

THE INTERNET OF SUSTAINABILITY DATA

- How the Internet of Sustainability Data in Web 3.0 will fill the emerging global Sustainability Reporting Framework with life and create Great Business Opportunities



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EXECUTIVE SUMMARY

The Elephant in the Room

One of the root causes of environment and climate-related **challenges** is the lack of transparency and of a global standard for **tracking and exchanging sustainability data**. Many companies talk about climate change, about what “should be done”, priding themselves on their individual goals, more from a marketing perspective than from a strong awareness of how **deeply-rooted** our current **systemic failure** is.

A truly circular economy minimizes its footprint both at the level of production and consumption: Consumption requires production. Reliable **data flows across supply chains** are key. Today, companies come up with their own data, making their books as green as a painted tree, with data protection and antitrust rules making it hard for data to move around the world.

As a result, ESG is increasingly scrutinized, although regulators are now catching up rapidly and companies realize **the tide is changing**. Carbon is becoming a **leading business indicator**. Competition exists, and will continue to exist. But we need to level up the game and collaborate so we can compete as a species that will survive. This requires us to exchange more and look at the value we bring to each other. Human selfishness requires **tangible benefits**.

Why this White Paper?

Firstly, it provides a **detailed overview** of existing and upcoming regulations on ESG and climate change which will help the reader prepare for what is coming. Secondly, the Paper points at specific solutions available in Europe, the US and China and explains how companies can use existing supply chains to capture Carbon Value.

The Carbon Cake

Global **carbon markets** reached a cumulative market value of over USD 270 billion in 2022 (MSCI, 2022). Pricing schemes today cover 23% of global emissions (The Economist, 2022). In 2021, higher carbon prices resulted in a record USD 84 billion of global carbon pricing revenue, around 60% higher than in 2020, incentivizing investment toward deep decarbonization (World Bank, 2022). Global **carbon flows** illustrate both the issue and the value of decarbonizing supply chains. In 2019, as one of the major global production bases, China exported 677.3 Mt of carbon through products consumed in countries across the world.



Closing the loop between production and consumption is needed to capture Carbon Value. One could say that a global Carbon Cake is in the making: Europe and the US are upgrading supply chain due diligence requirements; China is upgrading green manufacturing and public disclosure standards via online digital platforms, accessible anywhere in the world. The loop can be closed.

How to get your part of the Carbon Cake?

No single organization can solve the regulatory and sustainability challenges alone. This White Paper illustrates initiatives that companies can join, such as **PACT**, **Catena-X** and **Estainium**, adding to a global business ecosystem in the make, built on an *Internet of Sustainability Data*.

At some stage, the question arises: Can you afford to stay behind?

Solution providers such as **Insblue** and **CircularTree** contribute significantly to this evolving **Internet of Sustainability Data in Web 3.0**. Insblue delivers the carbon emission, circularity and ESG data for Chinese supply chains. CircularTree ensures transparency, traceability and interoperability of data. Consulting organizations such as **XSC** and **Purenessity** support companies with systems integration and business model redesign.

We as authors have created this White Paper to engage with you and welcome your feedback.

INTRODUCTION

Let's talk about sustainable business transformation in a global context for a moment

So how is the transformation going? And where are we heading in terms of sustainability? When will ESG be a standardized and truly global concept? And when will businesses finally have to report metrics for People, Planet, and Profit by default on a triple P bottom line?

It is all tangled up – like a plate of spaghetti or a giant hairball. All clear? Clear as mud!

The official scientific term for this is “VUCA”, which stands for volatile, uncertain, complex and ambiguous.

At this point in history, the world is in great flux on all levels. We intend to shape a positive future while experiencing tremendous turmoil. We are witnessing a horrendous war in Ukraine, we have to deal with skyrocketing inflation, we feel the urgency to take profound climate action whilst witnessing the fragility of global supply chains and watching how we are depleting all of our natural resources. In politics, we observe dramatic shifts in geopolitics, right- and left-wing polarization, difficulties in decision-making via complex and often outdated democratic structures, and the rise of autocracies. At the same time, there are many new legal provisions and regulations in all parts of the world targeting a swift transformation to sustainable business.

Igniting Global Systems Change - the Chicken and Egg Question of Transformation

It goes without saying that all sectors are critical in the transformation towards sustainable and dignified life on planet Earth. Alongside the business sector, tech development and politics, civil society, academia, non-governmental organizations (NGOs) as well as religions and spirituality have to play their part. As for the latter, the Covid pandemic as a global existential crisis caused many people to question the status quo and where society should be going. But in which sector does systems change start? In all of them simultaneously! This is called co-emergence.

Citizens who consume must be educated on the ramifications of their consumption and adapt their behavior. Academia needs to teach and research the core fundamentals of the transition. In pursuit of the goal “to turn off the carbon and material tap”, a broad comprehension of the issues and potential solutions in society is paramount. And NGOs need to serve as powerful integrators between all sectors in order to drive consciousness development and behavioral change. Key directional questions like following a path of “de-growth” or “green growth” will have to be answered. While many papers have already been written on the latter topic, our belief is that the convergence of all sectors during the great transition will deliver the answer.

As it has been observed in systems changes before, there is no linear process, but an ongoing co-emergence of change in the various sectors followed by a convergence of the very sectors which make up the system. What the world has learned from the Covid pandemic, the current geopolitical turmoil and the climate crisis, is that large systems are much more fragile than we had thought for a very long time.

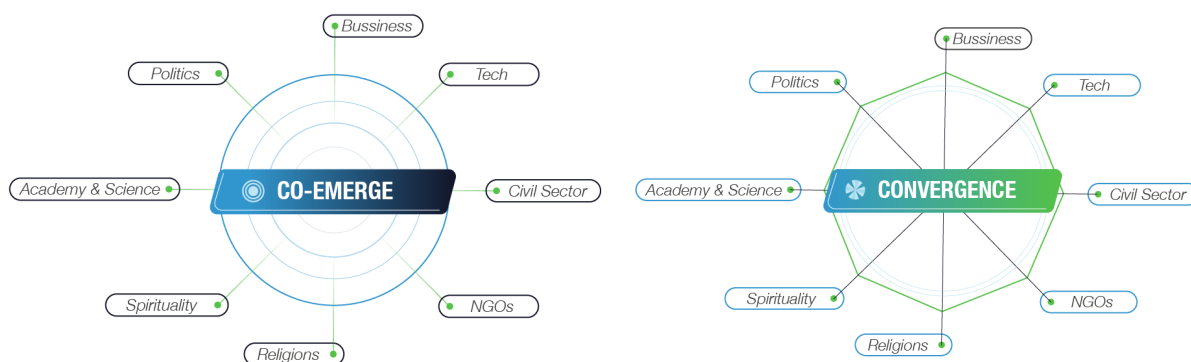


Figure 1 - Co-emergence and Convergence in Systems Change (Rob Gierke, 2022)

The Big 3 of Systems Change in Business - Carbon Emissions, Circular Economy and ESG

In the context of systems change from a business perspective, there are three prominent topics which dominate news headlines, financial community agendas and the general public debate. These heavyweight topics are:

- Carbon Emissions
- Circular Economy
- ESG (Environmental, Social, Governance)

These three topics are highly interdependent and are very often debated together. The climate crisis is visible all over the world. Today, it is a proven fact that carbon emissions are the reason for manmade global warming and climate change. The circular economy targets the use of our planet's precious resources in an attempt to eliminate or at least reduce waste by transferring material streams into closed loops. Ultimately, ESG is an approach to measure, manage and incentivize business sustainably by applying environmental (such as carbon emissions and circular economy KPIs), social (fair labor practices, human development, wellbeing) and governance (organizational setup, stakeholder orientation, decision making rules) metrics. All three topics have vast leverage. Addressing them successfully is fundamental for avoiding ecocide on our planet. They are crucial to effectively drive systems change in the business world and in global society.

This being said, it naturally leads to the following questions:

- Which new mindset does business have to adapt to drive systems change?
- Which technologies are catalysts for the transformation to sustainable business?
- What are practical approaches to “walk the talk” for the big ‘eco-centric’ turnaround?

The Climate Crisis - The Paris Climate Agreement and The Action Plans of Big Emitters

The 2015 Paris Climate Agreement represents the global consensus for climate action. As of today, we are far off meeting the 1.5 °C target by 2050. The recent COP27 shows us once again that governments wield little power in pushing for the rapid transformation we need: a further reason for companies to take more leadership. The need to act becomes ever more urgent for the survival of our species and all biodiversity. Let's take a look at the three biggest emitters from a regional point of view. Europe wants to be carbon-neutral by 2050 and cut carbon emissions by 55% by 2030, as compared to the 1990 base year. China wants to reach carbon neutrality by 2060 and has anchored a carbon emission reduction in its long-term plans as well as in its rolling 5-year plans. In the US, the Biden administration declared the goal to cut carbon emissions by 50% by 2030 as compared to 2005 levels right after its inauguration in 2021.

The global private sector, as one of the biggest emitters, has embarked on the mission to measure and reduce its emissions, although with enormous differences across industries and countries.

While many companies have started measuring and managing their Scope 1 and 2 carbon emissions, most of them are still completely in the dark when it comes to Scope 3, which includes a company's true end-to-end supply chain.

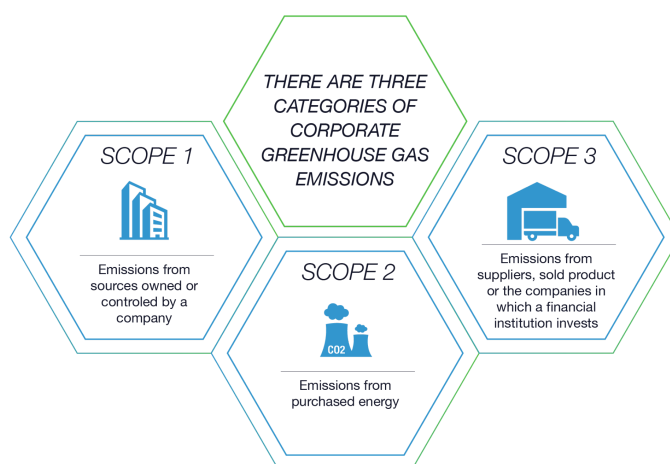


Figure 2 - Categories of corporate greenhouse gas emissions (MSCI, 2022)

Why Scope 3?

Indirect Scope 3 emissions are on average 11 times higher than operational emissions, according to the Carbon Disclosure Project.

