreted this to develop our green banknote concept, a green banknote for G+D is a next-generation hybrid advanced substrate, where we have tried to reduce carbon emissions, reduce virgin plastic content, reduce the amount of plastic, and reduce water consumption as well. When thinking about the core of the banknote, G+D uses cotton, and cotton is a waste product. The textile industry, and everyone is wearing products of the textile industry, use the cotton plant. They use the long fibers on the outside of the cotton plant, and the waste product is the short fibers on the inside, and this is what G+D uses to create banknotes. There are other uses for the short fibers as well. By using cotton, this is really the first stage in recycling, which, from G+D's perspective, is better than using fossil feedstock because one of the problems we have with plastic is that

plastic leaves plastic again, which can be recycled and created into other products, but there is a certain volume of plastic that needs to be used.

When we compare hybrid banknotes, and we have 10 years of circulation experience in multiple countries, we find that hybrid notes last three times longer than cotton banknotes, which is comparable with polymer notes but maybe not the high denominations from the Reserve Bank of Australia (RBA), but certainly for market notes, which is where hybrid notes are focused. We see a three-fold increase in the circulation lifetime, which is consistent over the different continents where hybrids have been in circulation. As a result, G+D decided that the core of a hybrid needed to have a green heart, and what we have done is taken the cotton fiber core and used 50% organic cotton and 50% Forestry Stewardship Council (FSC) certified wood pulp from responsible forestry. This leads to a significant reduction in carbon emissions by using it in the core of hybrid. The core of hybrid, or green banknote, is slightly thinner than a cotton banknote. Of course, alternative natural, renewable fibers, such as hemp, could be used as well. There is quite a big scope for and interest in using alternative fibers not only in this region of Asia but in other regions as well. G+D does not want to do away with using cotton entirely. Using cotton is the first stage in recycling, and when looking at the annual demand of banknotes and the amount of waste product from the textile industry that is used in banknotes, it is quite small and insignificant. There are a lot of ways, however, that central banks can support social sustainability issues by looking at the type of cotton that is used. We have had a lot of feedback from central banks in the last two years, with the impact of the Covid pandemic, on how central banks can do more to support social sustainability, local farmers, and so on in this area. Using organic cotton or BCI cotton, which is another source, can make a big difference in lowering carbon footprints and water consumption. This is something that is strongly promoted by the European Central Bank (ECB) and the 19 national central banks that are moving towards this use of organic cotton in banknotes. This is a process that has gone on over the last six years and is really a very simple first step for central banks to reduce carbon emissions in the substrate specification without having to change anything in the specification or change the physical properties of the banknotes by specifying organic cotton.

Interestingly, Cotton Made in Africa ("CmiA") is a project initiative that is not directly relevant for Indonesia but is still worth mentioning. Consumers are increasingly interested in wanting to know where the cotton comes from, such as

in their clothing, and this means that a certification scheme has been developed to trace cotton made in Africa that is used in the textile industry, and then the waste product, the cotton combings that G+D use in banknotes, is also traceable. G+D is now having discussions with central banks in Africa that want to specify the use of cotton made in Africa in their banknotes. There are a lot of opportunities with other fibers as well to show and use regional fibers, such as sisal, abaca and hemp, for example. These are fibers that are widely available in parts of Asia, Latin America, and so on. When looking at the influence of these alternative fibers on the CO2 footprint, there are some dramatic impacts. This DFG study is available for download on G+D's website to not only see in detail what the different effects are, but also look at water consumption as well. This is a direct result of using more organic natural fibers, which reduces the use of pesticides and fertilizers and increasingly uses rain-fed irrigation, all of which have positive effects on the CO2 footprint of the substrate. This is why G+D tried to prove the use of this within our banknote concept.

What is Better than Plastic? Less Plastic.

Every year, 400 million tons of plastic are produced, with 300 million tons ending up in landfills and 11 million tons going to the oceans. A study this year in the Netherlands detected that 77% of participants had microplastics in their bloodstream. The question is: do we need more plastic, and what can be done to reduce the use of plastic? This year, in March, there was the UN Environment Assembly in Nairobi that focused on putting an end to plastic pollution, looking at entire life cycle, alternatives, and what can be done to use less plastic and move away from fossil feedstock. For us, the challenge was how to minimize the use of plastics in banknotes, where they play a fundamental role in different aspects of the banknote.

The first thing G+D did was look at the protective polyester foil that protects each side of the cotton fiber core of a hybrid advanced substrate, and we reduced the thickness from 6 microns to 4 microns on each side. This means 30% less plastic, 5% less waste, and saving 5 tons of plastic for every 100 tons of the hybrid substrate. When we first developed hybrid over 10 years ago, this thickness of polyester was not available, which helps us reduce that aspect of plastic. Secondly, and what G+D believes is a first in banknotes, in the security features, in the security thread that is a windowed embedded security thread in this example, but also on the recycled polyester (rPET) foil patch, we have used 70% recycled foil for both of these features, and this is recycled polyester from plastic bottles. I am glad to see

we have glass bottles on the tables here today, but this uses post-consumer waste, which obviously reduces the use of fossil feedstocks and CO2 footprint as well. In addition, G+D has a program over the next 18 months to convert our production of security features, security threads and security foils to using this 70% recycled material. We have not been able to use 100% recycled material because we still need some virgin plastic in there, but we see great potential for reducing that aspect of our features going forward.

Sustainability. With Unmatched Security from Within.

Security can also be sustainable, and we think in banknotes there needs to be a balance between level 1 features for public authentication, level 2 features for commercial cash cycle authentication and Level 3 features for the central bank, that are embedded, applied and printed onto and into the substrate. For example, this is a Verifeye® color-change security patch with an animated effect of the bee's wings moving in animation. It uses a combination of color shift thin film and micromirror technology. This shows an example of what can be done with security features. Other patches or foils can be integrated into this substrate platform. This particular effect was also featured on the Azerbaijan 50 manat banknote that won this year's Best New Banknote Award. Such features can create great security in windows, 3-in-1 authentication from the front, the reverse side, and in transmission. This gives an example of what can be done with these recycled materials.

