

Tsinghua PBCSF Green Finance Lectures

3:00PM-4:30PM [Beijing Time], Friday the 27th of May, 2022

[Transcript provided by Center for Green Finance Research (CGFR), National Institute of Financial Research (NIFR), Tsinghua University and cross-checked by Climate and Energy Finance Group (CEEFGroup), University of Otago]

>> Tianyin SUN: Hello everyone. Welcome to the Tsinghua PBCSF green finance lecture series. I'm Sun Tianyi from the Center for Green Finance Research (CGFR) of Tsinghua University National Institute of Financial Research (NIFR). Before my introduction of the lecture series and our speaker today, I have a gentle reminder for the audience. Today's lecture will be fully in English. There's no simultaneous interpreter organized considering the difficulty in translating the very specific academic content. So in this case, I beg your understanding. And now back to the introduction of the lecture series. Nowadays, sustainable development and climate change mitigation are the mainstreams of the world's development, and green finance plays a crucial role in this development. With that being said, there are several critical questions to be answered.

- How to balance environmental protection, climate change mitigation and economic development?
- How to effectively mobilize the power of the market and the government to achieve sustainable development goals?
- Are there any effective low-carbon transition pathways that can be learned from international experiences?

These questions above have led to a heated discussion. Against this background, we launched the "Tsinghua PBCSF Green Finance Lectures" that are hosted by Tsinghua University PBC School of Finance (PBCSF) and organized by Center for Green Finance Research (CGFR) of Tsinghua University National Institute of Financial Research (NIFR), with an aim to build a platform to stimulate discussions and debate. The lecture series invite domestic and international leading scholars, leaders as well as senior policy makers to deliver lectures around the topics of sustainable development, green finance, carbon neutrality, ESG and climate risks.

This lecture series are held on-line on a bi-weekly basis and live broadcasted on all platforms of Tsinghua PBCSF. Today we have the great honor to have Professor Ivan Diaz-Rainey with us, he is an Associate Professor of Finance and the Director of Climate and Energy Finance Group at the University of Otago in New Zealand. He is also an Associate Editor of the Journal of Financial Regulation and Compliance and the Journal of Sustainable Finance and Investment, and has previously held academic positions at the University of East Anglia in the UK, the European University Institute in Italy, and the Higher Colleges of Technology in Abu Dhabi.

He has conducted research policy and consultancy work for a number of organizations, including the Ministry for the Environment, OECD, Eon UK, the European Capital Market Institute, and the Asian Development Bank. His research expertise include climate finance, carbon market, energy finance, banking, financial regulation, and energy and environmental policy. And now let me pass on the mic to Professor Diaz-

Rainey. Ivan, the floor is yours.

>> Ivan DIAZ-RAINEY: Thank you very much. Thank you for that very kind introduction, Tianyi. I'm very really honored to be here today. I'm sorry I can not deliver this lecture in Chinese, so I will try and be as clear as I can. Just to reiterate, thank you again for the invitation and it is a great honor. As you just mentioned, I will be talking about climate transition risk and some measurement challenges, and provide a little bit of an example where we have used those measurements in bank stress testing. My lecture will have 6 main components, actually the introduction is going to be a rather long introduction, and it is going to be a rather - I'm assuming no knowledge - a very basic introduction to climate finance and the risk taxonomy that has been used in financial markets to explain climate-related risks. Before I do that, I will talk about my group and a number of other organizations I'm involved in, then I will move into the measures of transition risk and some work that we have been doing with an exciting start up in Australia to try and fill some of the data gaps that exist, and then I will cover the application of those risk measures, those carbon intensities in the context of US banks, and then, I will talk about the limitations of carbon footprints as part of that conclusion as well. And I will provide you with some references and a contact detail should you have any questions.

I hope I get plenty of questions. I understand I have questions at the end. I look forward to getting your questions. What I take from the beginning, this is really a new area, it is a very exciting field to be in because every year it moves so much, the knowledge is moving very fast. So, unlike most other disciplines or a lot of other academic disciplines that are established, this is a new area and the change is happening very quickly. The methodologies are developing very quickly. And so my main job is to try and help develop those methodologies and engage with the policy world as Director of the Climate and Energy Finance Group, so we are one of the largest green finance groupings in the world. We have 19 faculty, a lot of postgraduates, and you know, we are quite interdisciplinary. We are also in Australasia but I also feel very passionately that Asia is going to feel the brunt of climate change. There is a mismatch, there's this capability in the global north and a lot of the impact is going to be felt in the global south. And, I have this wonderfully diverse group of people in my team, from New Zealand, Germany, but also from Sri Lanka, Pakistan, China... just a very interdisciplinary team with a strong focus in Asia. And although a lot of the work I'm presenting today is not necessarily Asian-focused, we do have an Asian focus and we think it is a real strategic priority for us, along with strong engagement with policy makers and industry.

Building Capability in the Global South



So in terms of - oh sorry, we are also part of, I'm also Director of the Global Research Alliance for Sustainable Finance Investing, that is a grouping of universities that is trying to lead in sustainable finance, so that is another role I have. A role I have recently taken on as I was just intimating, something I'm very passionate about, is the Global Business School Network. And as part of that, we have set up something called the Sustainable Finance and ESG Investing Impact Community. And it really is about building capacity in the global south... so those countries are going to be very strongly affected by climate change, like India, like Bangladesh, helping these countries to develop the capabilities and capacities they need to analyze climate risks and opportunities.

What is Climate Finance?

“The term climate finance has both broad and narrow uses. In its **broad sense**, it refers to an enterprise that uses financial institutions or technologies to advance the cause of environmental sustainability, such as by developing or deploying new solar panels or other renewable energy sources. In its **narrow usage**, climate finance refers to the transfer of capital from developed to developing nations in adherence to the recommendations laid out in international agreements such as the 2016 Paris Agreement.”

Source: <https://www.investopedia.com/terms/c/climate-finance.asp>

Green Finance: More than CC – water, sanitation, biodiversity

Sustainable Finance: includes social and governance issues (**ESG**)

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Diaz-Rainey

So let me take a step back and think about what is climate finance? Because, you know, there are a lot of terms bandied about, “green finance”, “sustainable finance”... in fact, in this short introduction I have used all these three terms, right? So let’s start off from

being very clear what these various terms mean. So, climate finance actually has two interpretations, there is a narrow sense and that is around the UNFCCC negotiations where the developed countries transfer money to the developing countries as part of those processes - that is a narrow usage. There is a broader usage and that is the usage I will use tonight, which is any finance related to climate change. So it could be solar panels, it could be energy efficiency, it could be assessing the risk related to financial systems from climate change. So yeah, there is that narrow and broad definition and I'm focusing on that broad definition.

Then there is green finance which is broader than just climate change and we have water sanitation and biodiversity. And the broadest concept of all, which I have already spoken about, is sustainable finance. So this includes social issues and governance issues, so it's close to the ESG that we have heard about. And we will talk a little bit more as we go through the lecture.

Momentum behind Climate Finance

- Climate Finance at the heart of COP26
- Alphabet soup of initiatives & groups
- Climate finance intelligence arms race
 - Spatial Finance
- Concern about greenwashing

So, as Tianyin was saying, there is incredible momentum around climate finance. It was at the heart of COP26. If you're in this space it is hard to keep up. Every day there is a new report, every day there is a new alliance or organization, and they come in many shapes and forms. You have got think tanks, coalitions of investors like Ceres; you have the Climate Bonds Initiatives that creates standards around climate bonds; TCFD which is creating a framework for analyzing climate risks and that is very important for our lecture today; and then you have the UN Principles of Responsible Investing which is more around the broader ESG; and you have stuff like the Network for Greening the Financial System, which is how I was introduced today, how I came to be at this presentation through one of those events; and the Science-Based Targets as well. So there is these initiatives and you've got the Climate Disclosure Standards Board. So you have a whole load of NGOs and regulators and standards boards, for instance, on the regulation you have the EU, and they are pushing very hard along with China on things like the green taxonomies. And not surprisingly, there is also a whole load of new firms emerging that are trying to provide data and services to be able to analyze climate risks, e.g., Four Twenty Seven, which is bought by one of the big data providers Jupiter; and a firm that we do quite a lot of work with, EMMI, in Australia. So

there is a lot going on in this space, it's a very exciting space, but it can feel a little bit too much. How can we make some sense of it?

Tragedy of the Horizons

"... Climate change is the tragedy of the horizon. We don't need an army of actuaries to tell us that the catastrophic impacts of climate change will be felt beyond the traditional horizons of most actors – It imposes a cost on future generations that the current generation has no direct incentive to fix..."

Mark Carney, Speech given at Lloyd's of London (2015)

- Impact of climate change is being felt now ▶
 - e.g. insurance losses
- Mitigation & Adaptation Finance
 - Need both
 - But there is a trade-off
 - Mitigation gap...



One of the pioneering individuals in terms of developing an understanding of how climate change would impact the financial system was Mark Carney and his famous speech at Lloyd's of London (2015), and it was a really important moment, it was before Paris agreement, but it really highlighted to investors very eloquently and effectively how climate change could impact financial institutions and financial markets. And he called it the "tragedy of the horizons" and I think this is a real challenge for capitalism, because, you know, capitalism looks short term, we look for short-term profits. And of course climate change is an inter-generational problem, where there is a mismatch there. So there is this whole attempt to - at a very broader sense in a governance sense as well - to refocus capitalism toward having a longer term perspective, and that is not easy straight off of the bat.

In terms of climate change we are feeling the impact on financial system already, and in particular insurance losses, so as Tianyi mentioned, I used to be at the University of East Anglia, and one of the main founders - twenty years ago - of the university, was the insurance industry because they knew that the University of East Anglia is famous for its climate change research, and the insurance industry knew that this was coming, and that this was an issue, and they were starting to feel it even then. So we are feeling those insurance losses. You just have to look around the world: fires in California, heat waves, floods in Brisbane, Australia - I think they flooded three times this year... so we are feeling those effects now. And so we need to mitigate, to take out, to stop and reduce the amount of carbon we are emitting and also, we need to adapt to climate change, so we need both.

Climate Change and the Financial System

- Eventually all finance will be green (climate aligned)
- Financing green [primary markets]: **Opportunity**
 - Solar, wind
 - Energy efficient buildings
 - Decarbonising transport
- Greening finance: **Risk and financial products**
 - Green Taxonomies
 - Monetary policy
 - TCFD (disclosure) and Risk - Physical, Transition and Liability risk

One way I like to think about climate change and the financial system, is well, one thing is clear to me: That eventually all finance will need to be green. So I see some business schools saying, oh well this is a niche, so we will set up a masters in green finance. But the strategy we have here at Otago is a dual strategy. We want to incorporate green and sustainability into our whole curriculum, but also have specialized courses for the specialized people, for the specific skillsets that you need. So ultimately, all finance will need to be climate-aligned, and we all live in the same planet and we all need to come together to address this incredibly important issue that is going to affect, you know, the lives of billions of people, and in particular billions of people in the poorest parts of the world.