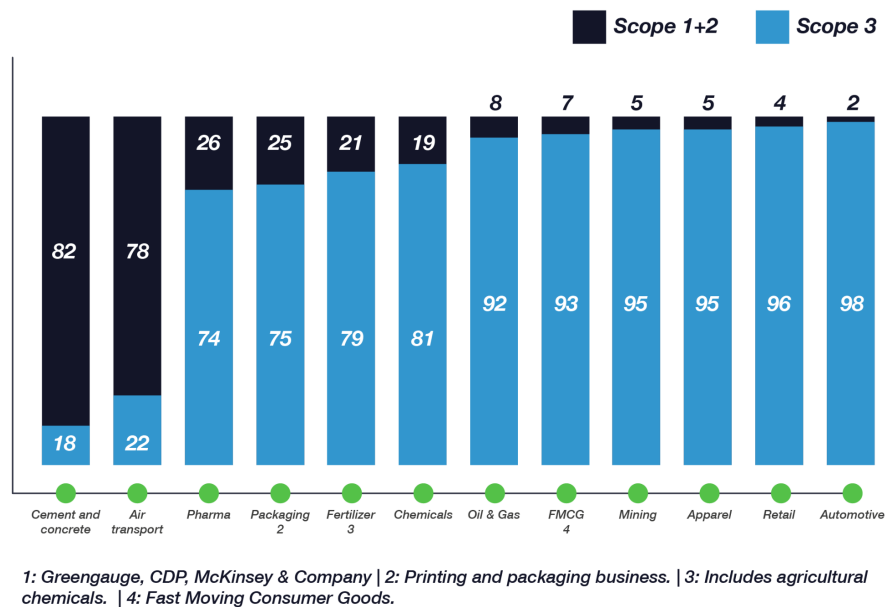


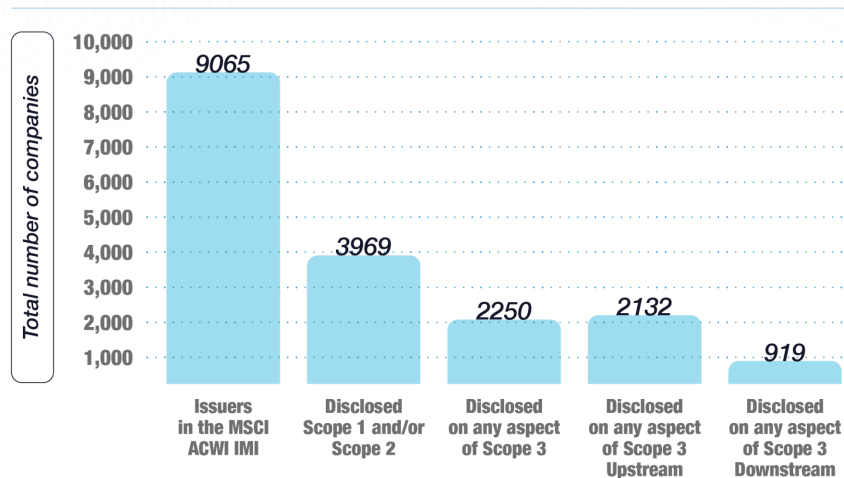
Figure 3 - Percentage of Scope 3 within industries (WBCSD, 2021)

Companies have little visibility over their Scope 3 emissions due to low levels of data collection and digitalization. According to the MSCI's Net Zero Tracker 2022, only a quarter of companies currently disclose Scope 3 emissions. Demand for such data will increase as investors need well-rounded emissions data to properly assess climate-related risks. Emissions quantification is becoming a key metric to compare and control emissions and emission trading systems (ETS) bring tangible financial benefits to the “best in class”.

Due to new legislation, all companies will also have to take on responsibility for creating transparency for the carbon footprint of their end-to-end supply chains. It comes as no big surprise that many of these supply chains begin and end in China. Hence, carbon data from Chinese suppliers and customers will be very critical for Western companies.

Barriers: Why is Scope 3 a challenge?

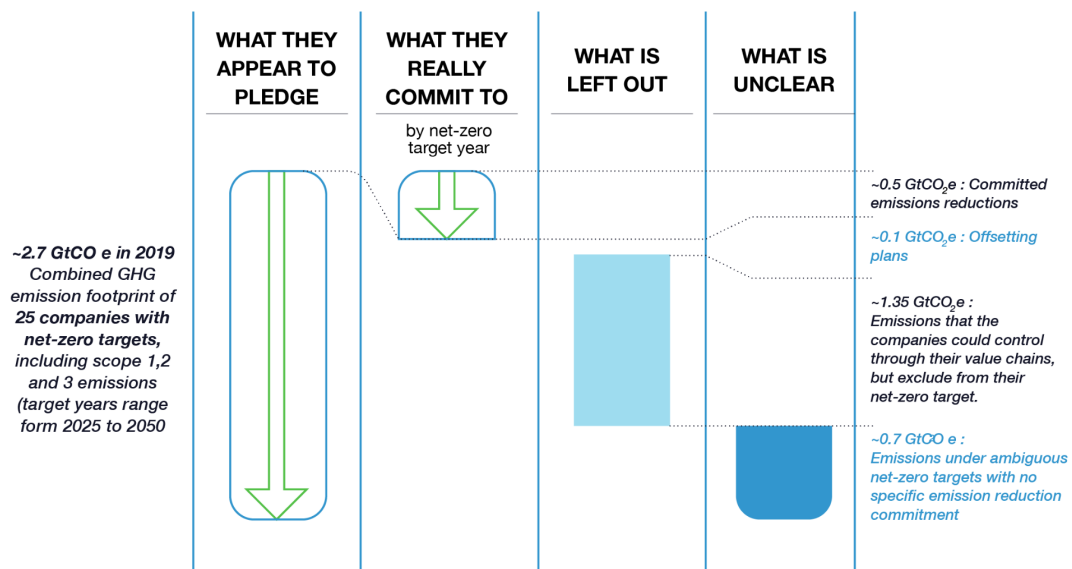
To address Scope 3 emission reductions, businesses need to tackle the most challenging part of their emissions as they occur in their value chains, which relate to the pollution from their supply chains, the use of their products by customers, or from companies in which financial institutions invest (MSCI, 2022). Companies have little visibility over their Scope 3 emissions. According to MSCI's Net Zero Tracker 2022, only a quarter of businesses are disclosing any information about Scope 3 emissions (MSCI, 2022).



Source: MSCI ESG Research, data as of Dec. 31, 2021

Figure 4 - Companies' carbon disclosure reporting (MSCI, 2022)

On the one hand, this data highlights the inconsistency in emissions reporting, and on the other hand, the need for a mandatory reporting framework of companies' complete carbon footprint across all emission scopes (MSCI, 2022). Indeed, if Scope 3 emissions are not properly reported, they may be left out of companies' net-zero commitments and targets when they actually represent the gap to be filled in order to achieve global environmental targets (Day et al., 2022).



The 25 companies assessed in this report are not necessarily a representative sample of all corporate actors with net-zero targets. They represent 25 of the largest companies in the world, accounting for approximately 5% of global GHG emissions and revenues of USD 3.2 trillion in 2020

Figure 5 - Net-zero commitments and target of 25 largest companies (Day et al., 2022)

Complex networks

The application of any reporting framework is challenging in global supply chain networks which are evolving, especially after the COVID-19 pandemic, when firms are exploring strategies to regionalize. In order to meet decarbonization targets, interconnected and complex supply chains require multi-company, -industry, -geographic zone-coordinated collaboration.

The illustration below provides an overview of global carbon flows.

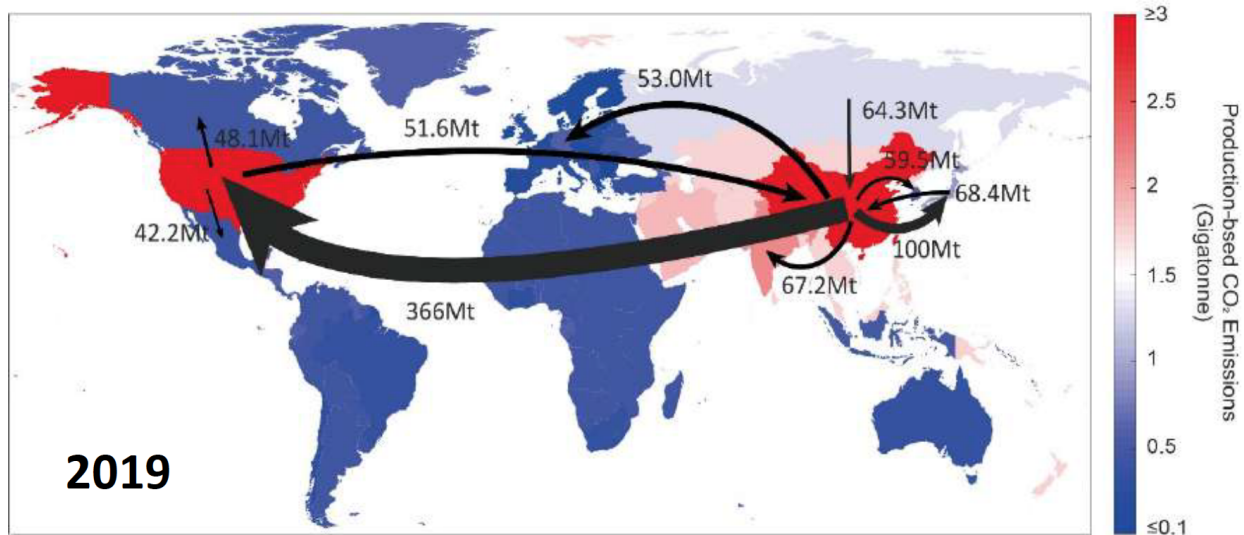
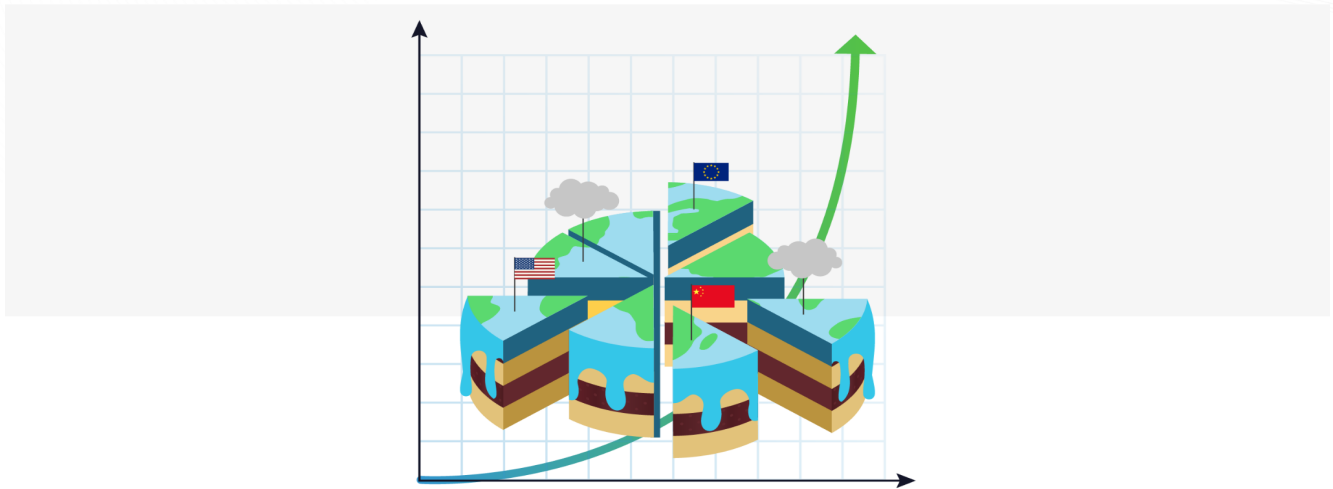


Figure 6 - Global Carbon Flows (Guan, D., 2022)

According to Dabo Guan (2022), the carbon emissions generated during the production in developing countries of products consumed in developed countries can be assimilated to a carbon emission transfer. From this perspective, embodied carbon emissions relate to international responsibility and calls for action from the consumption side of carbon emission reduction (Guan, 2022). Considering both production and consumption perspectives would help to close the loop of global decarbonization efforts.

Shifting responsibilities

As seen above, businesses often have little visibility over their supply chain (Emsol, 2020), and are wary of being held responsible for emissions over which they apparently have no direct control. However, businesses might influence their suppliers through contractual conditions (Hollinger, 2021). Despite these barriers, one of the first steps for companies is to calculate and report Scope 3 emissions. Indeed, acting upon the supply chain emissions represents a great opportunity to contribute even more toward the international climate change agreement and corporate sustainability goals (GEP, 2022). Additionally, emissions disclosure is needed by investors for the assessment of climate-related risks, for instance, financial risks generated by regulation changes. Finally, emissions quantification might facilitate their potential integration into an emission trading system (ETS).



Global carbon markets are growing fast

The global carbon market plays a significant role in the decarbonization of the global economy by putting a price on carbon and giving polluters an incentive to reduce their emissions. In total all carbon markets across the world have grown to a cumulative market value of over USD 270 billion, placing them on the radar of institutional investors as an investable asset class (MSCI, 2022). There are generally two types of carbon market: compliance carbon markets (CCM, equivalent to ETS) and voluntary carbon markets (VCM), which are very different in terms of regulation, impact and market size. While VCMs accounted for only USD 1 billion in 2021, experts predict a market size of USD 50 billion by 2030, with steep growth driven by tokenization (Kristina Thomas, 2022).