The rolling star i+ security thread is the second example of a security feature. We tried to integrate the design into the overall theme. When examining the gold dandelion, the color shifts to green to reflect green sustainability. Again, the substrate platform can integrate security threads in Indonesia's banknote series as well, but this is just to demonstrate what is possible and that such a feature is a level-1 feature, but it can also be combined with magnetism to provide authentication for the commercial cash cycle. Not forgetting the central bank, such a substrate concept can allow for the integration of central bank features into the substrate as well as provide a closed-loop authentication possibility for central banks across many countries.

Banknote Print

We must look at the banknote print, and green comes in many colors. The note is printed with mineral oil-free printing inks, increasing the bio-based content of the

inks and the finished banknote, we have looked at many different areas of the note and made improvements where possible. There is the paper core, which is the first stage in recycling and uses 50% organic cotton and 50% wood pulp. We have then integrated the security features made of 70% recycled polyester foil from drinking bottles. And we have reduced the thickness of the polyester foil layer by 30% to reduce the amount of plastic content. Mineral oil-free inks are used. We protect it with a varnish to create an example of a banknote concept that can really work with different features and aspects.

Green Banknote Initiative

The Green Banknote Initiative launched earlier this year to broaden the discussion, looking at the green cash cycle and the possibilities for alternative fibers because we think there are opportunities to develop these further. In the past, the discussion around sustainability has focused on durability, but there are other issues to consider, such as the circular economy, social sustainability, such as supporting local industries, as well as the wider cash cycle and carbon footprint across that supply chain. This is done by working directly with customers to develop solutions that are tailored to their specific requirements, as there is no one-size-fits-all solution. Furthermore, we are paying close attention and getting a lot of feedback from central banks on end-of-life solutions for banknotes because there is a lot of potential for future development. Unfortunately, when it comes to recycling, we cannot yet take old banknotes and turn them into new banknotes. There are numerous options, however, such as taking the material and recycling or downcycling it. Material recycling, for example, is where old banknotes are used in road construction in Croatia, or as insulation in India, and also used in hardboard, softboard and construction. Thermal recycling is more than just incineration, and it is a popular end-of-life solution for banknotes. It is also something that the European Central Bank and the Swiss National Bank are promoting as a way to contribute to European domestic heat and electricity production rather than using fossil fuels. We also think there is more potential in composting. The Central Bank of Pakistan has presented on this previously. Currently, we are conducting a study in Latin America to look at the potential for composting banknotes. Obviously, different substrates have different composting potential, and we will be able to present more on this in the future. Every year, billions of banknotes are printed and destroyed; therefore, anything that can be done to extend the life of those banknotes by using natural materials instead of plastic is clearly positive for

the environment. Furthermore, the Green Bank Initiative means working together. I am very pleased to announce an initiative with Perum Peruri to develop the concept for a sustainable green banknote concept for Indonesia, in which we will look at using local abaca fibers in the substrate to support social sustainability. We will also work with Pura Barutama on local content for security features, as well as look at recycled content for security threads and foils. This is a first concept, and we tend to expand on it to see the concept of sustainability at each level, such as looking at the core, security features, protective polyester foil, and the print to see what we can do to create a solution that fits Indonesia and its individual cash cycle challenges and requirements. It is something we are very excited about, and we have seen a lot of similar interest in such initiatives in different countries and regions.

Renewable Fibers Make the Difference

We believe that renewable fibers make all the difference. When summarizing what we believe to be the advantages of the green banknote and comparing our studies with others, we see less CO2 emissions than polymer notes, less plastic, but still the potential for high security in the notes, as well as similar durability—three times that of cotton—when compared to market notes, and naturally, there is a good public acceptance of using natural renewable fibers. We think that the sustainable banknote of the future must be based on natural, renewable fibers. At the UN Environment Assembly held in Nairobi this year, Kenya's cabinet secretary reiterated the need to develop viable, sustainable alternatives to plastics. We think the green banknote can provide a lot of potential for doing this. There is a lot that can be done with cotton as a basis for a substrate. A lot that can be done with raw materials. A lot that can be done with natural sustainable fibers. We want to bring the green banknote to life and hope that our local initiative here with Perum Peruri and Pura Barutama is a step in the right direction, because the future lies in all of our hands.

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Q&A SESSION

Question:

How do you manage the waste generated by your operations, and how much does the waste management process contribute to environmental sustainability?

Mark Spencer:

We manage our waste in production in a variety of ways, with recycling polymer waste being one of the key parts. I believe Victoria mentioned yesterday that NPA does something very similar in that all their waste from polymer production and printing is recycled on the same principle because we are both a paper and polymer provider. Our paper banknote waste goes through very similar processes, whether it is energy for waste or different recycling components. In the past, we have used things like reusing shredded banknote paper waste for animal bedding or finding other innovative ways to reuse it before it reaches its final state. I believe the key challenge at this point is intaglio waste, which is being worked on, so it is work in progress to overcome that. As I mentioned in the presentation, the current focus has been on print processing. I mentioned a couple of processes in place now, such as wiping solution reutilization. I think that the key going forward will be a focus on intaglio waste as one of the primary areas that remains unsolved from our perspective.

Andrew Forbes:

I completely agree. You may have noticed that I did not present anything on the intaglio aspect because this is a challenge, and we are still working on this aspect with G&D and hope to be able to present something going forward. We see intaglio waste as the biggest challenge in the printing process.

Question:

Regarding your commitment to reduce your operational footprint by 2030, can you describe the biggest challenge you will face to meet your commitment? What is the biggest challenge in achieving the commitments of both your companies?