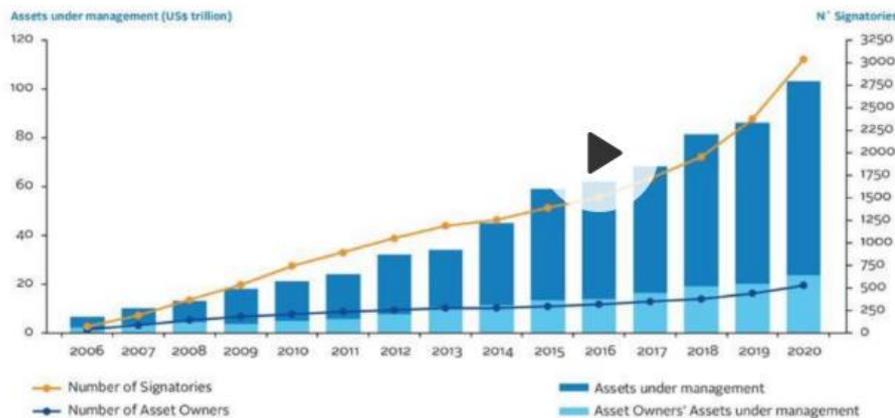
The other thing is, it is good to think of climate change and finance in terms of financing green and greening finance. So, financing is primary markets, the first time we issue capital - we originate/make a loan, or we issue bonds, or we issue shares, so there is new capital. And so this is really important if we are going to mitigate and adapt. There tends to be a lot of focus, at least in the western world, on the trading of existing securities. But it is essentially... climate challenge is more than anything a financing challenge. And it is an opportunity. There are unprecedented opportunities. Of course, China is a global leader in solar and wind and not just in terms of manufacturing it but in terms of deploying it. There are other areas that are obviously incredibly exciting like we need to have much more energy efficient buildings and there is a whole EV electric vehicle revolution which I think is just accelerating and will happen a lot quicker than people realize.

Then there is greening finance. So once those securities exist, what are the risks and are our financial products climate-aligned or are they green? And that is where the green taxonomies can come in, they can tell us what counts as green. They are just dictionaries that say this is green or this is not green. We have a number of important ones so the European Union has been working on and China has been working on green taxonomies.

Also there is a growing and very interesting work on the interface between climate

change and monetary policy, but also there has been this focus on risk. So this is where Mark Carney, as I mentioned, who is an incredibly influential person in the development of climate risk, came up with this classification of risks. So he talked about physical risk, transition risk and liability risk. And we will talk more about those as we go through.

UNPRI Signatory Investors: Sustainable Finance is becoming Mainstream

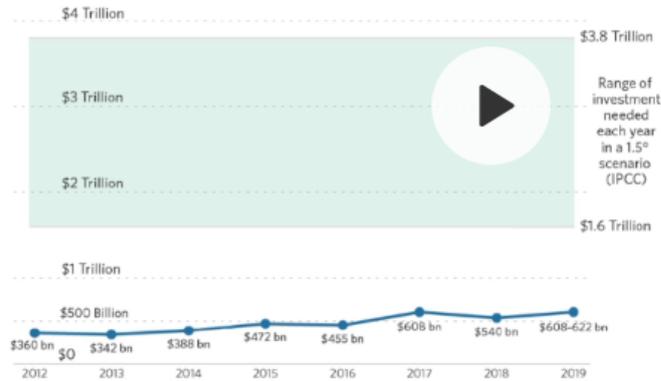


Before we get to that, I guess it would be good to think about where investors are on this, and so there is the United Nations Principle of Responsible Investing. This is where investors take ESG considerations - so remember, that's sustainable finance: environmental, social and governance issues - into their investment. And nearly a hundred trillion of assets under management say that they are taking the environment into consideration or ESG factors into consideration. So there is a hundred trillion of assets under management, so these are pension funds that say they are taking ESG into consideration.

The question is how meaningful is that? Is there green washing, does it really amount to that much? But at least it shows that the vast majority of investment funds want to be ESG aligned. Whether they are doing it effectively is another question. They want to. I think it is like over 80 percent of global assets under management are run by firms claiming to be aligned to UNPRI.

Climate Mitigation Funding Gap: Trillion Dollar Market Failure

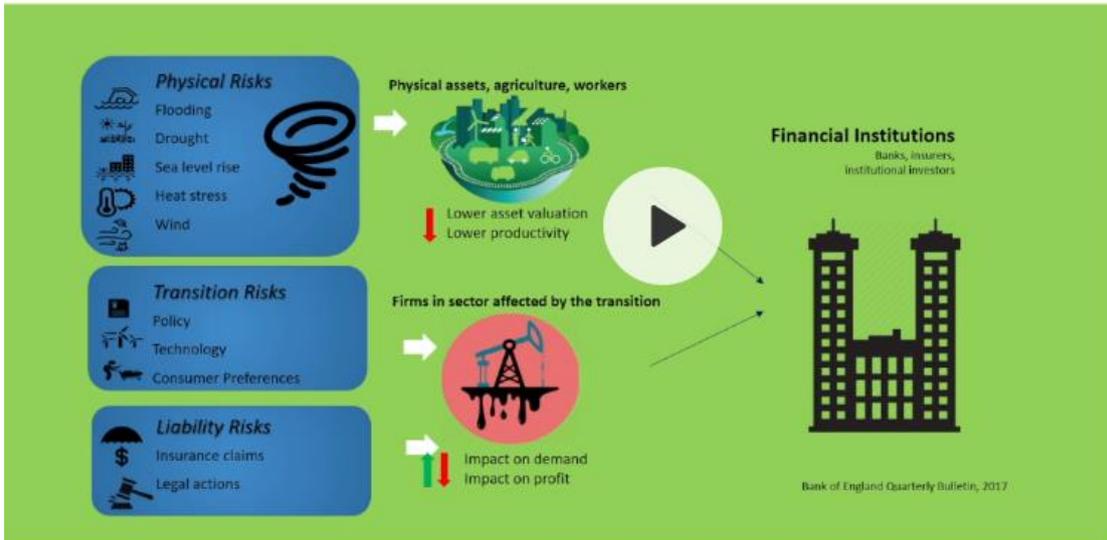
Vast investment is required to keep warming within a 1.5° C scenario



But despite this, so having a hundred trillion, right? I think the numbers here are interesting. So you have a hundred trillion assets under management and then there have been various estimates of how much do we need to invest per year to decarbonize the global economy. It is quite a big range. It ranges from 3.8 trillion to 1.6 trillion. So we've got 100 trillion of assets under management saying we take ESG into consideration. We need to invest 3.8 and between 1.6. Which is by the way in the range of global defense budgets, so this is not an impossible sum of money. This can be done.

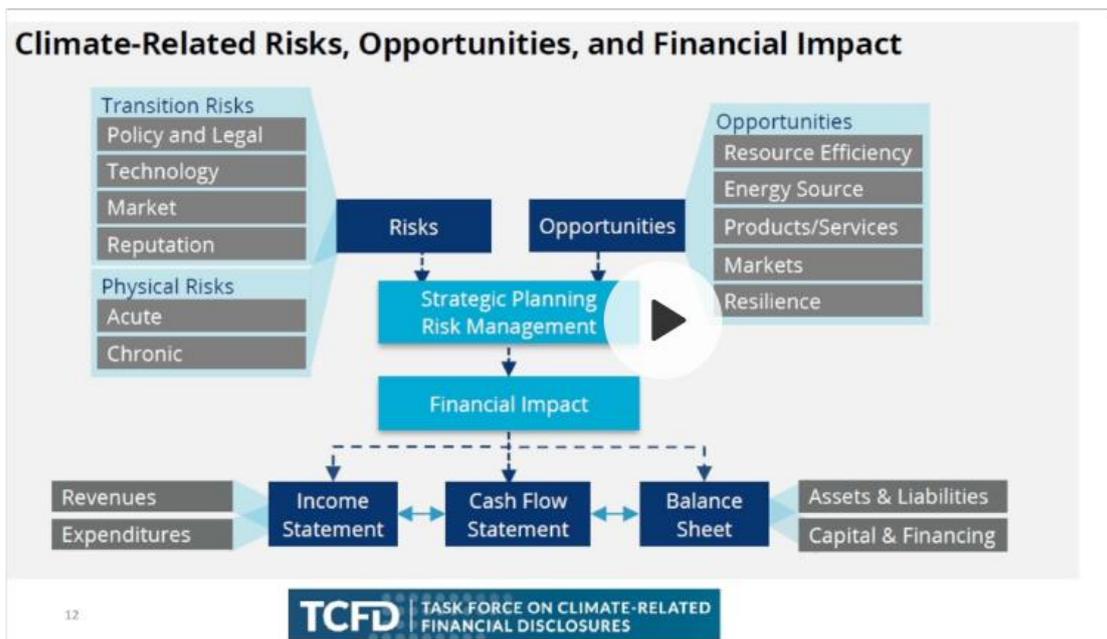
And how much are we investing at the moment? It is around 600 billion. So there is a very big gap between what we need to do, need to invest, and how much we are actually investing to try and stay within 1.5 (celsius degrees) or - I'm not a climate scientist, I'm a finance person but I think most of the climate scientists that I speak to acknowledge that 1.5 is now incredibly challenging. But hopefully they are staying well below 2 degrees. So, you know, there is a huge opportunity, financing green, a huge investment opportunity and I could talk about the opportunity but today, my focus is on risks.

CLIMATE FINANCE RISKS



As I said, this Mark Carney's classification of risks was divided into physical risk, transition risk, and liability risk. Physical risk is easy to understand, right? Flooding, droughts, sea level rise, heat waves, hurricanes, et cetera. And you know, their frequency and severity is increasing, and it is just very obvious from the news.

Transition risk is a lot more subtle. When I teach this to my students some of them really struggle with it, and it is really about winner and losers, old industries disappearing and new industries emerging. And then there is liability risk, so this is around insurance claims, so it could be insurance claims related to these physical disasters but also legal action and we are now getting around the world a lot more legal action. NGOs like ClientEarth which have offices around the world including a new office in Singapore, they have an office in China where they are trying to engage with firms to dissuade them from installing new fossil fuel power plants.



This is another view and it comes from TCFD. And so we have transition risk, physical

risk, they interestingly didn't include liability risk but they said there are risks, there are opportunities. And firms need to think about their strategic planning, they need to think about their risk management, and as part of that they need to think about the impact of these things as well as the opportunities that may arise from all these. And these things have an impact on income statements, so I imagine there are a few accountants in the audience, cash flows that businesses generate and balance sheets. So you know, you could have stranded assets, assets that need to be written down before their useful life. Revenues... if you're in an EV area, your revenues are growing; if you're in the coal business, potentially at least pre the Ukrainian conflict, your revenues would have been falling, right?