Carbon Market Type	Characteristics	Certificates	Global Market Size	Growth Potential
Compliance carbon markets (CCM) = Emission trading system (ETS)	Regulated by national or regional jurisdiction	High quality standards	USD 270 billion across appx. 30 ETS markets worldwide	Limited by ETS caps
Voluntary carbon markets (VCM)	Non-regulated/ Voluntary/ Private	Lack of quality standards	USD 1 billion across numerous markets worldwide	High growth expected

Figure 7 - Carbon market types and their attributes (Rob Gierke, 2022)

Global carbon markets are expected to accelerate in growth. Also, they are very likely to further develop in terms of comparability and interoperability. Hence, the 30+ national ETS markets and the numerous voluntary carbon markets can increasingly converge into a global carbon market.

Thinking and acting circular yet? Heard of closed material loops being the new cool?

You have probably heard about Earth Overshoot Day. This day marks the date on the calendar when humanity has used all the natural resources that Earth regenerates during a given year. In 2022, this day was on 28th July. Over the past decades, we have been using up these resources at an increasing pace, pulling the date of Earth Overshoot Day forward on a year-on-year basis. The industrialized Western world is the key driver of this resource depletion.

If you take a look at the price increases of raw materials these days, you will get dizzy. Yes, it is the old rule of supply and demand. Extracting and working with virgin materials has a large negative impact on the global carbon footprint. These are all compelling reasons which call for a swift transition to a circular economy based on circular product design and closed material loops. Tracking material flows digitally verified by the blockchain will be the key enabling technology for this urgently needed transformation. This will allow material tracking on all scales - from product passport over companies' material consumption to nation state level.

ESG - What the heck? Let's get real about it!

And there is ESG - the 800-pound gorilla! The heavy-weight topic of ESG standing for environmental, social, and governance is omnipresent and has been dominating political agendas and the financial community. Because of the changing narrative around ESG in the business world, private companies have adopted its terminology. As a matter of fact, the private sector has created a billion-dollar sustainability reporting industry over the past 20 years which so far has had little to no effect on the betterment of the planet and society. The inflationary use of ESG lingo has become especially obvious over the last five years.

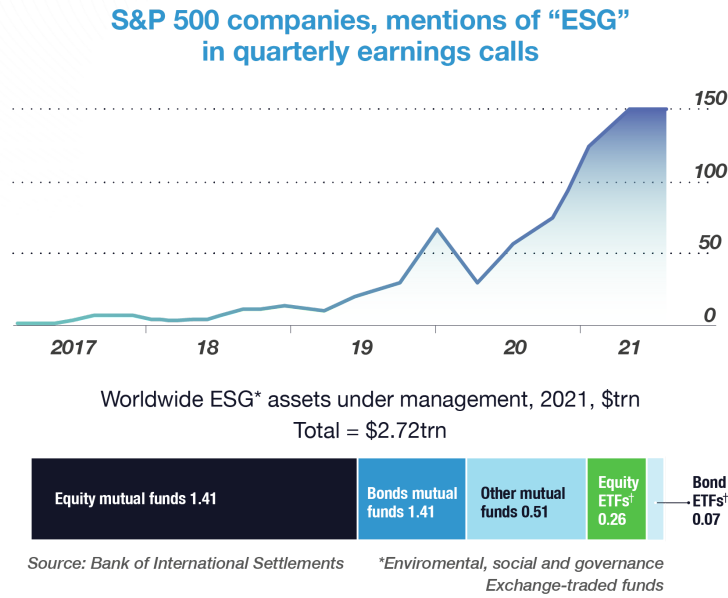


Figure 8 - Increase of ESG mentions in financial reporting (Bank for International Settlements, 2022)

But talking the talk does not automatically mean walking the walk. Far from it!

At its core, ESG calls for more people and planet metrics next to profit in business standard reporting. This is often also referred to as the “triple P-bottom line”. This broadened definition of business success goes hand in hand with balancing time horizons between the short-term (quarterly and annually) and the mid- to long-term perspectives for measuring and managing business results. This is the original intent of ESG.

Does it work today? No!

In a recent special report on ESG investing by The Economist (2022), financial expert and journalist Henry Tricks writes: “The environmental, social and governance (ESG) approach to investment is broken. It needs to be streamlined and stripped of sanctimoniousness”.

The ESG concept has become very popular and marketable in light of the world’s major challenges, especially climate change. However, ESG has so far had a negligible effect on carbon emission in the big picture, especially by the biggest polluters. The undertaking to address social issues such as forced labor, child labor, minimum wages, gender balance, employee wellbeing, and workplace diversity is cumbersome because it is hard to capture these ‘soft’ factors in the form of hard-fact metrics. Regarding the governance aspect, the ESG industry fails to hold those companies accountable which it is supposed to be stewarding.

While it makes enormous claims to investors, it places barely manageable demands on companies. And, as with social issues, there is a lack of hard fact-based metrics in the realm of corporate governance.

To illustrate the market size, assets with an ESG-tag in mutual funds and exchange-traded funds (ETFs) were almost \$2.8 trillion in March 2022 (The Economist, 2022). This is almost equal to the cryptocurrency market. Nonetheless, ESG investments are still a niche in comparison to the global portfolio investment as a whole.

Who creates the ESG ratings that asset management companies use? ESG rating agencies do this. And there are many of them! As one could read in The Economist special report, “The ESG rating agencies are the veritable acme of inconsistency. A study of six of them found that they used 709 different metrics across 64 categories. Only ten categories were common to all. Hence, ESG has a profound measurement problem: the various scoring systems have gaping inconsistencies and are easily gamed. Credit ratings have a 99% correlation across rating agencies. By contrast, ESG ratings tally little more than half the time” (The Economist, 2022). “Half the time” or, in other words, a 50% correlation of ESG agency ratings, is a far cry from cross-comparability and universal applicability. This means that companies play on different fields with different rules. What is missing today are clear global metric definitions along with non-falsifiable evaluation criteria.

The issue with ESG rating agencies is similar to the hypocrisy of carbon offset registries. In one of his shows, comedian and late-night show host John Oliver embarked on a sarcastic rant: “The problem with carbon offsets is that everyone wants to believe in them. Buyers want a cheap way to make a big claim and sellers want money for doing as little as possible. And ideally, there would be an entity in the middle charged with keeping both sides honest. And there actually is! They are called carbon offset registries. But these registries aren’t accountable to anyone. Technically, you and I could start a registry. It will not surprise you to learn that many experts say their standards are far too low”. Now for our planet Earth and humanity this is pure tragicomedy. Drawing on this analogy, you and I could open an ESG rating agency and define metrics according to our best knowledge and preferences. The commonality here is that both ESG rating agencies and carbon offset registries are not accountable to any governing body and, to a large extent, make up their own standards.

The topic of “ESG integration” has caused particular turmoil in the ESG world over the past year. Thanks to brave whistleblowers such as Ms. Desiree Fixler in the case of Deutsche Bank/DWS Group, we now know that big asset management companies around the world applied ratings from various ESG rating agencies as a risk management tool on non-ESG funds and then declared them part of their ESG portfolio. In reality, as Fixler said, “There were no tools in place

to measure it.” This points to an incredible degree of subjectivity and arbitrariness in the ESG asset management approach (The Economist, 2022). “ESG integration” might as well be translated as “ESG fudging”. In the Deutsche Bank/DWS Group case, legal investigations regarding investment fraud were initiated by the US Securities and Exchange Commission (SEC) and the German regulator BaFin.

John Gilligan, of Big Issue Invest, a USD 100 million impact fund allied to a social enterprise for the homeless, summarizes today’s ESG dilemma with the following words:

“The idea of measuring ESG is like trying to find a measurement for your favorite child”.



Scrap or reinvent ESG?

And yet, for all that has gone wrong so far, it may be better to radically redesign ESG than to throw it overboard altogether. The more regulatory pressure there is to make such information more accurate and trustable, the better for the long-term future of companies and the world we live in (The Economist, 2022).

When asked about the future of ESG, Ken Pucker of Tufts University sums it up as follows: “It will be necessary to measure less, better”. It is a sustainable business future we are looking for, but in order to create it, we need to establish a couple of universal standards and ensure data availability, quality, and trustability. Once again, there is a clear need for standardized metrics and verifiable data for the new iteration of ESG. In this context, it is new sustainable investment platforms such as Net Purpose which lead the way, by looking at true social and environmental performance of a company based on factual reporting rather than on financial risk as the current ESG rating default (TechCrunch, 2022).

The International Sustainability Standards Board's Mission

The pressure for a worldwide solution in terms of ESG definition is growing. A consortium of multinational companies, the four biggest global auditing companies, and several international associations all demand a unified global approach to ESG (Prof. Dr. Stefan Müller, Friedrich Geiger, 2022). On a global scale, the International Sustainability Standards Board (ISSB) attempts to orchestrate and standardize ESG metrics across countries and regions. Its version of the global ESG metrics set is housed within the International Financial Reporting Standards (IFRS) and referred to as the “global baseline”.

The ISSB is working with its counterparts in Europe (EFRAG), the US (SEC), China (CSRC), Japan (JCAS), and other countries to harmonize the different standards in order to create a truly global ESG metrics set. The latest launch of a holistic ESG metrics set took place in November 2022, when United Nations Research Institute (UNRISD) for Social Development introduced 61 Sustainable Development Performance Indicators (SDPIs) over two tiers, which attempt to contextualize indicator performance with respect to planetary boundaries which are defined by the natural capacities that our home planet Earth holds. As we write this paper, a reaction to the SDPIs by the ISSB is still pending.

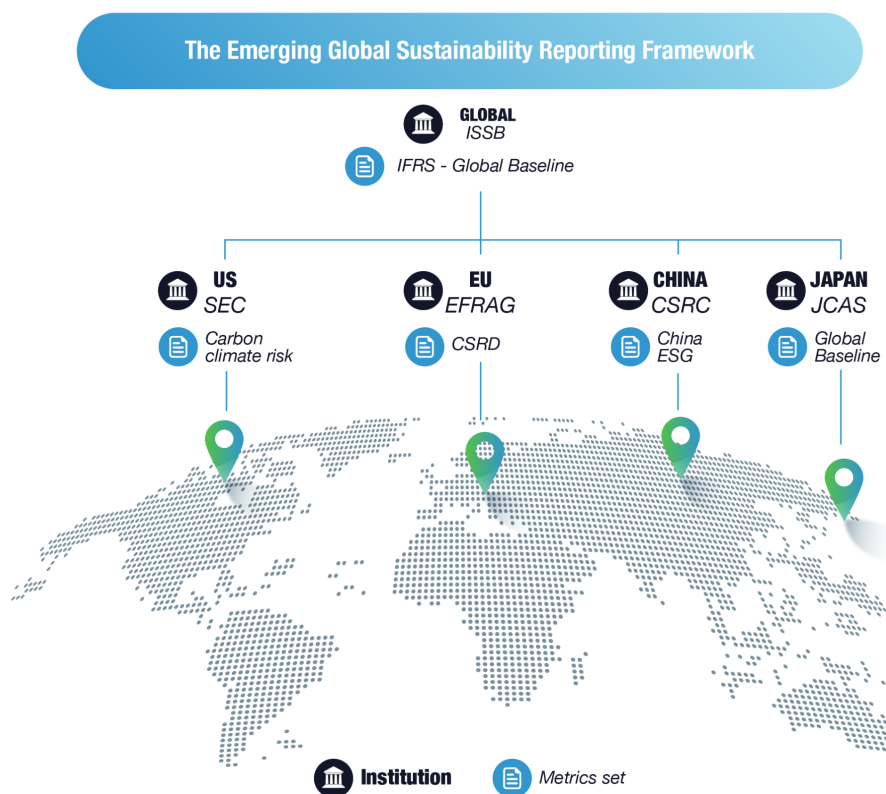


Figure 9 - The emerging global sustainability reporting framework (Rob Gierke 2022)

So which options do businesses have?

Option number one would be the “ostrich strategy”: putting your head in the sand while hoping that the company will somehow magically make it. That would be called the stoic approach to sustainability problem-solving.

We recommend option number two which is more proactive and optimistic. In essence, it is about vigilantly looking at this “plate of spaghetti” and connecting some ends in the form of synergistic megatrends. In fact, upon further and more detailed examination, these might present very lucrative transformational business opportunities.