Andrew Forbes:

The biggest challenge, as a commitment from the top of the organization that is driven down through the organization, is having conversations with customers to determine what is the best individual solution or what is the driving force for individual customers. This is because it varies greatly from region to region and from customer to customer. I do not believe there is a one-size-fits-all solution to everywhere. It is then trying to find efficiency within these various solutions in different regions that makes us all better and greener. It is probably the scale of the challenge when we are a global provider trying to find a solution that works for each country and each individual solution. This is a challenge.

Mark Spencer:

Yes, it is a similar principle from the De La Rue perspective. I do not necessarily know if the data represents this, but my opinion is that we have sites in multiple regions that are truly our own operations -up to the point of the 2030 commitment- it is the balance that we need to obtain. I mentioned renewable energy in the UK, and all the UK sites are 100% renewable sources. That is not necessarily as easy in Sri Lanka or Kenya, for example. Therefore, we must find alternative routes for them to be able to become more renewable, hence the solar power or solar panels that will be installed at those sites. It is a balancing act of multiple regions and how the impact varies in each and how we get past that.

Question:

What is the best waste management practice for the green banknote, given that it contains a plastic or polyethylene terephthalate (PET) component? According to your presentation, landfills currently handle the majority of waste. What is the challenge there with plastic or PET components in banknote waste? Should it be decomposed

or separated first to avoid landfill disposal? I believe that composting the banknotes would be even more challenging.

Andrew Forbes:

When it comes to the end of life for banknotes, the key aspect is the percentage of plastic within them. If this remains a small percentage, less than 15%, then the notes can traditionally be disposed of in the same way as cotton banknotes. When it comes to composting the notes, there is more of a challenge, and this is why we are running a study in Latin America to try and see in detail what the options are for the different types of substrates we produce. If you think about the green banknote as a type of platform with varying aspects of organic cotton, hemp, or different fibers, how far can you push these boundaries and how much composting is possible for a banknote with what percentage of plastic content and other content, and this what we are trying to prove. This is something that we will hopefully report back on at a future conference when we can and when we have more learnings, but again, this is something that we are still working on.

Online Question:

In your opinion, does the green and sustainable business process policy on your site cause an increase in production costs, making the price more expensive for customers? Is there any plan in your pipeline to change metal-based security thread into non-metal security thread without decreasing the machine readability, effectiveness, or the color changing effect?

Andrew Forbes:

I think these are two very different questions here. The first one concerning production costs, I think it is interesting to see how the development and trend toward sustainability has become self-fulfilling. Six years ago, the Dutch National Bank specified that they wanted 15% of the euro banknotes to be made from organic cotton. Initially, we looked at this and were concerned about the availability of the cotton and the price—it was a little bit more expensive. Six years later, there is a substantial market for organic cotton that is no more expensive than normal cotton—it is the same price. I think that because you are seeing this trend among consumers, the textile industry is pushing it as well. Therefore, this does not necessarily mean that

production costs and raw material costs need to be higher. Since recycled polyester foil is the base carrier for security threads and foils, this does not need to be more expensive either. We are seeing similar price points. The manufacture of different features depends on which process you use. Do you add a metallization process onto the threads or do you print color? These are different options, but I do not think they will be big drivers or have a big influence from a sustainability perspective.

Mark Spencer:

I also agree. I think that the opinion on sustainability is that it often comes with an initial investment for many of the sustainability initiatives. Again, I come back to solar panels because it is one of the most obvious to pick from that. Those investments are something that we are doing to be more sustainable. Going back to policies, our policies around our production processes are investments that we make. They do not necessarily mean production costs will go up. Over time, there should be cost benefits to most of the work we do. Some of these things take longer to see the true benefits. There may be an initial outlay that we as providers make, but that is for the long-term benefit.

On the pipeline of features, we have quite a diverse range of features across paper and polymer, including applied features, print features, security threads, and more. It is quite a wide topic that we could get into and how the pipeline moves, but sustainability is a fundamental core part of the research and development process. The product engineers sit alongside our design team. They are consistently looking at this part of the element and the raw materials that go into our products. It is something we will continually improve, but it does not necessarily mean an increase in cost to the end customer.

Question:

De La Rue launched the Transform Sustainability program with the aim of creating ambitious and innovative solutions to reduce energy consumption, waste generation, and plastic usage around the organization. Your holistic approach claims that you have reduced your consumption in a sustainable manner and continue to make progress in developing and improving the sustainability of your operations. How much do you believe that this approach improves the sustainability of your operations? What makes you sure? And is there an impact felt by the community around your business area?

Mark Spencer:

The Transform Sustainability Program is a cross-functional group of people across the business that are invested in continuing the road map of sustainability initiatives. The initiatives that we have and the goals that we have set are accredited and audited externally. We have auditors that come in, and we have very transparent reporting on what those initiatives will be, how they will work, what they will do, the investment that is going into them, and what they are there to achieve. We do not make the claim that we know this for sure, the third parties do that for us. They are the ones who make sure that we will reach these goals. To the first part of the question of how much we are committed to our goals, by 2030, 45% of our scope of 1, 2 and 3 emissions will be reduced, which keeps us on track with the 1.5-degree trajectory of the Paris Agreement. That is the goal we are working toward. The auditing and the way we have structured our initiatives are where the auditors and the third-party consultants feel that we will make sure we hit those targets. As for the impact, there is no impact felt by the community around the business area. If anything, being more sustainable and having these initiatives in place should have a positive impact. Some of what our sustainability approach has done is create more jobs as well. We have employed more people on sites that are specialists in these areas to help enable this. There is no negative impact.

Question:

Regarding going carbon neutral, you mentioned the Central Bank of Samoa. How does it work? And for the central bank, how much does it cost?