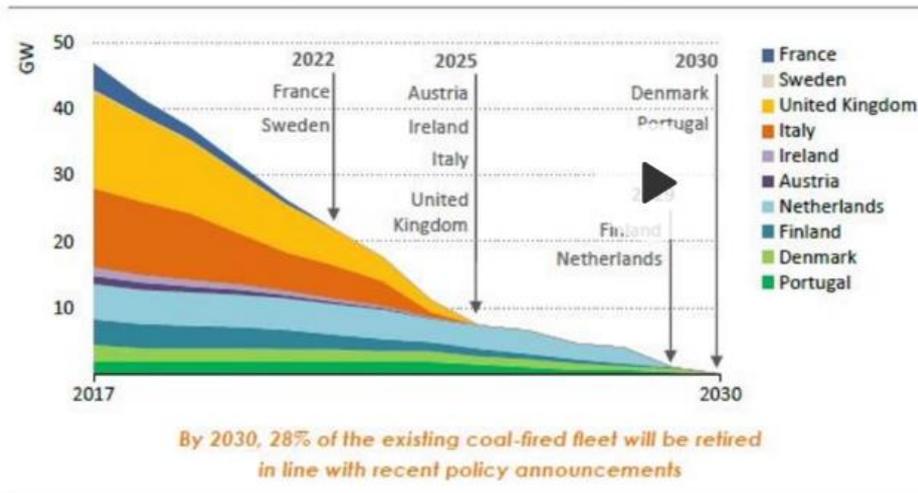
So these climate risks have a real impact on firms, on their income statements, on their cash flows and their balance sheets.



And so you know in my group we focus on both transition, physical risk and actually we do a little bit around liability risk. I could have spoken to you today purely around physical risk. This is an example of a project that we have funded by the Royal Society of New Zealand, involves the central bank, we are using the supercomputing facility of New Zealand and we have a data provider that provides us data in real estate, and we are working with a climate scientist and a hydrogeologist, so people understand what is happening under the ground in terms of water, and what we are looking at is how sea level rise and flooding hazards like storm surges and extreme rainfalls are going to affect flooding and therefore house prices, and therefore in turn the stability of the banks. Because in New Zealand 60% of the assets of our banks are in domestic real estate, in houses, so it's a big risk in New Zealand. So just an example of the work we are doing in physical risks, but today I'm going to talk to you about transition risk.

Transition (Risk) = Winners & Losers

Figure 8.29 > Plans to phase out coal in the European Union



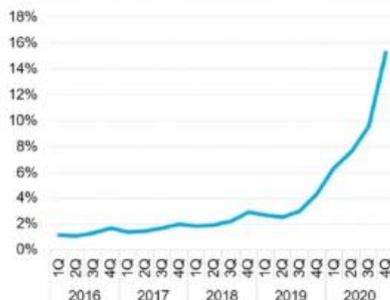
And as I said, transition risk is about winners and losers, or transition, and then there is a risk element. And here is just a - perhaps a rather dated graph - from Europe in terms of when European countries are exiting coal. I imagine actually the exit is going to be even sooner than this. But essentially, coal is dying in Europe, at least pre the Ukraine war, now we are having this - having to have some substitutions for gas - coal for gas, but you have a renewed effort from Europe to become less dependent on imported gas and accelerate that transition. So in the short term, actually, the conflict may increase carbon emissions but in the long term it may accelerate the energy transition. And clearly, we had a similar sort of situation, you will see it when we look at the bank stress testing, US banks have essentially exited coal, they are not funding coal. So yeah, that is interesting.

Transition (Risk) = Winners & Losers

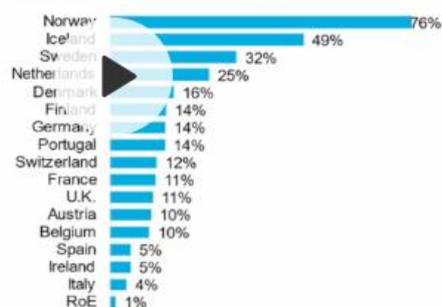
EV sales in Europe

Liebreich Associates

Europe EV share of passenger vehicle sales



EVs share of passenger vehicle sales 2020



Source: BloombergNEF EVO2021

But there is also the positive side to transition risk, and the rest of my lecture is going to focus on the risk side of it, but there is this positive opportunity. And so this is EV

sales in Europe again. And actually I think Norway in the last quarter reached 85% of all vehicle sales are electric vehicles. I think in this month the US got to 7%, so the transitions, I mean we think about mobile phones, I'm old enough to remember not having a mobile phone and the spread of mobile phones was incredibly quick. Obviously cars are bigger and changing car plants from internal combustion engines to electric vehicles is a much harder task, but I think this transition is going to happen a lot quicker. And so it creates incredible opportunities from lithium mining to steel and iron and also smart mobility as well. So there are huge opportunities there that investors can partake on. So there is a positive story as well.

2. Measuring Transition Risk: Carbon Footprints

Let me take a quick sip of water and we will move on. So measuring transition risk, sorry about my rather long introduction, as I said, my introduction was going to be long and I will try and keep the time.

Can we rely on ESG Scores?

- E part of the ESG scores contains climate inputs including carbon footprints
- But one of many inputs
- Many concerns (biases) around ESG scores

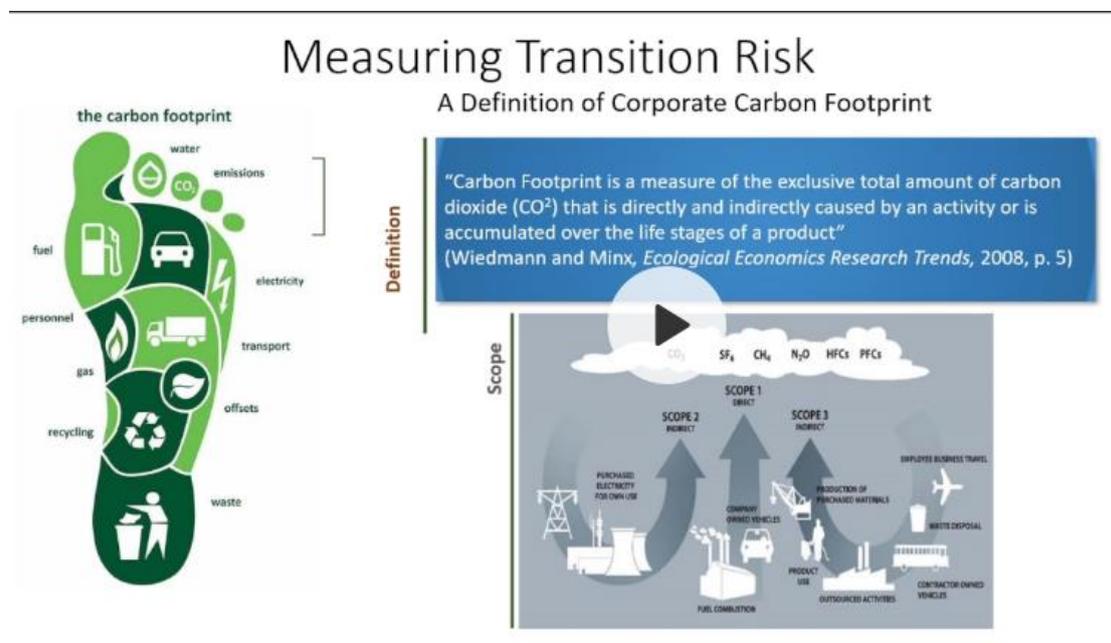


45K Retweets 4,922 Quote Tweets 315.6K Likes

So, we hear a lot of news about ESG and sustainable finance, and within my group we

have a tension - some of the group are very committed to sustainable finance and ESG scores. I don't like using them. Here is a tweet from a couple of days ago, May 19th, and Elon Musk was rather upset, and of course he got upset and he got on Twitter, and he was upset because Exxon is rated in the top best in the world for ESG by the S&P 500, whilst Tesla didn't make the list.

So you know, he says some rather angry words below, "ESG is a scam" and so on. And of course ESG has many components, there is environmental, there is social and the governance, and within 'E' it contains elements of climate scores. But I share his concern. Even if we extract the S and the G and end up with the E, can we just rely on ESG scores or E scores? I think the answer is not, I have looked at some of these scores and they have an inherent bias, an upward bias, or there is a reporting bias, or there is a large firm bias. So I have many concerns about ESG scores and I think we really, in terms of if we are serious about understanding transition risk, we need to look at other metrics. They may be contained within the ESG providers but yeah, we can not just rely on the E of the ESG score, we need to drill down deeper and find other metrics.



Which takes me onto measuring transition risk and the corporate carbon footprint. And so this is just measuring a footprint so the impact that firms have, across their businesses, not just CO₂ but across all greenhouse gasses.

The Greenhouse Gas Protocol [\[Video\]](#)

Scope 1: Direct GHG emissions

Direct GHG emissions occur from sources that are owned or controlled by the company, e.g. boilers, furnaces, vehicles, etc.; emissions from chemical production in owned or controlled process equipment.

Scope 2: Electricity indirect GHG emissions

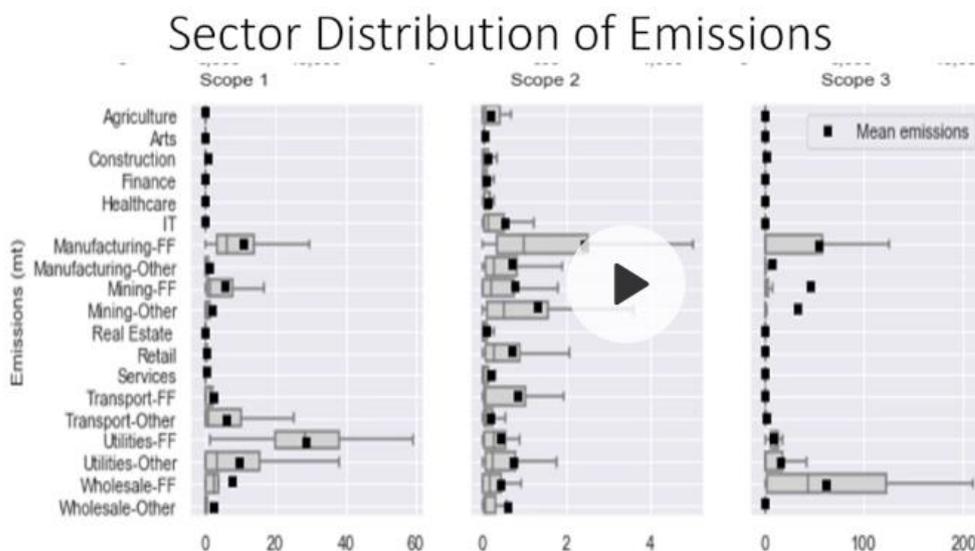
Scope 2 GHG emissions from the generation of purchased electricity. Scope 2 emissions physically occur at the facility where electricity is generated.