Let’s face it and be very honest with ourselves: despite our best collective efforts, climate change will not stop overnight, supply chains will not be reorganized and shifted in the short-term, and the political environment will remain challenging for the next decade or so. In other words, we will have to live in this hot VUCA mess for a while.

When nothing is certain, anything is possible.

So, with the clear intention to move forward with the sustainable business transformation, let’s look at opportunities within the chaos and make the best of it!

EMERGING LEGISLATION & REGULATIONS

CARBON EMISSIONS, CIRCULAR ECONOMY, ESG AND SUPPLY CHAINS

This chapter will give you insights into legislation structures and latest developments.

It has subsections for the areas of carbon emissions, circular economy, ESG and supply chains, and covers the three biggest industrial regions of the world: Europe, the United States and China. If you want to delve deeply into one of these areas and regions, we suggest that you go directly to the relevant section. If legislation and regulations are not of interest to you at this stage, you may skip this chapter and continue to [Emerging Sustainability Data Ecosystems and The Internet Of Sustainability Data](#).

EUROPE

Europe - Carbon Emissions

The Green Deal for Europe was passed in 2020. In essence, it is a program established by the European Commission (EC) with the clear objective to make the European Union (EU) climate neutral by 2050. The EC agreed on a variety of proposals to enable the EU's climate, energy, transportation and taxation policies to reach a reduction of net greenhouse gas emissions of at least 55% by 2030 compared to 1990 levels.

The three main tenets of the European Green Deal are as follows:

1. No net emissions of greenhouse gases by 2050
2. Economic growth decoupled from resource use
3. No person and no place left behind.

While the first tenet summarizes the overall goal, the second tenet clearly speaks about the transition towards a circular economy (CE). The third tenet encompasses social responsibility during the transition period.

The EC lists the following eight sectors as the main action drivers to bring the European Green Deal to life:

- Climate
- Energy
- Agriculture
- Industry
- Environment and oceans
- Transport
- Finance and regional development
- Research and innovation.

Within this context, it is planned to review each existing law in these eight sectors on its climate merits and to introduce new legislation on the circular economy, building renovation, biodiversity, farming and innovation.

As part of the European Green Deal, the Corporate Sustainability Reporting Directive (CSRD) is the new EU legislation requiring all large companies to publish regular reports on their environmental and social impact activities. These large companies need to meet two out of three criteria: 1) >250 employees 2) 40 million Euros in turnover 3) 20 million Euros in assets).

With the CSRD, the European Commission defines a common reporting framework for non-financial data for the first time. It was communicated in June 2022 and will take effect starting with the 2023 reporting period. In terms of coverage, CSRD will include GHG protocol Scopes 1, 2 and 3. As a result of the CSRD, many new digital tools and consulting offers (Climate Partner, Plan A, Cozero etc.) have popped up to support companies with these new reporting requirements.

Europe's emission trading system (ETS) was launched in 2005. It is a market-based cap-and-trade system applied to large power stations, industrial plants and flights within Europe (Norris, 2022).

The European Climate Pact and the New European Bauhaus are sub-initiatives within the overarching European Green Deal. The European Climate Pact helps communities share and implement measures to combat climate change. Furthermore, the New European Bauhaus aims to bring a cultural and creative dimension to the European Green Deal.

One third of the 1.8 trillion Euro investments from the Next Generation EU Recovery Plan, hence a total of 0.6 trillion Euro is dedicated to the European Green Deal. In addition, there is a separate seven-year EU budget specifically for the European Green Deal. These are the two main sources of funding for this epic endeavor. This being said, there are ample funding possibilities in the forms of grants and interest-free loans to spur innovation and accelerate the transition to a carbon-neutral Europe. Of course, impact criteria in the form of clearly defined environmental metrics will play a key role in the distribution of these financial incentives.

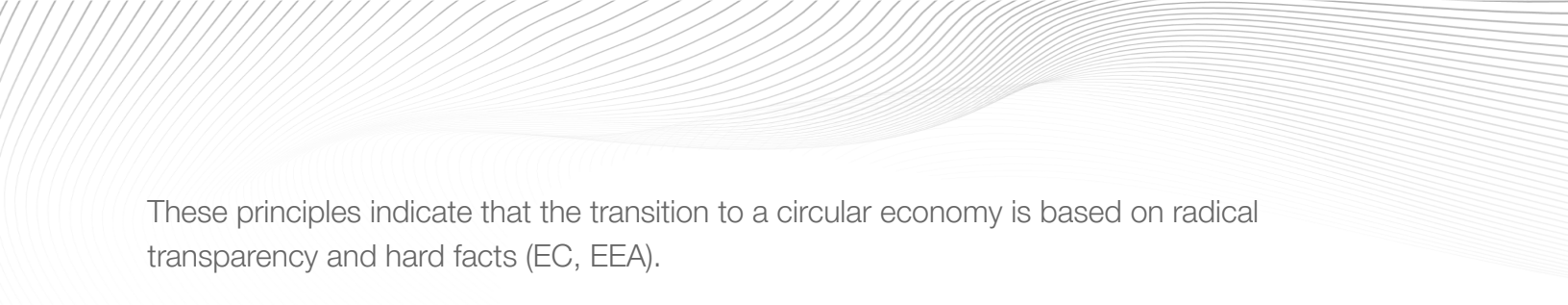
In conclusion, the European Green Deal will affect EU companies significantly via reporting requirements, sanctions and incentives. They will need to prepare for new regulations which have a direct or indirect impact on their carbon emissions. The financial “carrot” rewards good performers and sustainable first movers. Laggards and non-compliant companies will face painful penalties. Obviously, many operational and environmental metrics as leading indicators, such as energy consumption, water usage, circular economy, are strongly correlated with the sum total of a company's carbon emissions. Therefore, prudent forward-looking businesses will map these carbon footprint key drivers while measuring, managing, and reporting them transparently and professionally.

Europe - Circular Economy

In March 2020, the European Commission adopted the new Circular Economy Action Plan (CEAP). It is part of the second of the three main tenets of the European Green Deal. The EU's transition to a circular economy will reduce pressure on natural resources and will create sustainable growth and jobs. It is also a key prerequisite for achieving the EU's 2050 climate neutrality target. Within the EU, the European Environment Agency (EEA) shapes the regulatory framework of the emerging circular economy. The foundation was laid through the Bellagio Declaration which was signed in December 2020 by the Heads of the environmental protection agencies of Germany, France, Slovakia, Switzerland, the Netherlands, Austria, Italy and the EEA.

The Bellagio Declaration contains seven principles:

- Monitor the circular economy transition
- Define indicator groups
- Follow indicator selection criteria
- Exploit a wide range of data and information sources
- Ensure multi-level monitoring
- Allow for measuring towards targets
- Ensure visibility and clarity.



These principles indicate that the transition to a circular economy is based on radical transparency and hard facts (EC, EEA).

The European Circular Economy Monitoring Framework is comprised of four areas:

- Production and consumption
- Waste management
- Secondary raw materials
- Competitiveness and innovation.

Aspects related to maintaining the value of products and materials for longer, such as design for circularity, repair, reuse, and circular consumption are not yet included. However, there are plans to rapidly develop indicators for all areas of the circular economy in the monitoring system to fully capture progress and inform decision-makers.

For example, these EEA indicators are already being monitored:

- Waste generation and decoupling in Europe
- Diversion of waste from landfill in Europe
- Waste recycling in Europe.

Additional indicators such as the following three are currently being developed and will be made available later in 2022:

- Material footprints in Europe
- Consumption footprints
- Circular material use rate.

What is mainly available on an aggregated national or regional level today will have to be captured at the company and product level in the future. This then allows for connecting a financial incentive and penalty structure for businesses in the form of taxation, subsidies, grants, interest-free loans, or penalty fees directly to verifiable circularity data.

Europe - ESG

The EU ESG legislation framework is built on 3 major pillars:

- Sustainable Finance Disclosure Regulation (SFDR)
- EU Taxonomy (Green Taxonomy)
- Corporate Sustainability Reporting Directive (CSRD).

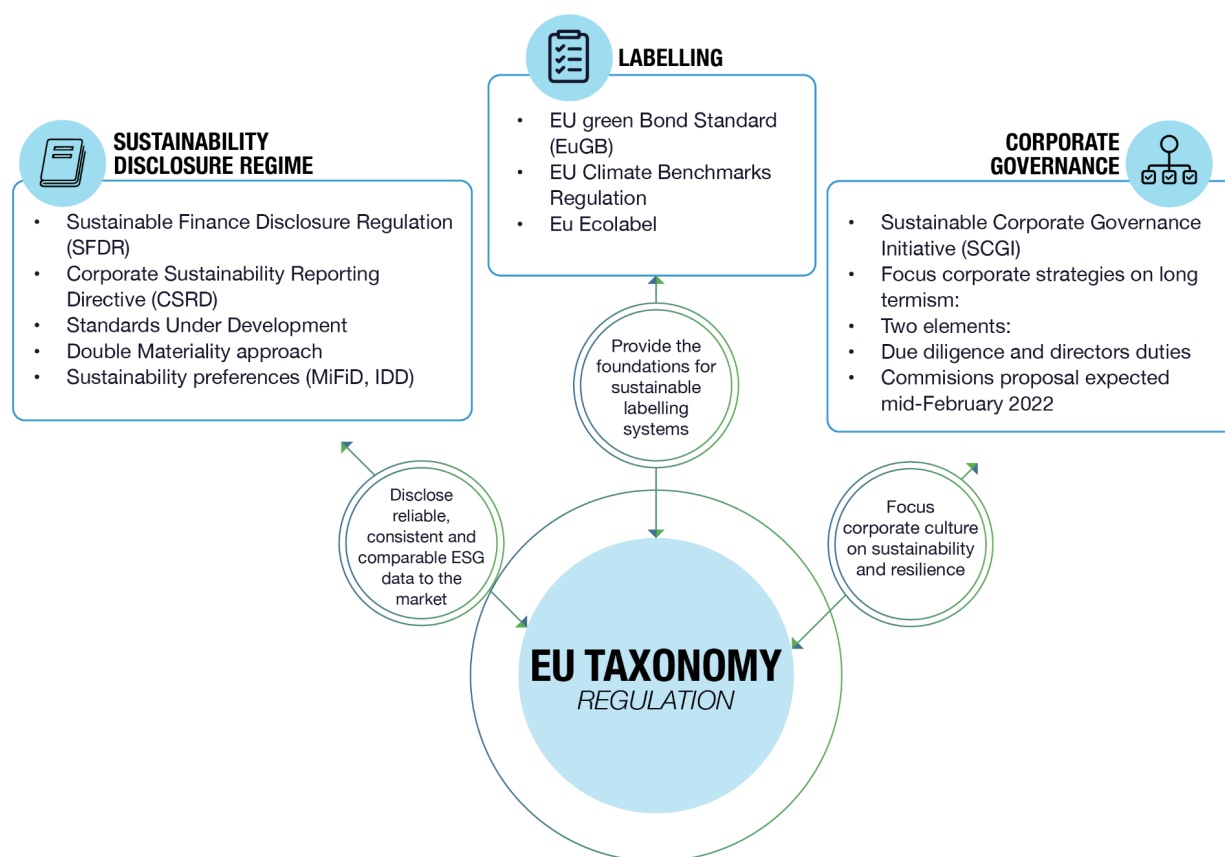


Figure 10 - The 3 pillars of EU ESG legislation (Harvard: Pettingale, de Maupéou, Reilly, 2022)

These three core legislation elements are aligned and work together in order to achieve the objectives of the European Green Deal. While the SFDR puts pressure on investors, the CSRD puts it on reporting companies with the EU Taxonomy as the connecting part (Pettingale, de Maupéou, Reilly, 2022).

HOW DOES THE EU TAXONOMY FIT WITHIN THE SUSTAINABLE FINANCE FRAMEWORK?