Mark Spencer:

The service itself does not cost anything. It is a tool that we have developed. We have a life cycle assessment tool that has been mapped to our production processes and to our products. We can generate the specification of a banknote and directly compare that to a new specification of banknote. In the case of Samoa, they had a 10 tala paper banknote and wanted a 10 tala polymer banknote to commemorate the Pacific Games. To accommodate them, we took the paper specification, compared it with the new polymer specification, and were able to adjust the specification around features, ink usage, the life cycle of the banknote itself, where it is printed, and the transportation. This gives us an estimate of the carbon reduction resulting from

that change. Off the top of my head, 1 million notes on those two specifications reduced the CO2 from 150 tons to 49 tons with the specification change alone by moving to polymer and changing the features. It became carbon neutral because the residual carbon that was left from that process was offset using the green initiative of geothermal in Indonesia.

Question:

Who paid for the geothermal investment?

Mark Spencer:

In this case, De La Rue paid for the investment.

Question:

This was a very good presentation and compares two completely different materials of the banknote directly. However, I am curious about this forum because we are still talking about the environment and considering the use of plastic material to create massive products. For example, if Bank Indonesia considers plastic or polymer currency, BI will not be responsible until the plastic becomes a problem. In other words, Bank Indonesia will not be responsible for the waste, perhaps for 100 years, because plastic cannot decompose in landfills in a short period of time. Perhaps plastic currency will have a good short-term impact. But after 100 years, I believe there will be an issue. For example, when we recycle something, say a chair, and it breaks, we must ensure that the chair gets recycled again too. Therefore, I believe it is a very long environmental responsibility. I would like to know what is next and what the plans are for the future? Will we continue to use plastic, or are there plans to conduct research or develop a product that is easier to decompose in order to reduce our environmental responsibility? Will we continue to produce plastic materials in the future, or is there another plan?

Mark Spencer:

De La Rue is a provider of both types of substrates: cotton and polymer. On the question of polymer banknotes and environmental impact, what I would say is that it is very dependent on what you are trying to achieve from your specification. One

of the things that we do when we are setting specifications for a banknote series is determine where the correct substrate is appropriate. It does not necessarily mean that all banknotes in the world need to be polymer to be correct. We have seen varying cases of high and low denominations depending on the region, cash circulation and how the environment interacts. It needs to be right for the circulating environment and the denominations that are being selected to generate an environmental improvement.

On the conversation about plastic and generating plastic and then being responsible for hundreds of years, I would argue that we are responsible for the environment for hundreds of years anyway. I do not believe that just because you have something that can disappear, you are no longer responsible. There are other angles to look at from the standpoint of responsibility in that sense. In terms of improving the product, De La Rue is heavily invested in polymers. Polymer is a growth area. Since the introduction of Safeguard in 2013, denominations have more than tripled on polymer. It is definitely a demand-driven supply. These are needed in territories, and they are being used for the right reasons. In terms of product development, we are consistently developing a product and we are heavily invested in that product, which we will continue to develop. In terms of biodegradable plastics, we are still in the early days in general. We are now starting to look at the introduction of packaging solutions as a starting point around that, and during those exercises and valuations, determining the right specifications for those is still in its early days. I could not sit here and commit that we are going to be doing a compostable polymer banknote in 5–10 years' time, but I would like to think that it is on our agenda for the road map discussions.

Question:

In terms of your commitment, you have already emphasized the technical parts of green cash management. How do you communicate that commitment from the top to the bottom in your organizations? We can focus on the how, but we should also focus on the why, and everyone should have the same strong level of commitment.

Mark Spencer:

At De La Rue, we have the Transforming Sustainability Committee from the bottom up. That committee involves the CEO, senior management, and then different levels

of different elements. From a head office perspective, it has people from our product division, sales division, and central parts, but it also has representatives from all the sites as well. Each of the sites also has training departments, and in fact, we have learned a lot this week about how some of the training could be rolled out slightly wider, such as the way the Bank Indonesia Institute has done here. That would then be cascaded through different communications from elements on the wall, including large A-3s showing our commitment and our road map for sustainability and the reasons why we do that. We also have dedicated training sessions that go out and reach every single person on the print floors, ink mills, or wherever that may be. It is through consistent communication of the message and alignment of that message throughout the business. This is why the Sustainability Committee is cross-functional and has someone from every area on it, so they hear the initial message first-hand.

Andrew Forbes:

I can say that the best ideas in our organization do not come from the management team. They come from the employees who are involved day-to-day in their individual jobs. We have tried to come up with three mechanisms to harness the creativity of individual employees. First, the IDM tools. Individual employees in their area can make submissions. It is an online tool where they submit an idea where they think that they can make a contribution to efficiency or sustainability, and this idea then goes through a committee as an evaluation, and they have a financial incentive. If we consider it a good idea and we can save money, improve efficiency, and see a customer benefit from it, then there is a multiplier that means they are financially incentivized to come up with good ideas. Second, we run hackathons. We have 77 different subsidiaries around the world where employees can join in this online hackathon. The one we have just been running is on sustainability. It is where we get ideas from the individual subsidiaries and divisions working in very different areas, not just to do with banknotes, but to do with secure infrastructure, identities, or internet communication, and other areas to contribute sustainability ideas. This is really communication from the bottom up. Third, within G+D we have an annual technology prize based on the best technology idea that is coming from the different divisions. Internally, within G+D, where there is a lot of focus on digital solutions and CBDC and such topics, our green banknote concept has won internal recognition from different areas. We use these tools to see what else could be achieved to try and improve the sustainability of a concept when a team works together from different

disciplines. We also use the tools to improve communication and take ideas from the bottom up because the management team does not have all the answers?

Closing Statement
Mark Spencer

In general, I think that the message has been quite clear from the whole group and the different presentations, namely that this is something that we are going to be doing collectively. No single supplier or business has the complete answer, and only together can we collaboratively make a change in this area.

Andrew Forbes

Maybe I can just add that the great fun of working in this industry is working with so many different people, customers and suppliers in a team to realize a project. This is no different in terms of going forward to make banknotes more sustainable and the cash cycle more sustainable. It is about working together, different teams, different disciplines, and respecting those two to fulfill the end requirements. Therefore, this is what makes our industry fun and challenging and will take us forward.