Scope 3: Other indirect GHG emissions

Scope 3 is an optional reporting category. All other indirect emissions.

Ranganathan et al (2004). The greenhouse gas protocol: a corporate accounting and reporting standard (revised edition). Washington, DC: World Resources Institute and World Business Council for Sustainable Development.

And there is this thing called the Greenhouse Gas Protocol. This has a classification system and this classification system is important for the rest of my lecture. Apologies if you're familiar with this, some of you may not. So it categorizes emissions - remember, it's all greenhouse gas emissions, GHGs - into 3 categories. There's scope one emissions and those are emissions that are directly emitted by the firm. So it could be the cars, burning fuel, the boilers that keep the buildings warm. Scope two is bought electricity. So if you're getting electricity to your buildings and you're buying it, how green or not green is that electricity? Firms need to estimate that. Then there is scope three, and scope three is the difficult one, because it's everything else essentially, all other indirect emissions. And that could contain upstream and downstream elements. And so, the Greenhouse Gas Protocol scope one and scope two and to some degree scope three emissions are being used by analysts to understand the transition risk of firms.



Here is the sector distribution of emissions of the scopes - so scope one, scope two, scope three - by different types of firms. Burning fossil fuels... well it's not surprising that utilities have the highest scope one emissions, right? Scope two emissions... manufacturing, so they will use a lot of bought electricity and have the highest emissions. Scope three emissions will be wholesale fossil fuel. In other words, oil and gas firms. These will count as scope three. So for instance, you might get some firms, oil and gas firms that will say, we want to go to net zero of scope one and scope two. And that may sound impressive, but the reality is that they have operational reasons to cut scope one and scope two emissions and they are small. The real impact of an oil and gas firm is when it delivers that oil, all that gas and its burnt by a utility to generate electricity that other people buy or they put it into vehicles and people drive those vehicles.

In principle, if everybody reported scope one emissions, that is all we needed. Hopefully, as you saw, as I jumped around, you see that there's a potential for double counting or even triple counting or more of these emissions. This is a real problem with this Greenhouse Gas Protocol and when we use it in financial analysis.

Measures

Carbon intensity = Total (Scope 1 & 2)/Revenue

- Sometimes total assets
- Sometimes also use Scope 3 (data issues and double counting)

Portfolio level: Weighted average carbon intensity (WACI)

Use at firm level: ('Hidden' or hypothetical) Carbon/GHG Liability

- Total (Scope 1 & 2) x \$ Carbon Price = \$ Carbon Liability
- Deduct from Profit Before Tax
- But cost pass-through (CPT) in reality (can be high)
- So real Liability = \$ Carbo liability x (1-CPT)

The basic measure of climate risk that's been used so far is the carbon intensity. So scope one and scope two emissions divided by revenue. Sometimes total assets are used rather than revenue, and sometimes they add scope three into the numerator. And then you can use this by company and then do a weighted average to get what we call a WACI (weighted average carbon intensity) of your portfolio.

Essentially, you'll see that we did that when we look at the bank stress testing. You can also use carbon intensities or carbon emissions to see a hypothetical carbon liability of a firm. You can take the emissions and essentially multiply them by a carbon price to see, to get an idea of what would that do to the firm. You could deduct it, for instance, from profits before tax, or you could deduct it from revenue.

Climate transition risk in New Zealand equities

Iamish Kennett, Ivan Diaz-Rainey , Pallab Kumar Biswas & Duminda Kurupparachchi

Received 23 Aug 2020, Accepted 15 Mar 2021, Published online: 05 Apr 2021



Table 5. Top 10 companies with the largest percentage change in revenue.

	PD-25 Scenario			PD-0 Scenario		
	2018	2030	2050	2018	2030	2050
<i>Panel (a): Based on Scope 1 & 2</i>						
Genesis Energy (scope 1 only)	-2.38%	-5.25%	-13.54%	-2.38%	-7.63%	-19.07%
Air New Zealand Ltd.	-1.63%	-3.59%	-9.27%	-1.63%	-5.22%	-13.06%
Contact Energy Ltd.	-1.37%	-3.01%	-7.77%	-1.37%	-4.38%	-10.94%
Vector Ltd.	-0.75%	-1.66%	-4.28%	-0.75%	-2.41%	-6.02%
Fletcher Building Ltd.	-0.60%	-1.32%	-3.40%	-0.60%	-1.92%	-4.79%
Mercury Energy Ltd.	-0.35%	-0.76%	-1.97%	-0.35%	-1.11%	-2.77%
Sanford Ltd.	-0.35%	-0.77%	-1.99%	-0.35%	-1.12%	-2.81%
Synlait Milk Ltd.	-0.35%	-0.77%	-1.99%	-0.35%	-1.12%	-2.80%
Fonterra Ltd.	-0.30%	-0.66%	-1.70%	-0.30%	-0.96%	-2.40%
Mainfreight Ltd.	-0.29%	-0.64%	-1.64%	-0.29%	-0.92%	-2.31%
<i>Panel (b): Based on Scope 1, 2, & 3</i>						
Fonterra Ltd.	-2.46%	-5.41%	-13.97%	-2.46%	-7.87%	-19.68%

And in a very simple paper, we did that for New Zealand published in the Journal Sustainable Finance and Investing. We looked to see and we used scenarios from a government agency, the Productivity Commission, that had different forward-looking price pathways. And we looked to see what impact that would have on the bottom line or the revenues of some of the biggest companies in New Zealand, the 50 biggest companies. If we take just scope one and scope two, one of the things that we do in New Zealand is we export a lot of milk powder to China. And if we take scope one and scope 2, our big milk exporter doesn't look to have a particularly big impact, but if you include scope three, then it has a much bigger impact. And these are generally upstream, farm, non-CO₂ emissions. So things like methane that comes from livestock, like cows. Just a very simple example of how the emissions are used. We multiply them by a carbon price, and there's all these questions. What carbon price do you use? Do you use an actual carbon price? Do you use the social cost of carbon? Or do you use something else like some forecast that's been done by economists.

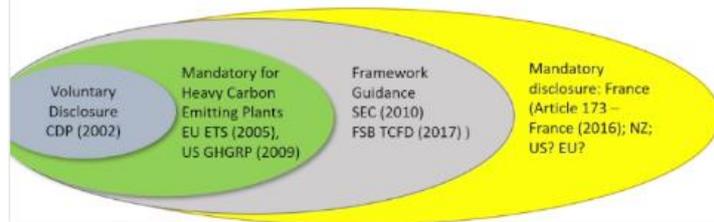
3. Using Machine Learning to fill data gaps

Predicting corporate carbon footprints for climate finance risk analyses: A machine learning approach

Quyên Nguyen *, Ivan Diaz-Rainey, Duminda Kuruppuarachchi

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- Most companies do not report and may not report consistently
- Concerns about reporting quality (assurance)
- Differences across data providers
- Scope 3 reporting very low



So this takes us to the next question. So when we did this work on New Zealand, we noticed that a lot of companies do not report. And sometimes some companies reported one year and not the next. We noticed that there was a lot of concerns about data quality and whether the estimates were accurate. It was clear that there were a lot of problems with the data and differences across data providers. And then scope three reporting was very low. So we did this international study predicting corporate carbon footprints using machine learning. So only a certain proportion of firms report. So we need to try and estimate for those firms that don't report what their emissions would be, right? And so, reporting can be voluntary through the carbon disclosure project. It can be mandatory as part of emissions trading schemes or there could be guidance, or it could be mandatory across the whole economy. So France, in 2016, had a law that had a big influence there. Recently we are moving towards mandatory in New Zealand. And let's talk about that in the US and EU. So more and more firms are having to report. But still, I think the numbers are around 6,000 currently report

out of an estimated universe of 43,000. So we did this work using machine learning to predict carbon footprints and it was very impactful. It led to a 30% improvement in accuracy, but absolute error was still high. So it's hard to predict emissions.

Method and results

- Two-step framework: Meta-Elastic Net learner to combine predictions from multiple base-learners as the best emission
- Scope 1 and 2 emissions: accuracy gain based on mean absolute error of up to 30% as compared with the existing models.
- Prediction accuracy can be further improved by incorporating additional
 - predictors (energy production/consumption data)
 - firm disclosures in particular
 - Sectors (utilities and real estate)
 - Regions (Asia & Pacific and South/Latin America)

Professional Investors Marketing communication February 2022
**CORPORATE CARBON FOOTPRINT:
A MACHINE LEARNING PREDICTIVE
MODEL FOR UNREPORTED DATA**



BNP PARIBAS
ASSET MANAGEMENT

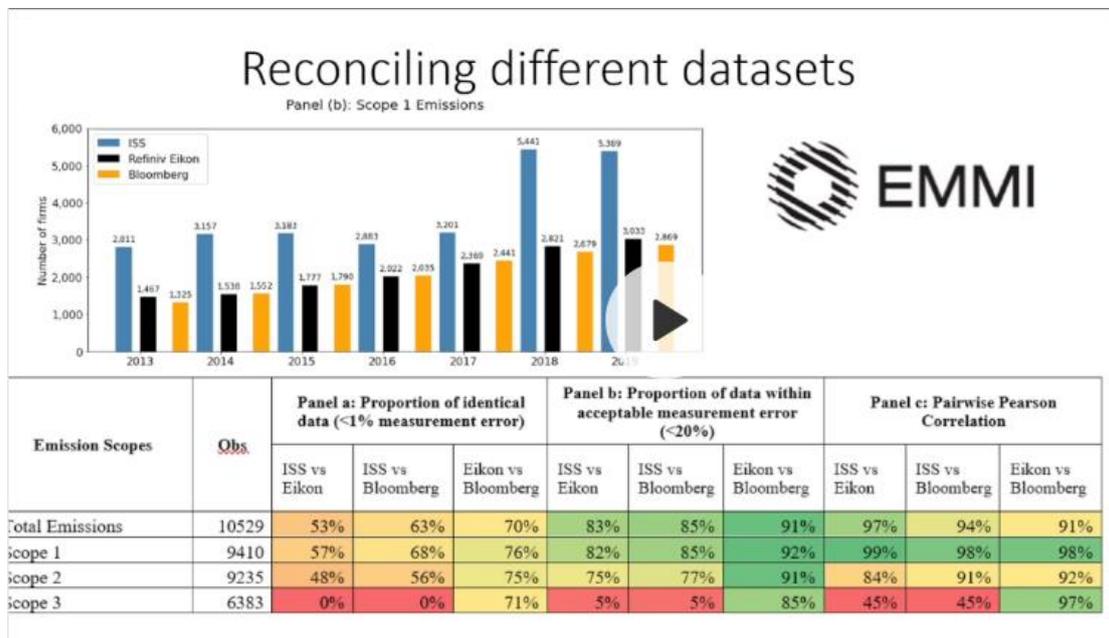
But we had a big improvement and actually BNP Paribas which manages, I think it's about 400 billion, essentially replicated our model and are using it in their climate risk assessments on transition risk. So it's had a big impact. Another thing we found from that paper is really the data. So it was very useful from the policy perspective is: what extra data does a market need to be able to estimate greenhouse gas emissions? So we need better data on energy production and consumption data by firms. Also in terms of firm disclosures, we need better information in terms of utilities. So what utilities are doing and interestingly enough, real estate as well. And this was a global study and also regions, certain regions require more data to improve accuracy, so Asia, Pacific, and South and Latin America, so emerging markets, we need more data in emerging markets to be able to get carbon footprints.