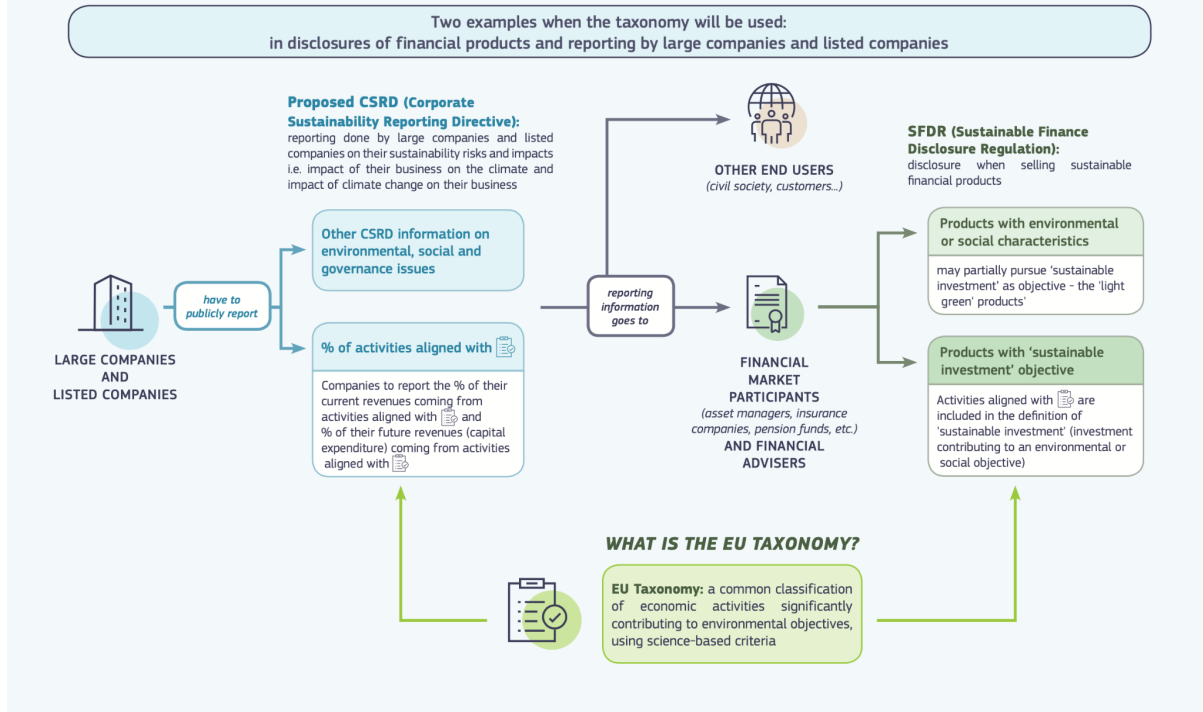


Figure 11 - EU green taxonomy and sustainability framework (European Commission, 2021)

The counterpart to the ISSB on the European level is the European Financial Reporting Advisory Group (EFRAG). In June 2022, the EFRAG presented the CSRD for European companies which sharpened the Non-Financial Reporting Directive (NFRD), launched back in 2014. The CSRD deviated widely from the ISSB's "global baseline". The differences are mainly due to two different perspectives. While the focus of the IFRS metrics is on general public financial communication to analysts and investors, the various EFRAG proposals try to capture all stakeholder perspectives. ISSB and EFRAG are currently working on the integration of the ISSB "global baseline" into the CSRD. Both parties are positive they will succeed in this undertaking as long as the integration is in line with European political objectives.

The EU's answer to the ESG's 'E' for Environment is the EU Taxonomy for Sustainable Activities, also known as the "green taxonomy". It is a classification system established to determine which investments are in line with the European Green Deal. The EU Taxonomy is science-based and determines whether an economic activity or investment can be considered environmentally sustainable. The ultimate goal of the taxonomy is to prevent greenwashing and to promote green investments through the provision of objective criteria to evaluate action on ESG and sustainability. Since sustainability is a dynamic and evolving concept, the EU Taxonomy is reviewed every three years.

Investments are rated in six categories:

- Climate change mitigation
- Climate change adaptation
- The circular economy
- Pollution prevention and control
- Protection of water and marine resources
- Biodiversity and protection of healthy ecosystems.

All EU funds with a sustainability objective have to comply with this set of regulatory reporting requirements. However, these reporting requirements are still being finalized.

In order for an economic activity to be deemed “environmentally sustainable” and thus be considered Taxonomy-aligned, it must meet the following three criteria:

- Contribute substantially to one or more of the six environmental objectives and comply with the relevant technical screening criteria
- Do no significant harm to any other environmental objective
- Comply with minimum social safeguards.

There is also an “intermediate stage” or “light green” version of taxonomy compliance by which activities can just be considered Taxonomy-eligible. In this case, a business activity only has to contribute positively to just one of the environmental objectives.

The EU Taxonomy was heavily criticized for including gas and nuclear as sustainable energy technologies. The reasons are fairly obvious: Natural gas causes significant greenhouse gas emissions. And to this day, there is no proven sustainable disposal or recycling solution for nuclear waste. To many, this was “public greenwashing” following political pressure from the two largest EU economies Germany and France.

Regarding the S in ESG, it is planned to add minimum social standards to the EU Green Taxonomy and the EU supply chain law. The CSRD metric set by EFRAG will include these measures.

There is currently also a debate around an EU Social Taxonomy. However, this discussion does not refer to the ‘S’ in ESG, but to a general classification of social services such as health and care services in order to attract more private investors to this sector.

‘G’ indicators for the government aspect of ESG are also included in the CSRD metric set in alignment within EFRAG and ISSB’s “global baseline”.

Europe - Supply Chain Regulations

The European Commission presented its proposal for a directive on corporate sustainability due diligence obligations to tackle human rights and environmental impacts across global value chains in February 2022. This new legislation aims to oblige companies to comply with the entire end-to-end global value chain. This EU directive goes far beyond the existing legislation at national levels within the various EU member states. It requires EU companies to audit their suppliers along the entire global supply chain. This applies to both all direct and all indirect business relationships of a company.

The EU supply chain law applies to European companies and organizations incorporated in other countries which are operating in the EU with a minimum of 500 employees and an annual minimum turnover of 150 million Euros. Following these criteria, this affects approximately 17,000 companies Europe-wide. In addition, there are so-called high-risk sectors where the risk potential for both humans and the environment is especially high. This includes the textile and leather industries, agriculture, forestry, commercial fishing and mining. Within these high-risk sectors requirements, more stringent criteria apply. The directive must then already be met by all organizations with at least 250 employees and annual sales of 40 million Euros (EC, EFRAG). Small and medium-sized enterprises (SMEs) are not directly affected by the law. However, if they are suppliers to large companies they will be indirectly impacted.

On the flip side, this also presents a big opportunity for “first mover SMEs” because the organizations clearly positioning and preparing themselves at an early stage will benefit from competitive advantages over their rivals. It goes without saying that this requires dedication, resources, and know-how and should be looked at as a strategic investment. Therefore, it makes a lot of sense for SMEs to rely on holistic solutions that digitally map their supply chains and track and manage the performance of the required metrics.

Companies must implement the following steps to fulfill their corporate due diligence obligations along the supply chain:

- Identify actual or potential negative impacts on human rights and the environment via audits
- Take appropriate measures to prevent, mitigate and remedy negative impacts on human rights and the environment
- Due diligence policies must be integrated into company management systems
- Companies must establish a procedure for complaints and ensure accessibility for everyone along the supply chain
- Transparent handling and publishing of information on the fulfillment of a company's due diligence obligations including an annual report
- Companies are obliged to control and monitor the effectiveness of the measures taken
- If annual sales exceed 150 million euros, companies must align their internal policies with the main goal of the Paris Climate Agreement of limiting the planet's warming to 1.5 degrees Celsius

In summary, the objective of the new EU Supply Chain Law is to ensure that all European companies comply with applicable human rights and environmental protection standards in order to promote a fairer and more sustainable global economy. The law also targets making corporate governance responsible for a more just way of doing business. Once the draft is approved by the European Parliament and the European Council, all EU member states will have two years to integrate the directive into their respective national laws.

While there might still be a couple of years until the new EU Supply Chain Law lands in all member states, the proactive first movers among EU companies get a head start and begin to prepare for it now - because it is coming.

UNITED STATES

US - Carbon Emissions

The US, so far a laggard in carbon data reporting, is pushing forward. In March 2022, the Securities and Exchange Commission (SEC) proposed that all companies that are listed on US stock exchanges will have to report a series of climate risk-related information and their carbon emissions. The proposed disclosures resembled the ones of the widely accepted frameworks like the Task Force on Climate-related Financial Disclosure (TCFD) and the Greenhouse Gas (GHG) Protocol (Friedrich Geiger). The SEC proposed a phased approach to the implementation of the new disclosure regulation starting with the 2023 fiscal year for big companies showing a market capitalization of more than 700 million USD. Hence, they would have to disclose the new data in 2024 for the 2023 reporting period for the first time.

Medium-sized businesses will follow one year later with the 2024 reporting period. And finally, small businesses will follow two years later with the Fiscal Year 2025.

In the first reporting year, the carbon emissions will capture at least Scope 1 and Scope 2 for big and medium-sized companies. As of the second reporting period being 2024 and 2025 for big and medium-sized companies, respectively also Scope 3 emissions will be included. Small businesses however will be exempt from Scope 3 reporting in general. Following the new SEC rules, companies must not include carbon offsets (compensation activity like tree planting) in their carbon emission reporting.

In an attempt to solicit feedback from all stakeholders, the SEC opened the proposal for public comments until 17 June 2022. As of today, the SEC proposal is not finalized or effective yet.

In August 2022, a climate bill of USD 369 billion as part of the Inflation Reduction Act (IRA) was passed - the most significant federal investment in US climate action history. Analysts project a lowering of US emissions by 40% by 2030 compared to 2005 levels, which falls short of the initial 50% carbon reduction commitment of the Biden administration (BBC, Forbes).

Over the next months, we shall see whether the SEC succeeds with the launch of the new climate disclosure regulations and whether the climate stimulus package gets traction.

In the United States, there are two regional emission trading systems (ETS): the Regional Greenhouse Gas Initiative (RGGI) and the Western Climate Initiative (WCI). Both of these ETS markets, launched in 2008 and 2012, are cap-and-trade programs.

US - Circular Economy

The United States Environmental Protection Agency (EPA) and other federal US agencies promote a circular economy via education campaigns. However, the only legislation with respect to the circular economy is the Save Our Seas Act 2.0 which addresses the increasing quantities of plastic waste in the US and its role in ocean pollution. It presents requirements for the EPA under three titles:

- Combating marine debris
- Enhanced global engagement to combat marine debris
- Improving domestic infrastructure to prevent marine debris.

The EPA is responsible for addressing nine sections under these titles.

In the US, circularity is embraced within the sustainable materials management (SMM) approach that EPA and other federal agencies have pursued since 2009.

While the federal agency EPA is developing strategies and programs to address ocean plastic, educate on closed material loops and coordinate efforts with national and international counterparts, neither specific legal regulations and a corresponding reporting framework nor a roadmap exist for the circular economy in the US today.

US - ESG

The US has traditionally relied on voluntary, private sector-led ESG guidelines, where compliance was driven by market competition and stakeholder engagement. Since the beginning of the Biden administration, ESG has become a greater priority for policy makers. As mentioned above, the SEC has signaled commitment to mandatory climate-related disclosure rules for public companies.

Currently, there is no comprehensive regulatory ESG framework in the US. However, the ISSB and SEC are working on the integration of the “global baseline”. How much of it will be

harmonized and standardized remains to be seen. Some US companies report ESG metrics on a voluntary basis in an effort to demonstrate good corporate citizenship.

On a darker note, ESG investing is now attacked by several Republican politicians. This is a huge backlash. Florida's governor Ron DeSantis banned state pension funds from screening for ESG risks. Similarly, Texas is seeking to isolate financial firms using ESG criteria as they are considered hostile toward the fossil-fuel industry by the Republican state government. And in Arizona, Republican Senate nominee Blake Masters has characterized ESG scores as “an existential threat to America”. These statements and actions are clearly politically motivated and were heavily criticized within the US and globally. This controversy is exemplary for the political polarization and the harsh inner conflict over sustainability matters in US society.

As stated, private companies and marketplaces such as stock exchanges create their own ESG standards. In August 2021, for instance, Nasdaq made board diversity disclosure for listed companies mandatory as part of its listing standards.