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- SESSION 7 -
SUSTAINABILITY IN CASH MANAGEMENT

Master of Ceremony:

Ibu Eva Aderia is head of the Currency Management Department at Bank Indonesia. She previously was assigned for six years as the Deputy Director of the Financial Systems Stability Department. She graduated from the University of Birmingham with a degree in economic policy management and a master's degree in law from the University of Indonesia.

Speaker: Eva Aderia S., Director of Currency Management Department, Bank Indonesia
Assalamualaikum Warahmatullahi Wabarakatuh

Welcome to my presentation Leading Towards Sustainable Cash Management. First, I would like to thank everyone for coming today. It is an honor to represent Bank Indonesia (BI) and speak to everyone in this forum about an important global concern. These are tough sessions, but hopefully everyone will be able to stay awake for the final presentation. Thank you very much to the Bank Indonesia Institute for organizing this international seminar on currency and cash management issues, as well as to all the speakers. The agenda of this presentation consists of four parts. First, a quick overview of Indonesia. Second, a guide through the cycle of cash management in Indonesia. Third, a discussion about what BI has learned, what we have done, and how we can do better in terms of sustainability. Finally, discussing the plans and challenges ahead.

Indonesia at a Glance

To begin, here is a brief profile of Indonesia, which is the biggest archipelago in the world with a little more than 16,000 islands spanning 5,120 kilometers from west to east. With 272 million people, Indonesia is currently the fourth-most populated country, and the gross domestic product ranks 16th in the world and among

members of the G20 countries. In fact, Indonesia's GDP growth in 2021 was 3.69%, showing a good recovery from the economic slowdown in 2020 due to the Covid-19 pandemic. Inflation in 2021 was 1.87% and has been low and stable in the last few years. Despite the rapid growth of digital payment in the last five years, cash is still the most preferred payment instrument. The compound annual growth rate (CAGR) of currency in circulation for the last five years is 9.4%, while the nominal amount of currency in circulation stood at around USD67.2 billion in 2021, which represents 23.6 billion banknotes and 26.5 billion coins in circulation. To manage currency operations in Indonesia, BI has 45 representative offices throughout the archipelago that work with commercial banks to set up 86 cash custody offices in regions far from BI offices. Additionally, there are 107 commercial banks operating in Indonesia, with a little more than 32,000 branches, supported by 25 licensed CIT companies with 307 branch offices, and a little more than 102,000 ATMs to support public access to cash across the country.

Cash Management Cycle

Bank Indonesia is an independent institution mandated by law to perform currency management activities in Indonesia. They are also a member of the Responsible Business Alliance (RBA) and follow a six-step business process that includes planning, printing, issuance, circulation, revocation, and destruction of banknotes and coins. Furthermore, BI carries out the planning and determination of the amount of banknotes printed and coins minted in coordination with the Ministry of Finance. Bank Indonesia conducts printing of the banknotes domestically through the state-owned company Perum Peruri to execute the printing of rupiah banknotes and coins. BI currently performs the distribution of cash to its regional offices in two steps. The first step is to distribute the cash from the central warehouse, which is headquartered in Jakarta. The second step is to transport the cash from one of nine regional cash depots to one of the 45 BI offices. These offices not only undertake cash deposit and withdrawal services to maintain the cash in commercial banks and direct cash services to the public, but also cash processing activities to check banknote authenticity and recover fit banknotes and coins for recirculation purposes. Finally, at the end of the life cycle, BI is responsible for destroying unfit cash consisting of soiled, damage and demonetized banknotes and coins.

What BI Has Learned

Banknotes

The journey of banknotes starts on land where the farmers plant and cultivate the cotton before the cultivated cotton is transported to the banknote paper manufacturer, which processes the cotton into bulk paper, paper rolls and paper sheets ready for the printing stage. This process involves the use of water to dissolve the cotton into paper pulp. It also involves the use of energy to power the factory operation and fuel for the shipment of cotton and other supporting materials to the paper mill. During the production process, the paper mill also releases emissions to the environment in the form of liquid, solid and gaseous waste. In post-production, banknote paper needs packaging materials consisting of plastic, paperboard, and wooden boxes to maintain the banknote paper at an appropriate level of humidity and temperature during storage and shipment. Finally, the factories, which are located predominantly in Europe, East Asia and Indonesia, would send the banknote paper to the printing company in Indonesia through the use of ships, aircraft and trucks. In addition to the papermaking process, an important component of banknote paper is the security thread. The production of security threads involves the use of metal and polyester materials, as well as energy to power the manufacturing facility. Energy and material storage also occur during the printing stage, which involves banknote paper and inks. The banknote printing process requires the use of many machines, which operate for long hours and require storage for approximately 20 days from start to finish. In the printing process, chrome nickel and polyethylene terephthalate (PET) printing plates, as well as cleaning materials, are also consumed. During the banknote printing process, solid and liquid waste are produced, along with additives and chemical scrap materials. For instance, ink needs to be burned in a highly secure incinerator facility. After the banknotes have been printed, they are packaged using polyester straps, plastic shrink wrap, plastic bags, and cardboard boxes before being shipped off to the central warehouse of BI in Jakarta. From there, the newly printed banknotes are distributed to the 45 BI cash offices, which require transportation through cargo ships, trucks, trains and sometimes aircraft.