Commercialisation Project: Predicting and Forecasting Carbon Footprint for Climate Risk Analysis



- CEFGGroup is working with EMMI to develop novel machine-learning approaches to estimate corporate carbon emissions in a timely manner, building on CEFGGroup world-class research expertise in this area.
- EMMI is leading the way in building a global standard to assess carbon financial risk for companies.

As I said, BNP Paribas Asset Management was very interested in our work. Then we were approached by this - I mentioned them before - Michael and Ben who cofounded EMMI. Ben is a former climate scientist at the University of New South Wales and Michael is just a finance practitioner and they've established this firm that comes up with its own transition risk rating. And I'll talk a little bit more about that. And they saw our machine learning model and we entered into agreement to help them out to improve their emissions forecasting.



Some of the work we've done with them is to look at how many firms report using three of the main datasets that are used in the market, and we saw large differences. So for instance, ISS is clearly using forecasting of its own, and so therefore reports a lot more. The other thing we looked at is the proportion of identical data points, right? And you would think this would be really high. But in fact, it's incredibly low. So most of these firms are doing some adjustment. So it becomes sort of difficult to know

what the reality is, what actual emissions are. So there is quite a bit of data and consistency. But I guess if you take a 20% sort of measurement error, there is pretty high coincidence between Eikon and Bloomberg, less so between ISS, and Eikon and ISS and Bloomberg. But if you take a 20% error, then it was getting acceptable. But not so in scope three emissions.

Scope 3 Emissions: Data Quality and Machine Learning Prediction Accuracy

Quyen Nguyen¹, Ivan Diaz-Rainey¹, Adam Kitto², Ben McNeil^{2,3}, Nic Pittman², Renzhu Zhang¹



- Scope 3 made up of categories (upstream and downstream)
- Obfuscation: report irrelevant categories (company travel) and ignore material categories (use of products and processing of sold products)
- Machine learning algorithms can improve the prediction accuracy
 - aggregated Scope 3 emissions (up to 6%)
 - components (each category is estimated individually and aggregated into the total Scope 3 emissions) (up to 25%).

So as a result of that, we decided to look at scope three emissions, and this is a working paper that is still not available, we're still working on it. We're going to be presenting it in the coming months. And so we look at scope three emissions in particular. So scope three emissions, in turn, are made up of different upstream and downstream categories. What we found is that there's an element of obfuscation.

And so what does that mean? Maybe firms select which parts of scope three to report and which ones not. So often they report irrelevant categories like company travel and sometimes ignore categories like use of products and processing of sold products. Not very many firms report scope three. When they do report scope three, you don't really know what you're looking at unless you look at what categories they have decided to report on. Now I don't want to be too critical of firms because actually doing scope one and scope two can cost a firm a lot of money. Doing scope three is incredibly hard as well because you've got to think about upstream and downstream of your business. But if you want to use this stuff for analysis and risk analysis, then it's very problematic, right? Because you got a lot of inconsistencies.

So we applied our machine learning algorithms to see if we could improve on the forecasts, on the predictions of this stuff. And we take aggregate emissions, so not break it up by category, we had an improvement of 6%, which was fairly disappointing. But then the analyst that does all this work, Quyen Nguyen, we'll talk more about her at the end. She's decided to break it up into the component parts, analyze each component part and then reaggregate it. And we had an improvement of about 25% - a big improvement. But again, the error is still very high in these things. So the more we move towards compulsory reporting, the better the data is going to become, and the more countries and jurisdictions that mandate reporting, then the

better investors are going to be able to analyze these risks.

4. Example of Application to US banks portfolios (Stress testing)

So hopefully you have some ideas of transition risk, how it's measured so this Greenhouse Gas Protocol, how we come up with a basic measure that adjusts for the size of the firm and that's dividing it by revenue, and we call that carbon intensity. So we now have a measure and with our first - with Quyen's first paper, and which is part of her PhD - with this paper, we then had forecasts for all firms in the universe, as I said, in this universe of forty two thousand firms.

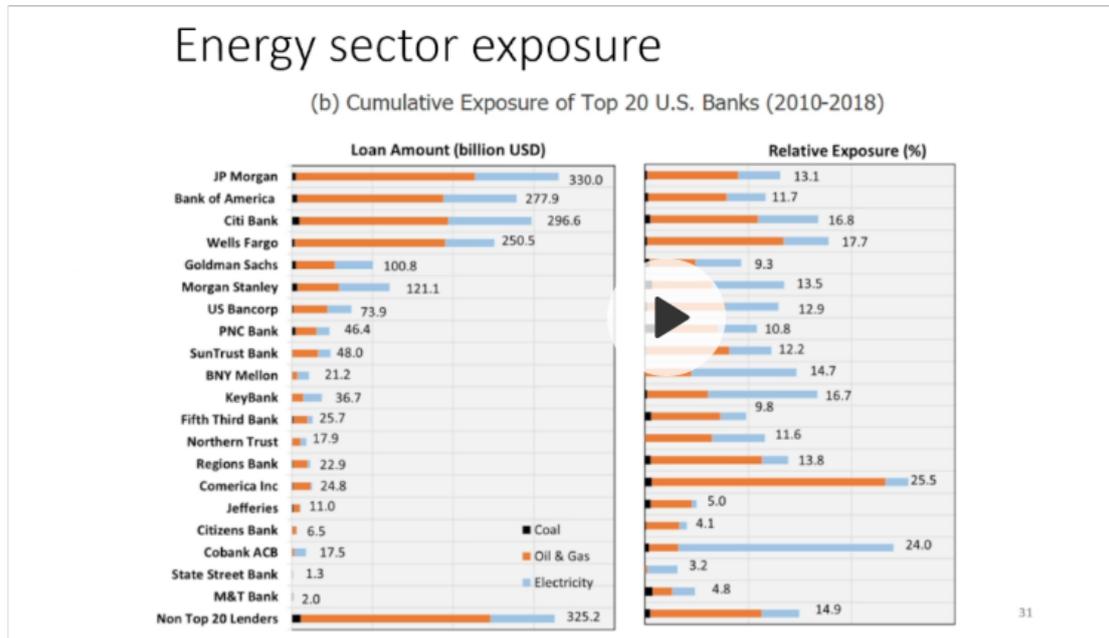
Example: Transition Risk in US banks Syndicated Loan Portfolios (Nguyen et al 2021)

- Most Current Analyses are top-down
- Limitations of top-down approaches
 - Do not address micro prudential question
 - but micro prudential problem can become a macro (systemic)
 - Therefore, need to micro prudential-level analysis to answer macro concerns
- Bottom-up very relevant to physical risk (geography)
- Transition risk for banks = bottom up asset-level data (loan level) given portfolio make up
- Transition risk most obvious in energy sector but affect every sector (agriculture – other GHS's)
- How**
- Historical exposure: loan-level data & ML predictions of corporate carbon footprint (& energy sectors) to examine bank's exposure
- Climate stress-test: To measure future bank's vulnerability (Merton model) in different pathways (IAMs)

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And so, we thought, well for her second study in her PhD, we would use that data to look at the risks to banks from transition risk. Because most analysis that looked at banks had looked at top down. So they had a representative portfolio, like an example portfolio, and then used that. But that doesn't tell us if one bank is more at risk than the other. If we want to know whether one bank is more exposed to transition risk than the other, we need to go bottom up. We need data on the carbon footprint of

each firm. And then we need to create these WACIs, the weighted average carbon intensity. So based on how much they lend to the firm, we apportion the carbon proportion.



The reason this is useful is because most previous analysis had just looked at the energy sector. How much do they lend to the energy sector? We did that as well. And we looked at the energy exposure of the Top 20 US banks to the energy sector. So coal is the black one, oil and gas is the reddish one, and electricity is the blue one, right? This is the absolute amount in US dollars, in billions of US dollars. And of course the bigger banks are at the top. Remember, I said that US investors or US banks, commercial banks, or investment banks as well, had basically exited coal, and you see that here, they have exited coal, it's seen as too risky, they are not touching it. Here's the exposure relative to the size of the bank and you get a very different picture. So those of you that have seen bank track, we coming up with a very similar picture to bank track. But actually, if you scale by size, you see that certain banks have big exposure to the energy sector.

Portfolio Carbon Intensity (PCI)

Bank	2010	2011	2012	2013	2014	2015	2016	2017	2018	All	PCI Rank	ESE Rank
JP Morgan	257	273	206	249	220	283	223	192	166	226	10	9
Bank of America	232	311	197	203	205	191	211	173	169	208	14	12
Citi Bank	355	313	246	336	251	323	254	256	217	278	4	4
Wells Fargo	223	272	259	288	243	212	234	243	223	244	7	3
Goldman Sachs	266	371	205	244	231	153	172	193	172	211	13	16
Morgan Stanley	371	387	291	185	213	217	276	261	148	246	6	8
US Bancorp	263	344	284	201	182	219	231	212	172	227	9	10
PNC Bank	221	250	280	179	315	134	214	209	183	217	11	14
Sun Trust Bank	223	395	249	237	210	283	225	137	181	228	8	11
BNY Mellon	393	321	427	229	351	166	299	357	265	303	3	6
KeyBank	362	561	544	536	451	298	358	284	330	413	2	5
Fifth Third Bank	222	465	147	189	126	158	192	146	147	187	16	15
Northern Trust	195	182	197	176	173	154	213	424	319	216	12	13
Regions Bank	271	201	202	226	235	147	133	224	175	198	15	7
Comerica Inc	333	291	225	240	195	276	199	401	281	269	5	1
Jefferies	92	77	221	42	73	57	89	114	85	88	20	17
Citizens Bank	216	105	100	101	95	86	100	85	111	100	19	19
Colbank ACB	349	493	436	373	507	669	863	652	529	539	1	2
State Street Bank	271	43	61	134	358	65	109	89	53	129	17	20
M&T Bank	108	92	222	125	99	134	175	101	97	121	18	18
Non Top 20 Lenders	178	221	224	245	248	229	231	231	215	225		
All Banks	254	298	235	241	228	228	226	212	189	231		
MSCI ACWI Benchmark										174		