On a positive note, many global organizations such as Task Force on Climate-Related Financial Disclosures (TCFD) and B Lab (parent organization of B Corp certification) originated in the US. In the absence of political frameworks and taxonomies, private companies, NGOs and movements are stepping up to promote a functional ESG approach.

US - Supply Chain Regulations

Following the global supply chain breakdowns during the Covid pandemic and in the light of the latest geopolitical tensions with China, the US mainly focuses on supply chain stability via risk management and the incentivization of domestic manufacturing. The Building Resilient Supply Chains Act from 2021 therefore aims to minimize the effects of supply chain shocks on critical industries and supply chains. Unfortunately, the US currently does not have plans to mandate supply chain transparency for environmental and social aspects via regulation. The only exception to this will be the disclosure of Scope 3 carbon emissions for large and medium-sized companies under the new SEC regulation proposal for non-financial metric reporting.

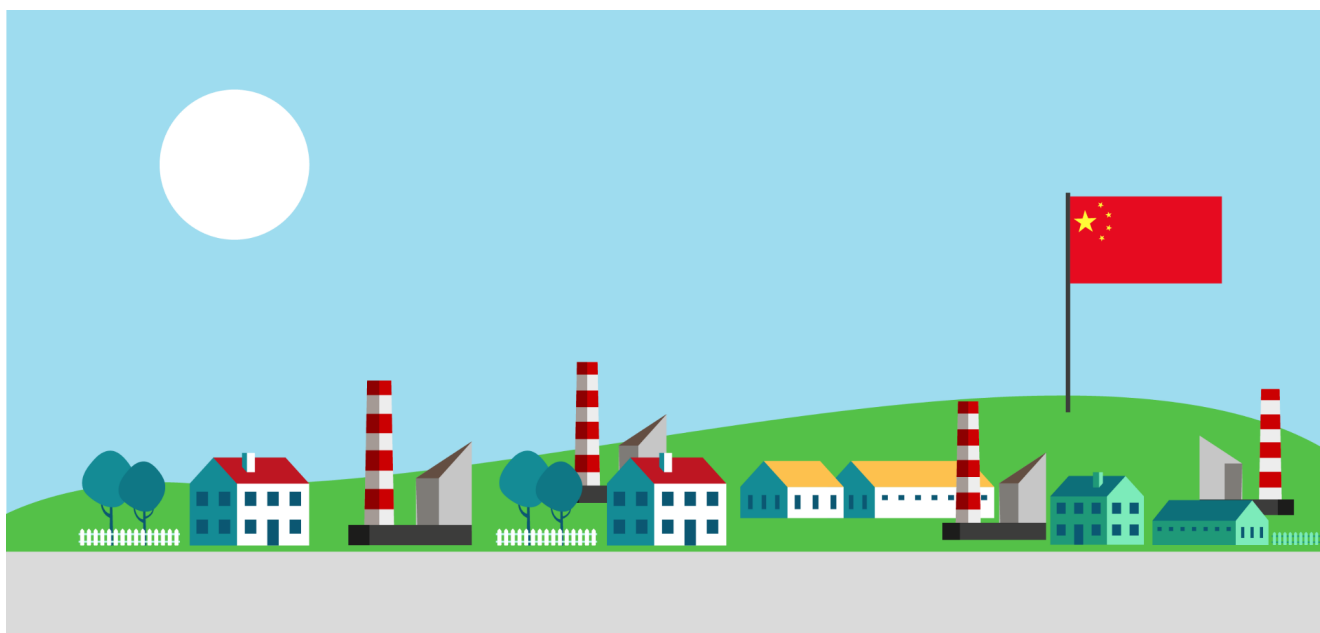
CHINA

China - Carbon Emissions

China reaffirmed its commitment towards Paris Agreement objectives (Holzmann and Grünberg, 2021) and shared the goal of reaching a CO₂ emission peak before 2030 and carbon neutrality before 2060 (Copley, 2020).

Fourteenth Five-year plan

To attain these objectives at a national level, the 14th Five-Year Plan (FYP) for National Economic and Social Development has set implementation targets. Indeed, the 14th FYP includes “Green Ecology” implementation indicators, some of which are binding targets, meaning they are Key Performance Indicators for the central government.



Category	Indicator	2020	2025	5-year average / [cumulative totals] ¹	Type of indicator
Economic development	GDP growth (%)	2.3	—	Kept within a reasonable range and annual targets will be set according to circumstances	Anticipatory
	Overall labour productivity growth (%)	2.5 ²	—	Higher than GDP growth	Anticipatory
	Urbanization rate (%)	60.6 ³	65	—	Anticipatory
Innovation-driven development	Growth in R&D expenditure (%)	—	—	> 7. Aim for a higher share in GDP than under the 13 th Five-Year Plan (2.2% of GDP)	Anticipatory
	Number of high-value patents per 10,000 people	6.3	12	—	Anticipatory
	Digital economy as a share of GDP	7.8	10	—	Anticipatory
People's well-being	Growth in disposable income per capita (%)	2.1	—	In line with GDP growth	Anticipatory
	Surveyed urban unemployment rate (%)	5.2	—	< 5.5	Anticipatory
	Average length of education received by the working-age population (years)	10.8	11.3	—	Obligatory
	Number of licensed physicians per thousand people	2.9	3.2	—	Anticipatory
	Basic pension insurance coverage (%)	91	95	—	Anticipatory
	Nurseries for infants under 3 years old per thousand people	1.8	4.5	—	Anticipatory
	Average life expectancy (years)	77.3 ³	—	[+1]	Anticipatory
Green development	Reduction in energy consumption per unit of GDP (%)	—	—	[13.5]	Obligatory
	Reduction in carbon dioxide emissions per unit of GDP (%)	—	—	[18]	Obligatory
	Days of good or excellent air quality in cities at or above prefecture level (% of the year)	87 ⁴	87.5	—	Obligatory
	Percentage of surface water with quality at or better than Grade III	83.4 ⁴	85	—	Obligatory
	Forest coverage (%)	23.2 ³	24.1	—	Obligatory
Security	Comprehensive grain production capacity (million metric tons)	—	> 650	—	Obligatory
	Comprehensive energy production capacity ⁵ (billion metric tons of coal equivalent)	—	> 4.6	—	Obligatory

Notes: 1. Figures in square brackets are five-year cumulative totals.
2. Estimate for 2020.
3. Figures for 2019.
4. The 2020 figures were significantly higher than normal years due to the COVID-19 outbreak.
5. It refers to the sum of the production capacity of coal, oil, natural gas, and non-fossil energy.

Figure 12 - 14th FYP main indicators of economic and social development during the 14th 5-Year Plan period (Liu et al., 2021 and Fung Business Intelligence, 2021)

China is accelerating the development of its legal system related to carbon peak and carbon neutrality.

Emission trading system

According to the Implementation Guideline on Carbon Neutrality for large-scale activities issued by the Ministry of Ecology and Environment in 2019, one of the paths towards carbon neutrality includes offsetting GHG emissions by purchasing carbon allowances or carbon credits (Yao, 2022).

China's carbon market consists of the Credit Emission Allowance (CEA) and the China Certified Emission Reduction (CCER).

In 2021, China launched its Emission Trading System (ETS) covering the power generation sector (Norris, 2022). It is expected that the national ETS's scope will expand to sectors such as cement and non-ferrous metals, possibly including their 2022 emissions (Luyue, 2022). China's national ETS is becoming the largest carbon market in the world in terms of covered emissions (ICAP, 2022).

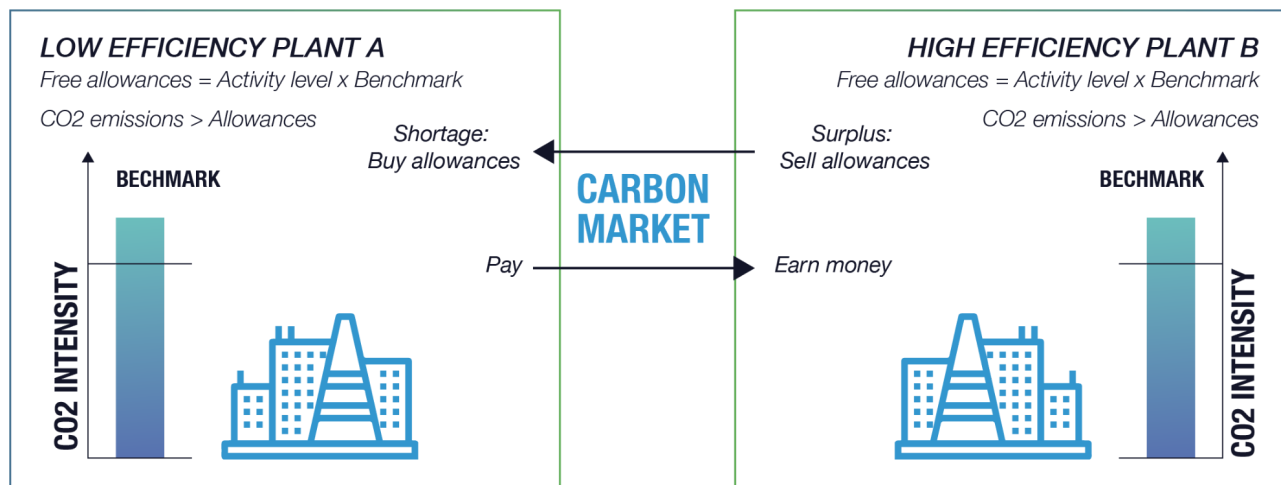


Figure 13: Allowance allocation method (adapted from Zhang D, 2022)

The ongoing scheme has no absolute cap, but a floating cap and is based on carbon intensity. Enterprises that belong to the industry, covered by the national carbon emission rights trading market and producing annual GHG emissions of up to 26,000 tonnes of CO₂ equivalent, are included in the list of key emission entities. Through the ecology and environment departments in the respective Chinese provinces, each key emission entity is allocated CEA or free emission allowances based on their electricity generation output and emission type.

For instance, for each kWh generated, key emission entities will receive a fixed amount of allowances. In other words, allowances will increase with the electricity generated. The trading stream between the entities will depend on their CO₂ intensity in relation to the benchmark (average carbon intensity).

Emissions of individual structures are compared against the benchmark of the relevant sector. High efficiency plants generating allowance surplus might sell them to the less efficient ones (Norris, 2022; Zhang, 2022), mimicking subsidy and tax schemes.

Key emission entities prepare GHG emission reports for the previous year, based on the technical specification for GHG emission accounting and reporting formulated by the Ministry of Ecology and Environment, and report to the provincial-level ecology environment department (Yao, 2022).

Based on simulations carried out with international energy agencies to evaluate the impact of this process on China's energy mix in the power sector, emissions will peak and decrease before 2030. The largest share of the emission reduction, within the next five years, will come from phasing out low efficiency coal technologies. The next contributor would be carbon capture systems.

However, the switch from fossil to non-fossil technologies under this process is very limited as it doesn't incentivize this substitution. The potential gradual introduction of ETS auctioning would further decarbonize China's power sector and increase the share of renewables.

This system would enable emission reduction through the concurrent phasing out of less efficient coal plants and capacity building for renewables, while maintaining the country's energy security.

As mentioned earlier, robust, verifiable and traceable emission quantification is the foundation for potential integration into the ETS, to avoid fraudulent practices threatening the country's emerging trading system. In fact, China's government investigation body has uncovered accounting fraud and misrepresentation (Xu, 2022). The Ministry of Ecology and Environment (MEE) discovered clusters of cases involving the falsification of CO₂ emission figures, fake coal samples used for testing, and false emissions reports. The fraudulent practices were conducted by GreenTech auditing company. Although their consulting contracts involved loss-making power utilities, the companies promised a return to profitability through carbon emission allowance trading.

MEE committed to intensify its efforts to monitor emissions and compliance reporting. Officials recognized that such practices could undermine the country's 2030 and 2060 ambitions.

The current ETS scheme in China differs greatly from those of other countries and regions, such as the EU ETS for instance, which is a market-based cap-and-trade system (Norris, 2022). Regional and global carbon market harmonization is challenging due to varying market maturity, infrastructure development and technological advancement. However, the question has been raised about how to advance on decarbonization without disadvantaging Europe economically in an open and competitive global economy. Indeed, it would for instance require that decarbonization priorities are priced into international trade practices (EC, 2018).