The story continues when BI hands the banknotes over to commercial banks. The commercial banks will then distribute the banknotes to their customers through their branch and ATM networks. The distribution of banknotes across commercial bank branches, ATMs, and CRM networks requires a vast number of armored vehicles made of stone and steel. The ATM or CRM operation itself consumes electricity to

operate 24 hours a day. ATMs consume energy whether they are idle or active. Both BI and commercial banks, as well as CIT companies, perform cash handling of the notes received from the public. These activities involve the counting and inspection of banknote quality and authenticity using a banknote processing system and packaging activities. At the end of the life cycle, if banknotes are considered unfit by Bank Indonesia, they are instantly shredded. The banknotes are shredded and destroyed using the banknote processing and cash destruction systems, while compacting is done using the bracketing system. The shredded banknotes are stored in 25kg bags. Finally, BI appoints a third party to transport the bags of shredded banknotes to a municipal landfill.

Coins

Coins, on the other hand, begin their journey below the Earth's surface, where metals are extracted. These metals are then sent to a factory, where they are refined to a high degree of purity and transformed into aluminum and steel plates for the production of coins. Production of the coin blanks involves a large number of heavy machines that prepare, anneal, blank, upset, strike and finish the nickel-plated steel blanks. The journey of the Rp1,000 denomination begins thousands of kilometers away at the coin blank factories in the United Kingdom, Europe, the United States, or Canada to our minting facility in Indonesia. However, the journey time for the lower denomination aluminum blank coins is reduced because they are produced at coin blank factories located in Indonesia. There is a significant material and energy cost associated with minting, storing, packaging, handling, and transporting coins throughout their life cycle. When it comes to coins, their journey is a bit different. Once they are no longer fit for use, they are transported to a melting company, where they are recycled and transformed into other metal-based products. However, like banknotes, the entire life cycle of coins, from cradle to grave, generates carbon emissions that can be harmful to the environment.

What BI Has Done and How We Can Do Better

The life cycle of cash shows that managing it involves various activities that support payment transactions in the economy. These activities consume resources, raw materials and fuels and also produce emissions into the air, water and soil. As a result, it is important for BI to understand and manage these environmental impacts.

Central banks across the world have put much concern into assessing the impacts of currency management activities across all life cycle stages, from the extraction of raw materials from the earth to the final disposal at the end of life. Complete knowledge about this matter will help the central bank establish a sustainability paradigm in carrying out its duties. Then there is the question of what sustainability means for BI and how the central bank can achieve its mission of providing a sufficient amount of cash to the public that is fit for circulation in a timely manner, without overusing resources and energy and minimal waste and carbon emissions into the environment? Moreover, we then ask ourselves at BI, what have we done, and how can we do better in the future?

Planning

Reducing banknote printing and coin minting volume is part of the grand strategy for BI to reduce our carbon footprint during currency production, alongside other environmental mitigation strategies. In the selection of substrate type for rupiah banknotes, BI has been consistently using renewable materials since the 2004 and 2005 series of rupiah banknotes. In addition, the use of cotton waste from the textile industry, known as cotton camber, has been common in banknote paper production. This brings efficiency in the use of resources in the papermaking process. BI has also improved sustainability by planning the issuance of a new banknote series that will use more durable substrates and have a 1.3x longer lifetime compared with the existing series. This policy could reduce the volume of banknote destruction and printing and, therefore, reduce the use of resources and waste. During the production of banknotes, banknote paper producers have been ensuring that any waste produced by the production process is safe for the environment. BI appreciates the continuous effort by paper producers who reduce the water footprint in the papermaking process.

Another important consideration for the future is how BI can increase the use of organic materials in the production process without reducing the quality of banknote paper. It is also important for paper producers to increase their use of renewable energy, while reducing the use of fossil energy. BI is also looking for ways to increase domestic material supply throughout the banknote paper supply chain to reduce carbon emissions from transportation activities. For instance, BI can continue coordinated research into the possibility of using abaca as a future paper banknote substrate. On the coin side, BI intends to implement a business model to increase the recirculation of coins in circulation, as only 6–7% of outgoing coins from BI currently

return to BI. This indicates that the public hoards the coins rather than using them for payment transactions. A successful coin recirculation program, according to BI, could reduce the need to mint new coins in the coming years. Additionally, BI will continue to research the most durable coin blank material for the next rupiah series. Recycling unfit coins is also critical to ensuring that BI does not overuse metals, which are non-renewable natural resources. BI also anticipates that coin blank manufacturers will endeavor to increase their use of renewable energy in the future.

Printing

Among other initiatives, Perum Peruri has taken steps to be green during the printing process, such as following the International Environmental Safety Standard. They have also been implementing a reuse program of the supporting materials in the banknote printing and coin minting processes to minimize waste. Furthermore, they have published the Annual Sustainability Report since 2019 in addition to the recent implementation of the use of green label ink through SICPA Peruri Securink for rupiah banknotes, specifically in the new printing line.

Cash Circulation

As part of our Cash Management Transformation Program from 2019 to 2021, BI has redesigned our cash distribution network. This is one of the most important changes we have made and achieved by reducing the number of regional cash depots from 12 to only 5. Instead of the two-step distribution process applied previously, BI increased the volume of cash distributed in a one-step process from Jakarta to regional offices, reducing the need for trucks and escorting cars. Moreover, BI has also reduced the mandatory cash inventory level in regional offices. This policy not only reduces the volume of cash printed, but it also lowers the frequency of cash distribution to regional offices. Cash circulation is one of the most challenging areas to address in terms of reducing carbon emissions. It includes cash storage, distribution, processing, and packaging, as well as cash dispensing activities to the public through the use of ATMs, CDMs, CRM machines, and bank branches. However, BI has implemented, and we will be implementing, several strategies to support sustainability. First, BI will construct a green building for our new cash management center in Karawang, West Java, and the new Eastern Cash Depot in the Gresik regency, East Java. Second, BI has redesigned its distribution network to minimize cash delivery frequency by

optimizing cash inventory levels within our branches without jeopardizing stock sufficiency. The cash is distributed to regional offices with the help of a centralized monitoring system operated by the BI Currency Management Command Center Unit in Jakarta. Additionally, all BI trucks run on low-emission fuel, and the company plans to use electric vehicles for cash transportation in the future when the head office is relocated to Nusantara, Indonesia's new capital city. In 2010, BI also switched the banknote and coin storage units from wooden boxes to carton boxes because the carton boxes can be recycled to make other packaging materials. Third, BI replaced the banknote processing system in 2015 with a new BPS® system that uses less energy to operate. In total, 119 units of the BPS® system are installed throughout our cash offices in Indonesia. Lastly, BI is looking into the possibility of using more bioplastic, a more sustainable alternative material, in the future to replace conventional plastic in banknote strapping and packaging materials.