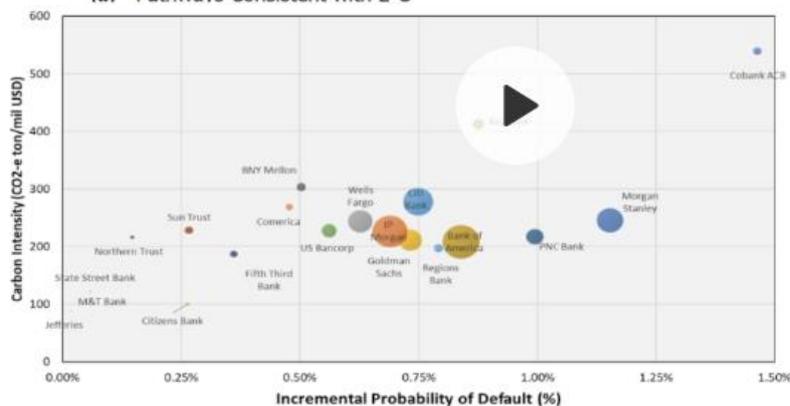
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But we know that decarbonization isn't just about the energy sector. It's about all firms in the whole economy. Every firm needs to reduce its carbon footprint. And so this is really where we calculated our WACIs for the banks, so this includes all sectors, all firms using our machine learning predictions of carbon foot footprints for this universe of 45,000 firms. And so the ESE rank here is the rank based on exposure to the energy sector, and the PCI one is the exposure based on all firms. And you see that there's some big differences, right? So if you take Regents Bank, it seems to be very exposed to the energy sector. But once you factor that in other firms, actually its exposure isn't as bad. So it underlines that if you're doing these risk assessments, you really need to look just beyond the energy sector. All firms are exposed. And so when you're doing these analyses, you need to look at all sectors. So whether it's a portfolio, an investment portfolio, or it's a bank portfolio, you need to look at the carbon intensity of all these firms.

2°C PCI vs. Incremental Prob. of Default

- Banks' vulnerabilities are also driven by the ex-ante financial risk of their borrowers.
- Morgan Stanley (higher ex ante conventional risk) vs. Sun Trust

(a) Pathways Consistent with 2°C



Another big takeaway from the stress testing: so then we did forward looking projections using IPCC scenarios of 1.5 or 2 degrees. And another big takeaway here is, for instance, you look at the carbon intensity of SunTrust Bank and the carbon intensity of Morgan Stanley's portfolio and they're very similar. However, the probability, incremental probability of default is much higher for Morgan Stanley. And so, what this tells us is we cannot look at climate risk independently. We need to look at overall risk. Was this firm investing in riskier firms anyhow? And then you add climate risk or the transition risk on top and it has a much bigger impact on its probability of default.

Extrapolation

- Getting a sense of the scale of the risk weighted by loan amount relative to CET1 (equity capital under Basel #)
- syndicated loan portfolio in 2010-2018 is representative of climate risks in the rest of the banks entire portfolio

Median Climate Vulnerability on Syndicated Loans (%)	2020	2030	2040	2050	2060	2070	2080	2090	2100	All
Above 2°C	0.018%	0.089%	0.128%	0.130%	0.152%	0.161%	0.209%	0.242%	0.250%	0.132%
Higher 2°C	0.024%	0.393%	0.630%	0.608%	0.593%	0.650%	0.681%	0.801%	0.947%	0.578%
Lower 2°C	0.025%	1.047%	1.286%	1.394%	1.363%	1.261%	1.268%	1.395%	1.269%	1.117%
1.5°C high overshoot	0.018%	0.732%	1.362%	1.611%	1.728%	1.820%	1.904%	2.112%	2.218%	1.468%
1.5°C low overshoot	0.013%	1.564%	2.235%	2.256%	2.113%	2.421%	2.191%	2.113%	2.107%	2.030%
All	0.021%	0.396%	0.602%	0.611%	0.619%	0.654%	0.680%	0.707%	0.809%	0.509%
Median Loss on CET1 Capital (%) ¹	2020	2030	2040	2050	2060	2070	2080	2090	2100	All
Above 2°C	0.144%	0.714%	1.027%	1.043%	1.219%	1.291%	1.676%	1.941%	2.005%	1.059%
Higher 2°C	0.193%	3.152%	5.053%	4.877%	4.757%	5.214%	5.463%	6.425%	7.596%	4.636%
Lower 2°C	0.201%	8.398%	10.316%	11.182%	10.933%	10.115%	10.171%	11.190%	10.179%	8.960%
1.5°C high overshoot	0.144%	5.872%	10.925%	12.922%	13.861%	14.599%	15.273%	16.941%	17.791%	11.775%
1.5°C low overshoot	0.104%	12.545%	17.928%	18.096%	16.949%	19.420%	17.575%	16.5	截回(AIt + A)	6.283%
All	0.168%	3.176%	4.829%	4.901%	4.965%	5.246%	5.455%	5.6		4.083%

As I said, we did some stress testing to look at what this would do to banks, portfolios and to be clear, we did this just for syndicated loans. So small proportion of US banks' balance sheet, not all the balance sheet. Then we did an extrapolation saying, what happens if there were similar risks in the rest of the balance sheet? And we do get some quite big numbers relative to regulatory capital CET1 under the more carbon constrained, more rapid transition, right?

And all this modeling assumes that the banks don't change their portfolios over time. So it is stylized. But again, it is just an example of how we start off with carbon intensities or carbon emissions by corporates. We aggregate to try and see what the different exposure is for different banks. There are lots of limitations, but we're developing these approaches.

5. Conclusion

- Limited reporting (prediction)
 - Circa 6,000 companies for a universe of about 42,000
- Poor quality of reporting (e.g. NZ and work with EMMI reconciling datasets)
- Lag in reporting (forecasting)
- Scope 2 and 3 double, triple ... counting
- Backward looking
 - e.g. company may have Credible NetZero policies 
 - e.g. fails to account for assets disposal e.g. Vector
- Carbon liability **actual vs. hypothetical**
 - Abatement investments or allowances bought or carbon tax paid
 - Hypothetical: true (social) cost of carbon
- Carbon liability useful but only one element of transition risk

That takes me towards the end. So to conclude and summarize, there's very limited reporting of carbon emissions by firms. It's growing every year and the number of jurisdictions and countries that are requiring disclosures is growing, as I said, currently, currently 6,000 likely... but still a long way from the 42,000 of regularly traded companies that have shares in accessible markets and often issue bonds as well. There's also poor quality of reporting, so we need more countries mandating reporting, but also establishing rules around what that reporting looks like. And there is detail. And there needs to be consistency internationally on this. And in particular areas like scope three where there are different categories and there's the risk that people cherry pick – choose what to report.

The other big issue is lagging reporting. So when we work with EMMI, this is something that we're working on as well. One thing is to predict firms that don't report, but also to try and have quicker forecasts of firms' current emissions. So often it can take them 18 months to report the carbon emissions, right? The world in 18 months, a year and a half can change an awful lot. A firm may dispose assets, may sell assets.

There are plenty of problems with the carbon intensity. And I guess, by when I talk about this lag in reporting is that they are backward looking: they tell you what the firm did in the past. It doesn't tell you what it's going to do in the future. So they have limitations. So for instance, many companies are creating net zero policies. And some of these are credible. I gave the example of a not credible one, an oil and gas firm saying they're going to go to net zero on scope one and scope two when all their emissions, the really important emissions are scope three. but some firms have really tight and good net zero policies, right?

So, you know, it may be unfair. And actually, in the work that I did for New Zealand, we came up with a chart of the top ten firms with the highest carbon intensity and we had an energy company, Vector, and they were very upset with me. They called me and they said, this is backward looking. We've just sold this gas plant, which has just cut our carbon emissions by 80%. And so, yeah, it was great, I'm glad they were upset with me because it showed that they really cared and I clarified in the article that they

were historical emissions. It was clear, but yeah, and I emphasized it in a newspaper article where I had originally been cited and that wasn't clear. So it's great that firms care about this and yes, firms are disposing of assets. There's a risk that they shift the assets, so they sell the asset. And then they buy the equivalent product, and then it gets hidden in the scope three. So there could be some switching from scope two, scope one to scope three. And actually, there was some interesting research presented at our symposium last year that was suggesting that's happening.

Which carbon risk measure?

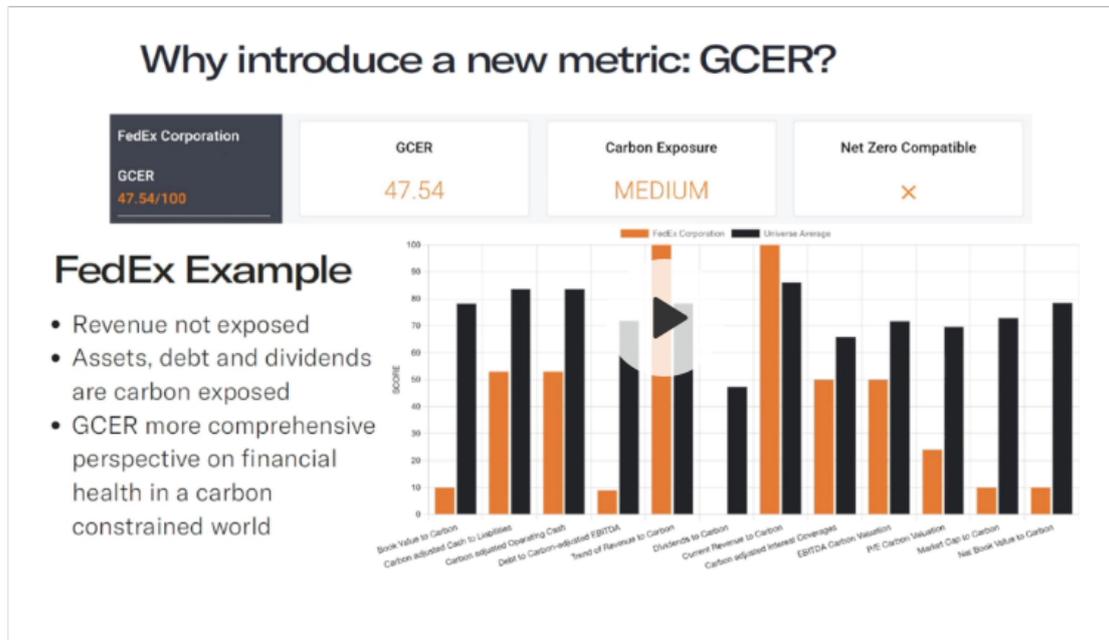
- Need model **change in demand** (top line revenue effect)
 - Not just for energy sectors
 - CC is likely to affect demand of all sectors
- Carbon intensity used so far
 - TCFD recommends Carbon Intensity
 - Revenue or total assets in denominator
 - Has limitations - low margin business (denominator is inflated) e.g. FedEx has low carbon intensity
- EU Technical Expert Group (TEG) on Sustainable Finance recommends EVIC (enterprise value, including cash) as denominator
 - Financed emission
- EMMI Global Carbon Efficiency Rating (GCER)
 - Emission relative to 12 financial metrics (across value, leverage and liquidity)
 - Current and forward looking (three scenarios)

Then I gave the example of a carbon liability. What carbon price do you use when you're doing that? And that's a bottom line. So for those of you that are accountants, that's a cost, would you use actual carbon cost, do you use a social cost of carbon? But there's a lot more to transition on the bottom line. There's a top line. So there's a change of the demand that I talked about when I said there's going to be winners and losers, right?