An alternative to harmonizing carbon markets could be the implementation of Carbon Border Adjustment Mechanism (CBAM) proposed, in July 2021, by the EC, as part of its “Fit for 55 package”. The aim of CBAM is to apply equivalent carbon costs between imported and locally produced goods to avoid carbon leakage. The latter happens when goods produced in regions with strict climate rules are substituted with imports from a region with lower carbon price, or the production of goods is moved from high ambition areas to lower ones. A tax would be applied, via CBAM, on imports based on their embedded carbon emissions (KPMG, 2021; Norris, 2022). The full implementation is expected for 2026, however some countries already show resistance arguing that CBAM violates trade principles (see Figures 2-6 above).

Mandatory environmental information disclosure

Back in 2016, Chinese authorities issued “Guiding Opinions on Building a Green Finance System”, laying a foundation for the establishment of a mandatory environmental information disclosure system for listed companies. In 2017, the China Securities Regulatory Commission and China’s Ministry of Environmental Protection signed the “Cooperation Agreement on Jointly Developing Environmental Information Disclosure of Listed Companies”. In 2018, the China Securities Regulatory Commission revised the “Listed Company Governance Code”, making companies responsible for disclosure of information on companies’ environmental governance, and China’s Asset Management Association issued the Green Investment Guide. In 2020, the People’s Bank of China issued trial guidelines for financial institutions’ environmental information disclosure.

In June 2021, the China Securities Regulatory Commission revised the format for standards in annual reports and semi-annual reports of listed companies, and China’s central government released an action plan to reach the carbon emission peak before 2030 (Zhang, 2022).

In December 2021, China’s Ministry of Ecology and Environment (MEE), released the “Measures

for the Administration of Legal Disclosure of Enterprise Environmental Information”, providing a framework to standardize and mandate corporate environmental reporting. The relative guidelines came into effect in February 2022. The companies affected by the measures are those involved with “a high environmental impact and receiving a high level of public attention” (Huld, 2022).

The yearly report covers the main environmental topics; for instance, environmental management, pollutant generation, carbon emissions and contingency planning for environmental emergencies (Choong, 2022). Carbon emissions data are a relatively new addition to the previous regulations on disclosing environmental information and include the volume of emissions and emission facilities. Major carbon emitters under the scope of carbon-trading quotas will have to disclose current and previous year’s emission data information on quota settlement (Sha, 2022).

Finally, according to these new rules, instead of being disclosed on companies’ own websites, environmental data will be gathered on dedicated platforms that are set up by the local government authorities, and will be publicly accessible (Ziying, 2022).

The new rules apply to five categories of company (MEE, 2022):

- Key pollutant-discharging entities
- Enterprises subject to mandatory clean production examination
- Listed companies and their subsidiaries that received administrative penalties for violating ecological and environmental regulations in the previous year
- Bond issuing enterprises that received administrative penalties for violating ecological and environmental regulations in the previous year
- Entities that were subject to environmental penalties.

The MME published the guidelines for the legal disclosure format of corporate environmental information, in January 2022, which came into force on February 8, 2022.

The municipal Ecological and Environment Bureau in charge of the region organizes the development of the list of enterprises for environmental information disclosure in accordance with the law within the administrative region, on an annual basis. Companies that breach the requirements could be liable for penalties (Shi, 2022). The fact that the MEE made carbon emissions a parameter for mandatory disclosure for both public and private companies is a big step towards more transparency. However, despite their importance, for instance for directing finance towards the low-carbon transition, Scope 3 emissions are absent from the existing standards (Sha, 2022).

China - Circular Economy

China's government has been promoting a circular economy (CE) and enacting supporting laws (Geng and Doberstein, 2010) since 2002. In 2008, the Circular Economy Promotion Law made the CE a national strategy of economic and social development, moving beyond the realm of an environment policy (Mathews and Tan, 2011). The 14th Five-Year plan (14FYP) promotes the implementation of CE policies (Liu et al., 2021) through the Development Plan for Circular Economy (Koty, 2021). National strategies are cascaded to regional, provincial and city levels through incentives and penalties (Mathews and Tan, 2011) with the exception of some municipalities that are under direct administration of the central government, such as Shanghai.

In July 2021, the National Development and Reform Commission released the Development Plan for the Circular Economy. The development of CE became a national priority and the Circular Economy Plan contains a number of hard numerical targets to be met by the government before the end of the 14th FYP:

- Increase resource productivity by 20% (base year 2020 levels)
- Reduce energy and water consumption per unit of GDP by respectively 13.5% and 16% (base year 2020 levels).
- Reach utilization rate of: 86% for crop stalks, 60% for bulk solid waste, 60% for construction waste
- Utilize 60 million tons of waste paper and 320 million tons of scrap steel
- Produce 20 million tons of recycled non-ferrous metals
- Increase the output value of the resource recycling industry to 5 trillion RMB.

Besides the soft and hard targets, the plan lists three key tasks to achieve CE. These tasks are largely directives for regional governments to interpret and implement according to local conditions:

- Building a resource recycling industry system and improving resource utilization efficiency
- Building a recycling system for waste materials and fostering a recycling oriented society
- Deepening the development of the agricultural circular economy and establishing circular production (Chipman Koty, 2022).

From the CE system perspective, the system level approach to transition to a CE requires fundamental and simultaneous changes (Fang et al., 2007) at macro, meso and micro scale levels of the CE system (Kirchherr et al., 2017). In this way, decision makers in China supporting CE can employ different strategies intervening at different levels.

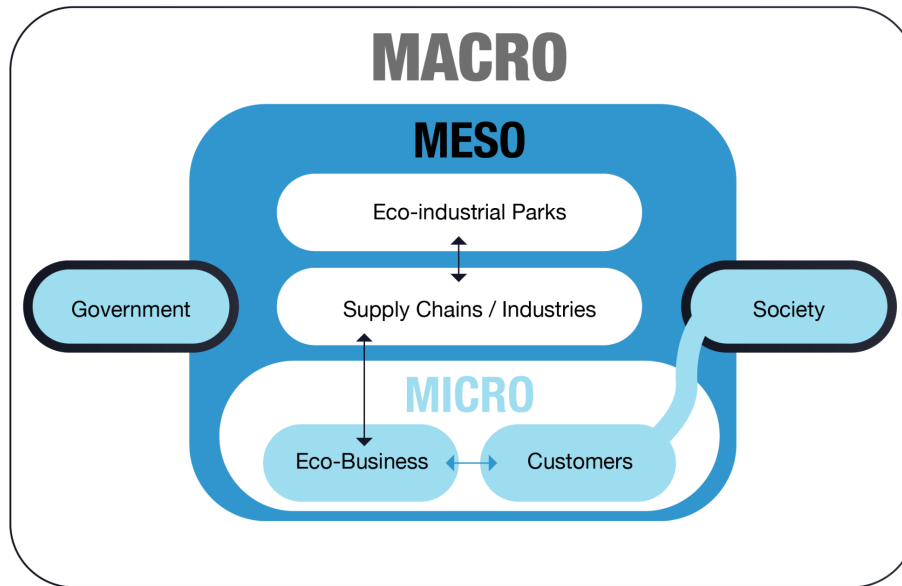


Figure 14 - Macro, Meso and Micro level representation of CE system (Neto et al., 2020)

LEVELS	CHINESE GOVERNMENTAL INTERVENTION LEVEL	CE ACTION LEVEL
MACRO	Region City	Changing fiscal and economic conditions (economic and administrative incentives and penalties) Developing eco-cities and promoting sustainable production and consumption (alignment with SDG 12) Adjusting industrial composition and structure Creating resource recycling systems (infrastructure, processes and policies)
MESO	Clusters and networks Eco-industrial parks Supply chain industries	Leveraging Industrial Ecology concept: optimisation of resource use and planification of resource efficient by-product cascades Development of eco-industrial parks (EIP) and symbiosis Development of eco-agricultural systems Promoting inclusiveness in EIP: areas for business, production, residence and scientific research Development of eco-living parks Moving to green supply and reverse logistics.
MICRO	Company Product Consumer	Applying Cleaner Production Principles (Clean Production promotion Law 2008) Putting in place corporate level initiatives: eco-design of products, manufacturing plants, waste minimization, environmental management system (EMS). Developing eco-innovation Changing production processes Changing the use and consumption of materials and products Changing customer behavior.

Figure 15 - Circular economy system levels and governmental intervention level, synthesis from literature review (Fang et al., 2007; Geng and Doberstein, 2010; Kirchherr et al., 2017; Liang, 2021; Prieto-Sandoval et al., 2017; Su, 2013; Yuan et al., 2006)

The top-down dynamics of policy instruments and initiatives (Keyou et al., 2021) triggers, at city level, a bottom-up dynamic of innovation at the three levels in order to reach the government's targets, or to take advantage of the new framework for business model innovation. For instance, enterprises need to define firm-specific indicators and implement new production processes to become compliant with governmental CE policies (Su et al., 2013).

China - ESG

Voluntary ESG reporting

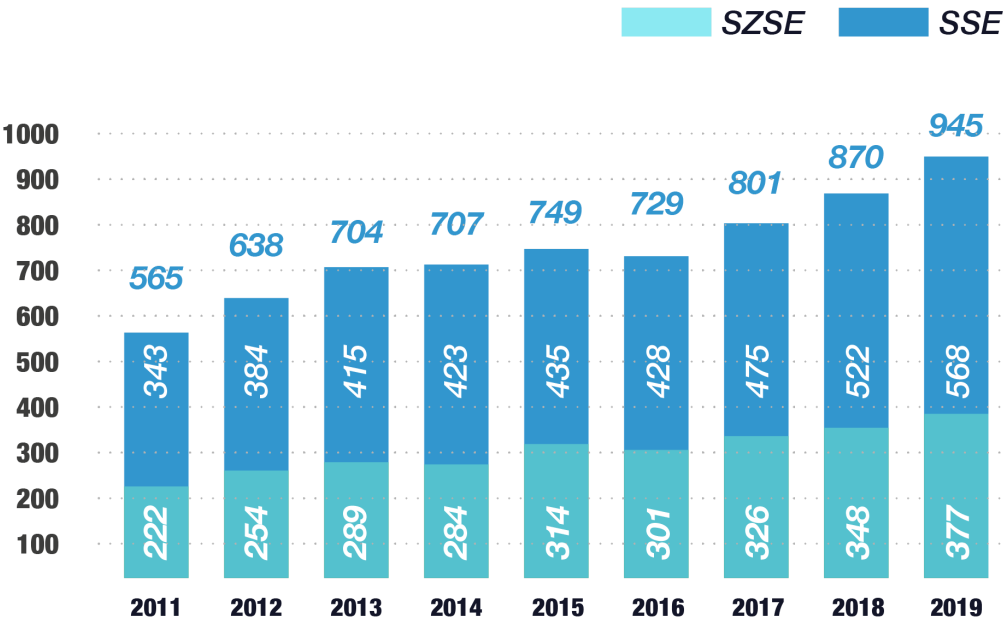
Stimulated by the opening capital market, many Chinese companies have already voluntarily started reporting information related to ESG. In 2020, more than 25% of A-share companies (companies listed in RMB on the Shenzhen and Shanghai stock exchanges) published their annual CSR/ESG reports. The challenge for ESG investment strategy and considerations resides in the availability and quality of ESG data and disclosure standards (Zhang, 2022). In June 2022, a new set of voluntary guidelines took effect for Chinese companies to report ESG related metrics published in the “Guidance for Enterprise ESG Disclosure”, the country's first disclosure standards (CERDS, 2022) in the context of a voluntary reporting program.

This program, a great example of public-private collaboration, includes standards aligned with the global benchmark of draft rules issued by the International Sustainability Standards Board and developed by China's biggest companies and government backed think tanks, led by China Enterprise Reform and Development Society, a think tank under mainland China's State-owned Assets Supervision and Administration Commission (Lee, 2022). The differences with the international standards reside, on the one hand, in a more holistic and comprehensive view of ESG in China and, on the other hand, in the absence of given methodologies for quantifiable metric measurement. The CSRC raised concerns about ISSB's positioning of its standards as a global baseline, arguing that a phased approach would be recommended for big, medium and small sized companies and taking into account local specificities. Indeed, it is mentioned that the outlined high standards, for instance Scope 3 disclosure, do not fully consider differences in economic development levels of different countries and in sustainability disclosure capability (Verney, 2022).