New Cash Center: Green Building

In the new Cash Management Center, the green building concept incorporates three principles: smart waste management, smart energy, and smart area. Smart waste management means recycled waste treatment for organic, non-organic, and hazardous waste. Smart energy entails the use of solar cells to convert solar radiation into electrical energy for use in buildings, as well as energy efficiency via the use of a gas engine and absorption chiller to integrate the primary source of electricity with the building's cooling system. A water treatment plant will also be built to treat rainwater for safe drinking water. The smart area implies optimized parks and green open spaces. Also, the use of retention ponds for water storage to preserve biodiversity is encouraged, as is the use of electric vehicles in the area. In 2000, BI's first distribution green building was implemented at the Solo office in Central Java, which received a Platinum Green Building certificate from the Green Building Council Indonesia. The green building will become a common concept for future cash operation buildings.

BI is currently working on a study to revisit the cash cycle model in order to optimize the velocity of cash in circulation, which would increase the cost efficiency of cash management in the industry. Currently, commercial banks can still deliver fit banknotes to BI if the industry has a cash liquidity surplus. If the industry can retain fit banknotes, we would be able to reduce transportation activities from commercial banks to Bank Indonesia. BI is in the process of putting together a working group with

the cash industry to discuss a new cash cycle model that will enable better, faster and cheaper management for Bank Indonesia and the industry. In terms of the sustainable use of energy, as there are currently over 1,000 ATM, CDM, and CRM machines in Indonesia, it is critical for the industry to devise a strategy for reducing operational energy consumption. For example, they could turn off the electricity to the ATM machines located inside shopping malls and bank branches in the evening. The use of green energy for ATM operations will require more consideration in the future. Meanwhile, the industry could begin deploying electric or hybrid vehicles, develop alternative materials to conventional plastic, and find alternatives to strapping and wrapping. BI also plans to make sustainability matters one of the strategic issues that will be discussed at the cash industry forum and working group in the near future. This will help speed up the implementation of green initiatives in the Indonesian cash industry and create a more coordinated strategy. Moreover, it will include representatives from various stakeholders, such as commercial bank associations, the CIT Company Association, the Financial Service Authority, and suppliers.

Banknote Destruction

Banknote destruction is one of the main areas we are focusing on. This slide shows BI waste statistics resulting from unfit banknote shredding and destruction activity. In the last seven years, BI has destroyed at least 5 billion banknotes per year, resulting in approximately 5,000 tons of waste annually. BI destroys unfit coins every two or three years. The most recent coin destruction was in 2019, when more than 206 tons were melted down. The coins are transported to private smelters to make metal plates, which are then used to make other metal-based products. Additionally, the volume of waste produced by banknote destruction activities accounts for only 0.003% of the total paper and cardboard waste produced by household activities nationwide as of 2021, while the coins accounted for about 0.0001% of total metal waste in the same year. However, as a central bank, BI is committed to reducing the carbon footprint of its operations, no matter how small the volume.

Destruction: Green Waste Management Concept

Waste management has evolved from the landfill dimension to a more environmentally friendly paradigm. This new paradigm prioritizes prevention and resource reduction, as well as resource recovery through the reuse, recycling, conversion or transformation

of waste as an energy source. The final disposal of waste should be avoided and done in the smallest volume possible to ensure that it does not harm the environment. Currently, a little more than 80% of shredded banknotes from BI end up in landfill. However, we changed our approach in Jakarta in 2020. The volume of shredded banknotes produced in Jakarta accounted for nearly 20% of the total shredded banknotes nationally. This number includes the shredded banknote paper in Perum Peruri that occurred because of a printing defect. Since 2020, BI has also incinerated all waste from its Jakarta headquarters, including shredded banknotes and banknote paper, in a municipal waste incinerator. The work principle of the Jakarta municipal waste incinerator facility was designed to be environmentally friendly. First, the waste materials are burned in an incinerator, which generates heat that is converted into energy and used to power a turbine. This process generates 300kWh of energy from waste burning activity, which is sufficient to power the incinerator operations. In addition, the solid residue is used to make paving blocks, and the smoke produced by the incinerator facility is environmentally safe. This facility is able to not only convert waste into energy but also reduce the final waste volume to near zero. Meanwhile, BI has set a five-year goal of reducing the share of landfill in our waste management program from 80% to less than 40%. How can we do that? The Government plans to build 12 more municipal waste incinerator facilities in Sumatra, Java, Bali and Sulawesi. BI offices nearby, therefore, will deliver the waste to the incinerator facility rather than to landfill. In order to meet our target of less than 40% landfill or waste management, we must develop a more sustainable waste management network across our entire regional cash offices. For the regions where the municipal waste incinerator facility is not available, BI will cooperate with private companies whose activities involve energy-generating processes, such as cement factories, palm oil factories, paper factories, and so on, to receive waste and use it for burning activities. BI will be very selective in our selection of partners, which means that their processes and facilities must be very clean and environmentally friendly. The first guiding principle in the waste management of shredded banknotes would require the facility to be as close to our premises as possible. Second, the waste management process should ensure that no traces of banknotes are visible at the end of the process. Third, the process is safe for the environment. Furthermore, BI will also explore the viability of recycling the waste into carton boxes, cardboard and other packaging products.