And most of the IPCC scenarios that we used in our climate stress testing give us changes of demand, but for the energy sector only, so we need to know how demand is going to change for other sectors. For instance, in New Zealand, a big question is, what's going to happen to agriculture? There's a big move towards eating less red meat. We need scenarios that incorporate changes to demand in all sectors, not just the energy sector. So, so far, as I said, there's been this focus on carbon intensity as the key measure. And TCFD recommends carbon intensity, but it also has its limitations. No measure is perfect. It can be misleading. So for instance, a low margin business. So a low margin business is one that has a lot of revenue, but very little profit. Therefore, its sales can look huge. And therefore, the denominator, the number on the bottom of the equation is huge, and it makes the intensity look lower. And if you think of a good example of that is FedEx, right? So they are low margin business, high revenues, and therefore they divide their emissions by a very big number. So relative to other higher margin businesses, it can be a bit misleading.

It's in part for this reason that the EU technical expert group has started to recommend EVIC, so 'enterprise value, including cash flows', but it too has its issues.

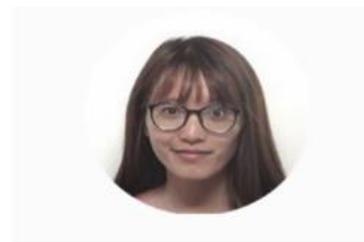
So no measure is perfect. And actually, our partners at EMMI are working on something called the global carbon efficiency rating and it actually uses 12 financial metrics across value, including revenue, leverage, and liquidity. But critically, it also looks forward, uses the current state and also uses scenarios to come up with a metric, the CGR metric.



And here's the example of FedEx, which on a carbon intensity measure, so a higher score is better, suggests that they are very good. If you look at a lot of the other metrics relative to other financial metrics that they use in their score, they are a carbon intensive firm, and their overall score is somewhere in the middle. So there are exciting firms trying to solve some of these data problems, it's early days, and as I said, our work inputs into this by providing them improved forecasts of emissions.

6. Questions & References

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I think my timing is being reasonable. I just want to say a few words. I get to speak to all of you, but really all this has been possible largely due to one individual, Dr. Quyen

Nguyen. So she's my amazing data scientist, incredible work ethic, really all the credits. To the extent that this is good, it's down to her, and to the extent that is bad, it's probably my fault. Amazing work that she's done. And really the work I've highlighted here was essentially three papers that I have been working with her. One, as I said, the simpler one didn't involve her.

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- Diaz-Rainey, I, Griffin, P.A, Lont, D, Mateo-Márquez, A.J, Zamora Ramírez, C, (2020) 'Shareholder activism on climate change: evolution, determinants and consequences', Working Paper

Also, we're doing lots of work in CEFGroup, across energy finance, carbon markets, and climate finance. Hopefully at some point in the future I can come and visit you and perhaps talk about physical risk. And actually financing, that opportunity side. I think we need more research on that side and we have a whole load of exciting working papers that that keep us very busy.

Thank you very much. I really appreciate the time that you've given to me and this opportunity to present my work.

>> Tianyin SUN: Thank you very much Ivan for the wonderful presentation. Also actually my sincere gratitude to Quyen. And I think from your talk we can see a clear logic flow from the origin of sustainable or green or climate finance to climate related risks. And then the methods and applications of these risks and finally the limitations and challenges in measuring these risks. So thank you very much. I think, all these will give the audience a very clear and very comprehensive overview of this topic. Now we enter the Q and A session. So before taking questions from the audience, I'd like to post one from myself. In New Zealand, what are the biggest risks? And what do the climate transition risks look like? Thank you.

>> Ivan DIAZ-RAINEY: So New Zealand has a very unique greenhouse gas profile. A lot of our emissions, so most OECD countries and even emerging countries, or middle income countries, the preponderance of their emissions are CO₂ emissions from energy. In New Zealand, actually around half of our emissions come from agriculture. So from methane, from agricultural greenhouse gasses. So in that sense, our profile is quite different on the transition risk. So as I sort of intimated in that chart that I showed the study on New Zealand, especially if we account for on-farm emissions, the biggest firm at risk is not an energy company which would be the case in most countries. It's actually, once we include scope three, it's our dairy, our farming multinationals.

That's transition risk. But actually, as I said, the rest of my work is on physical risk. And that project that I mentioned at the beginning, the STRAND project. That really is probably the physical risk to real estate. And we have a very concentrated banking system. We have 4 large banks that are... the ultimate owners are in Australia, and 60% of their balance sheet is domestic real estate. We live in a wonderful country, where we live very close to the coast, but that makes us very exposed to sea level rise. So I would say that's the biggest risk, it's the physical risk to our real estate and the second major risk is - also a large category in the bank's balance sheet, but much much smaller - is the loans to agriculture and in particular, intensive agriculture.

>> Tianyin SUN: Thank you, Ivan. I think that's a very interesting point, because the transition risk faced by New Zealand is a bit different compared to other countries.

>> Ivan DIAZ-RAINEY: Yeah, it highlights every country is unique, right? So you really need to understand the country to analyze the risk.

>> Tianyin SUN: But normally when people talk about transitional risk, their focal point will be on coal power plants and fossil fuel based industries, right? Following up on your response, I wonder whether there are some concrete measures taken to constrain the development of agriculture or to limit the emissions from the agriculture industry in New Zealand?

>> Ivan DIAZ-RAINEY: We have an expression in English. It's the elephant in the room. It's the thing that we haven't really addressed. Everybody knows it's a big issue. It's talked about a lot. We have an emissions trading scheme. It's probably... it was designed as the most ambitious emissions trading scheme. It was meant to be all sectors and all greenhouse gasses. It was established in 2008. And agriculture was meant to be part of it, but it's still not in it. And so there are negotiations between the government and the industry to include agriculture in it or to come up with an alternative arrangement. And if that alternative arrangement isn't reached, then agriculture will fall into the scheme. To be clear, the agricultural sector reports, so it reports its greenhouse gas emissions, but it isn't charged the emissions price. Farmers pay a carbon price for the fuel, but not for their methane and other biogenic emissions.

>> Tianyin SUN: Great. Let me check some questions from the audience. Question one is about what risk mitigation and adaptation measures have the dairy and farming sector taken in New Zealand? It's quite similar to what I just asked, but probably can somehow extend it a bit.

>> Ivan DIAZ-RAINEY: Yeah, I mean there's a lot of talk and there's a lot of work around this at the moment. As I said, there is this initiative that involves the private sector, farmers, government, that are looking at adaptation and mitigation plans. One thing that farmers can do, something that's absolutely unique about our emissions system and isn't covered by any other emission system, is that we have forest as a sink. So if you plant a forest, you can get an allowance. So there's an element of offsetting. I think there's a big variety of farming practices. As I said, most farmers farm incredibly sustainably in New Zealand. There are some intensive farmers and I think that's where the focus needs to be. I think there are strong interests that are preventing a good focus on that. But there is a focus on it. And as I said, yeah, there is this Sustainable Agriculture Finance Initiative (SAFI), and it is part of something called The Aotearoa Circle. And as part of that, they're using the EU type taxonomy, a framework, to look at adaptation and mitigation plans at farm level.

It's broadly seen as an opportunity for New Zealand. So one of the reasons I'd like to talk about this is, everybody is going to be solving the CO₂ problem from energy, and once that gets close to being solved, they're going to look at other parts of the economy, like agriculture. And I think it's a great opportunity for New Zealand. So for instance, we're doing some really interesting basic research on genetics, on food, to try and reduce emissions from cows, in particular. For instance, feeding them seaweed. I think there's some genetics. Yeah, some fascinating research. So it's a big focus.

>> Tianyin SUN: Great. Let's take another question, probably. So it's about ESG. You touched on the concerns of ESG scores. Would ESG be replaced by something else? Or would ESG providers fix the problems?

>> Ivan DIAZ-RAINEY: Yeah, that's a tough question. And there are different ESG

providers. So some of them are more black box. Some ESGs are willing to provide the component parts. I think those are more willing to be transparent and provide the component parts and dig deeper, may be alright. But within my group, as I said, we have quite a debate and I have a view - I was shocked to see the tweet by Elon Musk, because we are in 2022, and for Exxon to be in the Top 10 ESG, I think it's just greenwashing, it's incredibly misleading. and I think there's a real risk that we cause finance damage, reputational damage. I actually think that eventually, if this stuff carries on, then ESG is going to lose all credibility and even the good ESG providers, so the market for lemons, right? The ones that do it badly, affect the ones that do it well. And I think what we're going to end up with is people focusing on core issues like climate change, like biodiversity loss, like ethical supply chains.

>> Tianyin SUN: Great. Another question is about taxonomy. What is the role of green taxonomy in the context of transition risks?

>> Ivan DIAZ-RAINEY: Yeah, so I see taxonomy is on the opportunity side, on the opportunity side of transition and green finance, whereas TCFD is on the risk side. So I think they're complementary. And in particular, so if you take... taxonomy is literally just a dictionary, a green taxonomy - what counts as green, what doesn't. And there has been an incredible amount of work on that. But really to be effective, as in the case of the EU, it needs to come with regulations and it has in the EU. So firms are now going to have to start reporting what percentage of their revenues are green and not green. So that's quite a powerful tool. It's a powerful tool against greenwashing, this ESG greenwashing. And in fact, the funds under management in the EU that are classed as ESG has gone down by 2 trillion. This is because the regulations come in and, in essence, found out the greewashing. So the firms that said they were ESG funds, sustainable funds, can no longer claim it. So I think taxonomy is very important, we need them, especially to drive that positive side.

Also on the firm's side, one of the things that firms are going to have to report is CapEx. What percentage of the CapEx is green? And I think then this starts to tie in a little bit with the risk side. Because, as I said, when I was talking about carbon intensities or carbon footprints, they are backward looking. And so one of the exercises I get my students to do here in a course I have on climate and energy finance, they have to value an oil and gas firm. And one of the things they go and do is that they go and look at where these firms are putting their CapEx, how much of their CapEx is green, and it's actually very hard for them to figure this out. And so forcing firms to report relative to a taxonomy, what element of capital expenditure is green or not is a very powerful tool to be able to know if firms are really transitioning, if their net zero target means something or if it's just a statement, greenwashing.