Plans and Challenges Ahead

In summary, first, sustainability in cash management demands focus and real action throughout the cash life cycle. This can be done through efficiency in resources and energy consumption, reduction of emissions, and environmentally friendly waste management. Second, sustainable cash management begins with awareness and knowledge, and requires solid commitment to turn knowledge into action. Sharing awareness and knowledge about sustainability should be encouraged and fostered. Third, sustainable cash management cannot be accomplished solo. Cooperation and synergy are needed to green the entire cash life cycle from cradle to grave. Finally, and perhaps most importantly, an agreed framework in the cash management function serves as a common ground for all cash management actors. Based on this, BI and industry-wide roadmaps should be developed and agreed upon by all parties involved.

Challenges

Implementation is not easy, and BI is aware of the many challenges they face. How can BI measure our carbon footprint? Which methodology and metrics should be used? The Bank of England has been among the first central banks to release a sustainability report since 2019, and it could be one of our references in dealing with this challenge. Should BI establish a sustainable office to manage and organize sustainable cash management? What is a realistic goal for lowering the carbon footprint? How is the road map going? What is the ideal timeframe? Who are the counterparts? Could the industry, as a major player in the cash cycle, take collaborative and sustainable action? Before concluding, here is a quote from Lao Tzu, "A thousand-mile journey begins with a single step." Here's another quote from Robert Louis Stephenson. "Do not judge each day by the harvest you reap, but by the seeds you plant".

Q&A SESSION

Question (Peruri Research Institute for Authenticity):

Thank you for your great and insightful presentation and also for your support of Perum Peruri as the government printing company. First, we see that digital transactions have and will continue to increase. How do you think this will impact the need for cash in Indonesia given that we have a business printing money? Second, as you prepare CBDC, how do you see the future of money in relation to the BI? Third, will CBDC have a significant impact on reducing carbon emissions?

Eva Aderia:

Since our Governor said that the CBDC will be issued in Indonesia, a lot of people have asked about it. What impact does the rapid development of digital transactions have? For the past two years, BI has been conducting research on the impact of digital payments on the demand for cash in Indonesia. The last two studies concluded that the relationship between digital payment instruments, such as electronic money, debit cards, and credit cards in Indonesia, and the demand for cash is still complementary, implying that digital payments have a substitution effect on cash demand. In the long run, our internal study predicts that currency circulation will continue to grow at a rate of 5% over the next 20 years. As a result, Bank Indonesia will still have to issue new banknotes to the public. Do not worry, Perum Peruri. The impact of CBDC on cash demand is unknown because we are still conducting an internal study, making assessments, and having discussions with many central banks. CBDC could be one of the options for accelerating the velocity of money, which would ultimately have a negative impact on cash demand. Comparing the carbon footprint between cash and CBDC, I believe we need to further investigate the life cycle assessment and the carbon emissions of both payment instruments, which depend on which CBDC technology is selected.

Question (Bank Central Asia (BCA)):

You mentioned in your presentation that reducing the volume of banknote printing could significantly contribute to lowering the carbon footprint and that reducing the number of shredded unfit banknotes is one of the strategies. What is the grand strategy of Bank Indonesia to accelerate this?

Eva Aderia:

Bank Central Asia is larger than BI. Our strategy to reduce the volume of banknotes covers two major aspects. The first aspect is the banknote itself. By selecting more durable banknote paper based on the technical strength in the banknote paper specification, we could increase the banknote lifetime. But there is another aspect that we have been focusing on more in the last three years, which is public education. BI not only talks about how to strengthen the banknote material but also educates the public. Through a new BI framework, which includes public education as an important tool in the cash management transformation program, BI is attempting to change the public mindset on how they treat banknotes. As you may know, the conventional public education campaign program entails several educational programs on television to educate the public about banknote authenticity. Our world has changed a lot. There are now many effective channels, not only TV, that BI uses to promote proper rupiah usage to the public. Education can also be done through social media channels, such as Instagram and Facebook, and through virtual meetings. We have now expanded public education to include not only educating the public about authenticity but also historical aspects of the banknote, such as the portraits of national heroes printed on the banknote. We also educate them on how to properly treat the banknotes in their daily activities. The second aspect will change public behavior in holding and handling banknotes, resulting in a longer lifetime in circulation and, as a result, a lower volume of unfit banknotes. At the end of the day, this will help BI save energy, resources, waste and carbon emissions from banknote production, circulation and destruction.

Online Question:

There were rumors during the pandemic that cash could transmit Covid-19. Is there any scientific evidence to back up the rumor? Can BI expand on the most recent studies in this area in response to the rumors?

Eva Aderia:

Public use of cash has changed as a result of the Covid-19 pandemic, with less cash being used for transactions and more people using electronic money. We have popular electronic money systems in Indonesia, such as GoPay, OVO, and others. This is due in part to a decrease in overall consumer spending, but some people may have believed the rumors and become hesitant to use cash. In response, BI commissioned research to determine how the virus behaves on banknotes, and our findings indicate that the risk of virus transmission via banknote is low. Meanwhile, other studies from medical experts emphasize that the risk of germ, bacteria, or virus exposure is the same when holding cash and everyday items like door handles and cellphones. As a result, everyone should take universal precautions, such as washing their hands with soap and water after touching common surfaces. Furthermore, BI informs the public that there is no compelling evidence that cash transmits Covid. We saw that public confidence in holding cash in Indonesia has remained high and that the average growth of currency in circulation in the five years preceding the pandemic was still growing. The increase in currency in circulation during Ramadan 2022 was 16.6% over the previous year, indicating that public confidence in using cash remains high.

Closing Statement:

On behalf of BI, thank you all for being here today. I appreciate you taking the time to attend this presentation and participate in the discussion. This is just the beginning of our efforts to provide better and greener work through our contribution to cash management. Everyone has a role to play, and we should all do our best to fulfill them. Finally, let us ***Recover Together***, ***Recover Stronger*** to provide a better life for our children and grandchildren. Stay healthy, happy, and blessed. Thank you.

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