>> Tianyin SUN: Thank you Ivan. I'd also like to share some of my personal understanding. Taxonomy probably served as a pre-screening tool, like a simple classification, but transition risk analysis really provides an in-depth analysis to dig out whether - even within the same categories of companies, to identify which one is probably better than the rest or perform better than the rest, not just from an industry

categories perspective to choose the most promising.

>> Ivan DIAZ-RAINEY: Yeah, that's true. Yeah, I see that. So for first-level filter you use the taxonomy, and then within that... Yeah, absolutely. Yeah, I see the complementarity there.

>> Tianyin SUN: Another question is actually similar to my question to New Zealand and says, in Asia, where do you see the biggest transition risks?

>> Ivan DIAZ-RAINEY: Yeah, I think you intimated that when you said it's unusual to hear around New Zealand talking about agriculture. So clearly, coal. So I'm managing a special issue of Climate Policy that should come out in the next month or two. And it was focused on green finance in Asia. There are ten papers, and I think four of them are on China and China's coal assets. So clearly, coal is a big issue. It's interesting that China got so much attention. Clearly, there was nothing on India, for instance, they burn a lot of coal. So does Indonesia, and of course, Australia exports a lot of it. You get a sense that coal is really the first thing that is most exposed and we need to exit. And largely you've seen that in the western world the US banks won't go near it. Obama regulations, EPA regulations really slowly killed the coal industry there. So yeah, coal is definitely the biggest transition exposure and then gas would obviously come in the next one. And there's this complementarity, right? There has been a lot of focus on utilities, a lot of focus on oil and gas firms. But I think the car industry is particularly interesting here on transition risks. So which firms are really going to be able to transition towards EV manufacturing and which ones aren't, which ones are going to have the best models. There's a whole revolution there that I think is under analyzed.

>> Tianyin SUN: Okay. Actually, one question relating to also the mitigation or adaptation of those risks. I wonder whether you have also conducted some research regarding transition finance. It's seen as a measure to solve, certainly solve the transition problem or the challenges faced by high carbon industries. I would like to hear your thoughts on this.

>> Ivan DIAZ-RAINEY: We have a couple of projects. I did something for the Asian Development Bank Institute. It's an energy policy for ASEAN. And then following that, we did a project where we looked at the ASEAN energy utilities. It was a very simple exercise. So then we said, well, what fossil fuel assets do they have? What would it take for - how much money would they need to transition that to, say, gas and wind. And then we looked at their capital structure, and we figured out, well, what's the capital structure at the moment? And what's sort of an ideal capital structure? So how much could they borrow? How much extra could they borrow under their current capital structure? And it was a small fraction of what they need to do, right?

There's a huge amount of financing that needs to happen. And actually, what they're

going to need to do if they are going to transition is they are going to have to raise a whole lot more equity, which then they can leverage to more debt. The balance sheets, the current balance sheets only have so much room. And actually, there were huge differences by different utilities as well. So that's not quite publicly available, that paper. But that's something that I'll be working on in the next few months.

>> Tianyin SUN: Following this discussion, I think also relating to what we talked about - the taxonomy. Actually, my understanding is that the former, like the prevailing green taxonomy somehow limits the resources, the capability to support the high carbon industry to transit towards a low carbon pathway. Do you agree or how do you think about this?

>> Ivan DIAZ-RAINEY: Sorry, the taxonomy prevents the transition or encourages the transition?

>> Tianyin SUN: Prevents the transition for high carbon industry somehow. Because they target on the green industry or assets. If they talk about high carbon industry, they try to move away. That's –

>> Ivan DIAZ-RAINEY: So taxonomies, I think they are powerful tools. Clearly with the EU taxonomy, there are problems, right? So gas was included in the EU taxonomy. Nuclear is more controversial, but we don't need nuclear in New Zealand. I think you probably need nuclear in China given just the scale, right? So I can sort of understand nuclear being in, but certainly gas isn't. But absolutely, I really see taxonomy as a really important tool if it's a good taxonomy, if it hasn't been compromised by corporates lobbying. And I think it's better that we have the current EU taxonomy than we don't. And as I said, it's going to drive that opportunity, it's going to drive that financing side of things. And as I said, it's already causing the number of ESG funds who were claiming to be ESG to go down. So then people will put money into genuine ESG funds. That's a lot of capital that needs to be raised. For researchers, I implore on them. I say, look, don't just look at, you know, shares, how they're traded, this is about raising capital. If we are going to solve this problem, we are all in this together. We need to raise a lot of capital. The capital exists. We need to... there is 100 trillion of assets under management. Bank assets are of equivalent size. The problem is solvable, right? We just need to understand the barriers to make sure that capital comes.

>> Tianyin SUN: Okay, I certainly agree. Another question regarding disclosure and policy in New Zealand. We worry about New Zealand, probably because, you know, there are so many scholars we can talk to from New Zealand, maybe many from Europe. Ivan, how is the development of policy in New Zealand about disclosure? Especially the environmental and climate information disclosure and also the climate risk analysis disclosure in this regard.

>> Ivan DIAZ-RAINEY: Yeah. So New Zealand has seen an incredible transformation in 3 or 4 years. Since we've had the Ardern government in place, then they've started to move on this. And so New Zealand, the claim is that we are first to do TCFD, mandatory TCFD reporting, and that's coming. And there's a lot of work done. And to me it is a wonderful example of regulation working, right? My North American colleagues will probably die here and say that they don't like regulations, but we have this coming through – TCFD - It's a headache. It's difficult, like there's a lot of what do we mean by scenario analysis and so on. And I used to sit in conference calls or meetings around understanding climate risks with New Zealand practitioners. And I was horrified at the lack of knowledge. And then we had this regulation. And all of a sudden I go into meetings and people are talking about WACI and IMs, and all of a sudden... Do we believe disclosures? Are they right? Do they give us an answer? No, but at least firms are now thinking about it, and they are going to start disclosing it.

So, New Zealand... the first ones to really mandate disclosure were the French back in 2015, and that was even before TCFD. So in a sense, we are the first to mandate TCFD, but the French were really the leaders in this. And I think we're probably second at the moment, but other countries are moving in that direction.

So, TCFD is hugely important. And our big banks are investing heavily, talking to climate scientists, there's a lot of service providers that are helping banks understand their climate risks. My own project involves the Reserve Bank, and we have an advisory board with a lot of the banks on there as well. So yes, it is exciting and I think we are well ahead of a lot of countries in that respect.

>> Tianyin SUN: Yeah, I do agree. Thank you. From your talk, actually, I've noticed that in your stress test, you only take the carbon price into account. Actually, very often, like transitional risk analysis also takes the impact from, say, the reduced demand into account. Have you ever thought about these issues?

>> Ivan DIAZ-RAINEY: Actually no. So in the stress testing we do take into account change in demand, but only for the energy sector. The IMs explorer only had changes in demand for the energy sector. So this is a real headache, right? Because as I said, every sector is going to be impacted. And this highlights some of the data problems we have and scenario problems we have. In the analysis, we do factor in changes of demand. But then there's all these spillover effects, right? If one bank is affected, it affects the other bank, there are macroeconomic effects, right? But building that from a bottom up approach is difficult. That stuff is done quite well, very well by people like Irene Monasterolo and Stefano Battiston, these top down approaches. As I said, it's the start of this new science and new modeling approach. And at some point, the top down and bottom up will have to meet, right? But then you have models on top of models. Then you have issues there integrating these models.

>> Tianyin SUN: You mentioned Stefano's work because they somehow also introduced this second round effect. Also, as I said, from top down, the bottom up

approach, I wonder have you ever... in your study, did you take this into account?

>> Ivan DIAZ-RAINEY: No, I think for the study to be tractable as a publication, I think that's a nirvana. And to be clear, our study only looked at their syndicated loan market. So it's a subset of the balance sheet, right? And then you think about it, right? You think of the real complexity to model this really well. I know the Bank of England just came out with a report on its biannual climate stress test. I mean, you think, and that's just looking at one risk. What's the interaction between physical and transition risk and liability risk? So if you just look at one risk... There's a whole area. You have to merge the top down, the second round effects, the macroeconomic effects with high quality granular data, bottom up, and then you have to add to all these different risks. So it's a difficult task, and we're only getting started in it.

>> Tianyin SUN: Thank you very much. Let me check whether there are further questions from the audience. I guess not. If not, let me take the liberty to end this session today. With that, thank you very much Ivan for contributing to our green finance lecture and for your wonderful presentation. And also many thanks to the audience today. Our next lecture will be in 2 weeks, on the 10th of June. The lecture will be given by Professor Chen Shiyi, Fudan University professor and at the same time, he's also the Vice President of Anhui University. So we look forward to seeing you next time. Thank you. Bye bye.

>> Ivan DIAZ-RAINEY: Yeah, thank you guys.

>> Tianyin SUN: Ivan, thank you. Bye bye.

[END]

Introduction of Tsinghua PBCSF Green Finance Lectures

Nowadays, sustainable development and climate change are the mainstream of world development, in which green finance plays an irreplaceable role. There have been hot debates and discussions in China and worldwide on questions such as how to balance the relationship between environmental protection, climate change and economic development, how to effectively combine market and government efforts to achieve the Sustainable Development Goals, and is there a most efficient pathway of low-carbon transition.

Against this background, we launched the "Tsinghua PBCSF Green Finance Lectures" that are hosted by Tsinghua University PBC School of Finance (PBCSF) and organized by the Center for Green Finance Research (CGFR) of Tsinghua University National Institute of Financial Research (NIFR), with an aim to explore the future development of green finance and carbon neutrality targets. We invite domestic and international leading experts from academia, industry and government to give lectures on cutting-

edge issues such as Carbon Neutrality, green finance, ESG and climate risk, for faculty members, students at Tsinghua and also audiences beyond Tsinghua's community. This lecture series are held online on a bi-weekly basis and live broadcasted on all platforms of Tsinghua PBCSF.

Introduction of Center for Green Finance Research (CGFR) of Tsinghua NIFR

Center for Green Finance Research (CGFR) of Tsinghua University National Institute of Financial Research (NIFR) was established in 2018 and is led by Prof JU Jiandong, the Unigroup Chair Professor at Tsinghua's PBC School of Finance. As a leading green finance research platform with extensive international cooperation experience, the center is dedicated to academic and policy research, innovation, and global partnerships in sustainable finance. With China's commitment to carbon neutrality, the center strives to serve the nation's climate strategy and sustainable development worldwide. Through researching the tools and paths toward carbon neutrality, conducting environmental risks analysis and developing green finance standards, the center supports China's policymaking and advises the country's top financial institutions and corporations on green business development and strategic planning.