The ESG disclosure standards seek to fill the gap in corporate ESG disclosure reporting in mainland China through, among other guidelines, a comprehensive indicator system including 118 metrics. More specifically about the disclosure of quantitative data related to GHG emissions, the guidance does not include a metric for the disclosure of Scope 3 GHG emissions (Davies and Green, 2022).

These standards are intended to be used for the purpose of self- and third party-evaluation and cover enterprises of different types, industries and sizes; thus taking this set of standards beyond those published by the China Securities Regulatory Commission. Indeed, the latter covers only listed companies under the Securities Regulatory Commission’s supervision (Roberts et al., 2022).

The hope among investors is that such a framework will eventually become mandatory to drive change among state owned enterprises in China (Meager, 2022; Gov.cn 2022). According to Principles for Responsible Investment (PRI), the world’s leading initiative on responsible investment, China’s market is ready for stricter ESG disclosure as Chinese companies have been disclosing environmental information for years and their ability to disclose is increasing (PRI, 2020).



Source: SynTao, 2019. Statistical Analytics of CSR Reports of Listed Companies in 2019

Figure 16 - Statistical Analysis of CSR Reports of Listed Companies in 2019 (PRI, 2020)

China - Supply Chain and Green Manufacturing Regulations

Businesses with key supply chain operations in China are under pressure from increasing environmental regulations.

For a number of years, China has considered both "digital" and "green" as critical to future national competitiveness. Along with the adoption of a green credit scoring system that influences availability of finance, China has taken the concepts of digital and green further than any developed economy. With the data-informed introduction of green bonds, China is reportedly aiming at even bigger shifts in economic momentum, analogous to the country's previous impact on the development of the solar marketplace.

China's initiatives are sufficiently mature at this point that they define a "new normal" for any company with significant reliance on a supply chain in China. They potentially represent a new competitive benchmark for economic policy makers.

The position of circular economy principles as a high-level policy priority began over 15 years ago. Developing a circular economy became a national level "mission" under the National Development and Reform Commission (NDRC) in 2004. "Ecological civilization" subsequently has become a constitutional commitment at the core of many of China's policy decisions since 2007, and China's Circular Economy Promotion Law was approved in 2008.

China initiated a national drive for companies manufacturing in China to develop green supply chain management processes. The establishment of "green factories" was put forward as a strategic task in the "Made in China 2025" Program issued by China's highest-level policy making body, the State Council, in 2015. The "Industrial Green Development Plan (2016-2020)" was issued around the same time to establish a green manufacturing system by 2020.

Green supply chains are required to minimize consumption of energy and resources during production, to minimize environmental impact and to maximize reutilization. Enterprises are required to consider the ecological and environmental impacts from product design, procurement, production, sales, distribution, usage, recycling and treatments aimed at reuse. The aim is for green requirements placed on companies to be passed on both upstream and downstream. This will eventually drive companies to recycle and reuse, resulting in both economic and environmental benefits.

Furthermore, in 2019, Chinese authorities moved from a system that used inspections to push factories to comply with environmental regulations to a new system that supports and incentivizes factories to upgrade their environmental performance.

Examples include criteria for issuance of production safety licenses, approval of new projects, customs certification, government-based procurement, restrictions on financing and stock transfers, and implications with respect to environmental liability. Some mechanisms under consideration for upcoming regulations are disclosure of environmental ratings, differentiated supervision based on credit levels, and market and industry ban mechanisms.

China's Corporate Social Credit System introduced a "digital hand" to monitor, score and drive environmental performance of companies in China and can be tied to credit access. In addition, the People's Bank of China, the National Development and Reform Commission, and the China Securities Regulatory Commission published a Green Bond Endorsed Project Catalog in July 2021 to support investments in green manufacturing upgrades.

On March 22, 2020, China's State Council announced measures that aim at building a digital business ecosystem. This digital ecosystem connects state-owned and private enterprises with universities, innovation centers and service providers. The purpose of this link is to boost employment and economy while enabling a more systemic upgrade of industry by leveraging big data and artificial intelligence.

In parallel to the implementation of ecological civilization policies over the last 10 years, China has digitized environmental information and government information channels and made this information publicly available to an extent that goes beyond many Western countries. Companies and NGOs, such as Beijing based organization IPE use these channels to access and dynamically monitor, score, identify and mitigate business interruption risks and anticipate how the competitive landscape will develop.

Back in 2009, the Institute of Public and Environmental Affairs (IPE) and the Natural Resources Defense Council (NRDC), both non-profit environmental research organizations, jointly developed the Pollution Information Transparency Index (PITI). This index has, over the years, led to increasing disclosure of environmental information, originally by the authorities and later also by companies, today totaling more than 1.8 billion enterprise online emission monitoring data points (IPE 2022).

In 2021, IPE designed a Corporate Climate Action Transparency Index (CATI), upgraded in 2022, to assess both manufacturers that outsource production to suppliers and manufacturers that consume a lot of energy during production, as illustrated in Figure 17 below.

	Textile & Leather	IT & Household Appliances	Household & Personal Care	Paper & Pulp	Food & Beverage	Auto Parts	Real State	Environmet & Waste Managment	Photovoltaic	Petro Chemical	Iron & Steel	Civil Aviation	Power Generation
1													
2													
3													
4													
5													

Figure 17 - CATI Index - Top 5 www.ipe.org.cn, (IPE, 2022)

The CATI uses five dimensions: 1) corporate climate policies and mechanisms; 2) GHG measurement and disclosure; 3) carbon target settings; 4) carbon emissions reduction performance tracking; and 5) climate actions in owned operations and supply chains. The CATI is distinguished by its ability to motivate entities to push their affiliates and suppliers to measure and disclose carbon data at the facilities level.

By applying sector-specific weighting factors, CATI distinguishes between companies that rely on outside supply chains for their manufacturing and those that themselves are big energy consumers in their own direct production, allocating points differently depending on the type of company being evaluated. CATI includes indicators such as carbon intensity targets, carbon neutrality targets, carbon assets and third party verification.

CATI also benchmarks with international mainstream standards and criteria, such as the United Nations Sustainable Development Goals (SDGs), the GHG Protocol Corporate: A Corporate Accounting and Reporting Standard, the CDP Climate Change Questionnaire and the Science Based Targets initiative (SBTi). With respect to information disclosure, CATI benchmarks with reporting standards published by the Global Reporting Initiative (GRI), China Securities Regulatory Commission (CSRC) and Hong Kong Exchanges and Clearing Limited (HKEX).

In the first six months of 2022, close to 30 brands have encouraged more than 1,050 facilities in China to publicly disclose their carbon data. These facilities primarily deal with textiles and apparel and information technology (IT), with a growing carbon-intensive industry presence, such as chemicals, iron and steel.

Online digital platforms for measurement, reporting and verification (MRV) are enabling more cost-effective GHG management, and encouraging certification of operations and supply chain decarbonization. Meanwhile, advanced technology is facilitating collaboration for better MRV efficiency and accuracy.

Harnessing the latest information technologies, companies in China such as Insblue have developed digital platforms that enable companies towards more cost-effective ESG and GHG management and certified emission reductions in their operations and supply chains, as illustrated below in Figures 18 and 19.

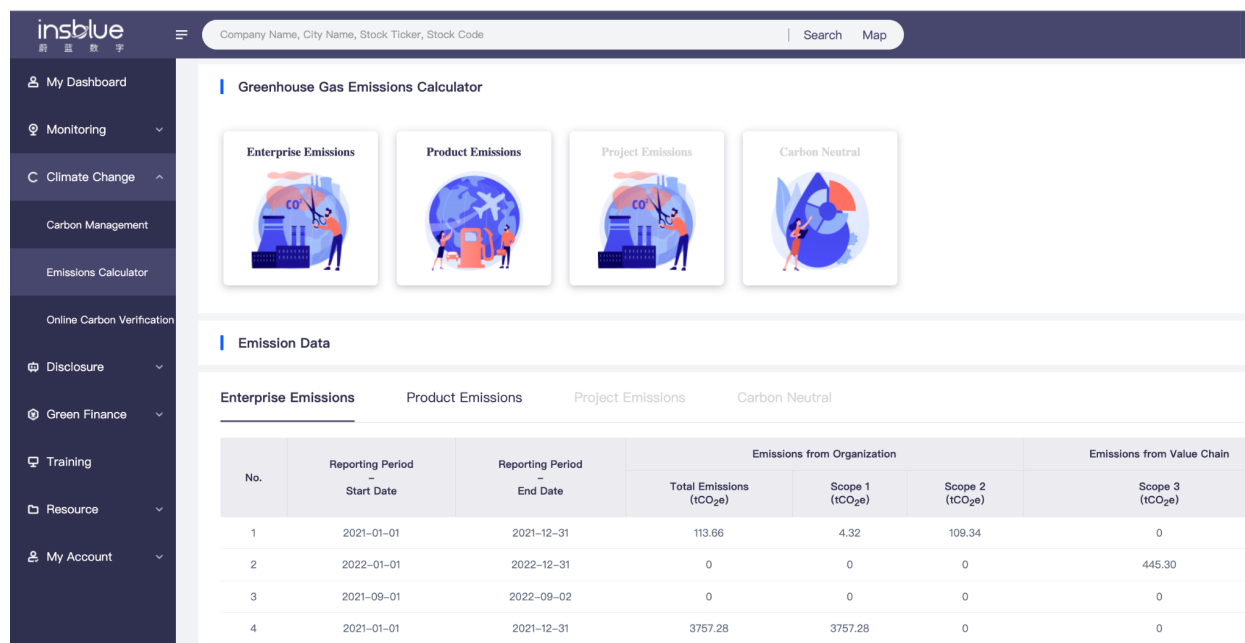


Figure 18 - The Insblue Platform supports GHG calculations at company and product level, in own operations and in suppliers. The platform also facilitates running decarbonization programs remotely, including verification and certification www.insblue.com.cn (Insblue, 2022)

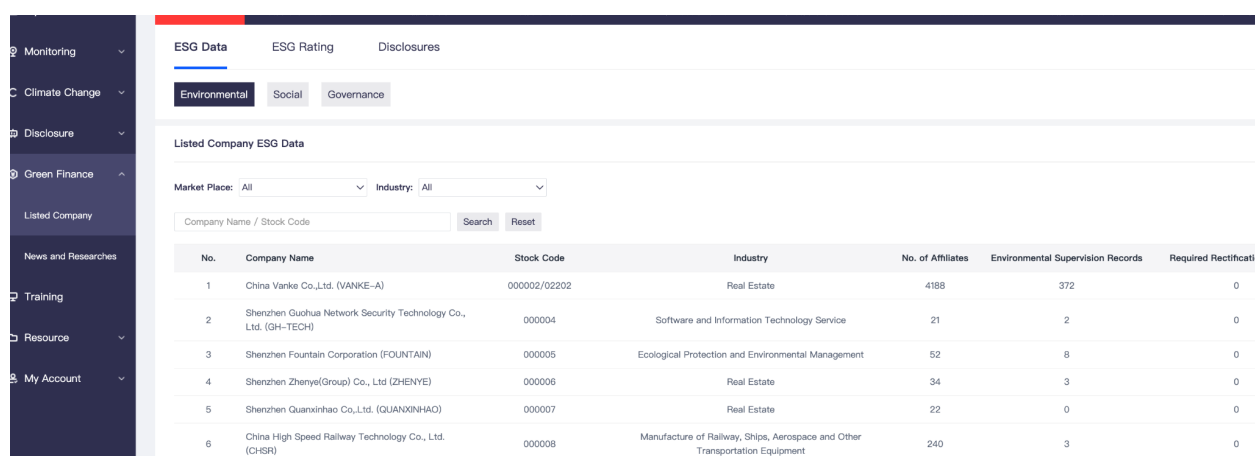
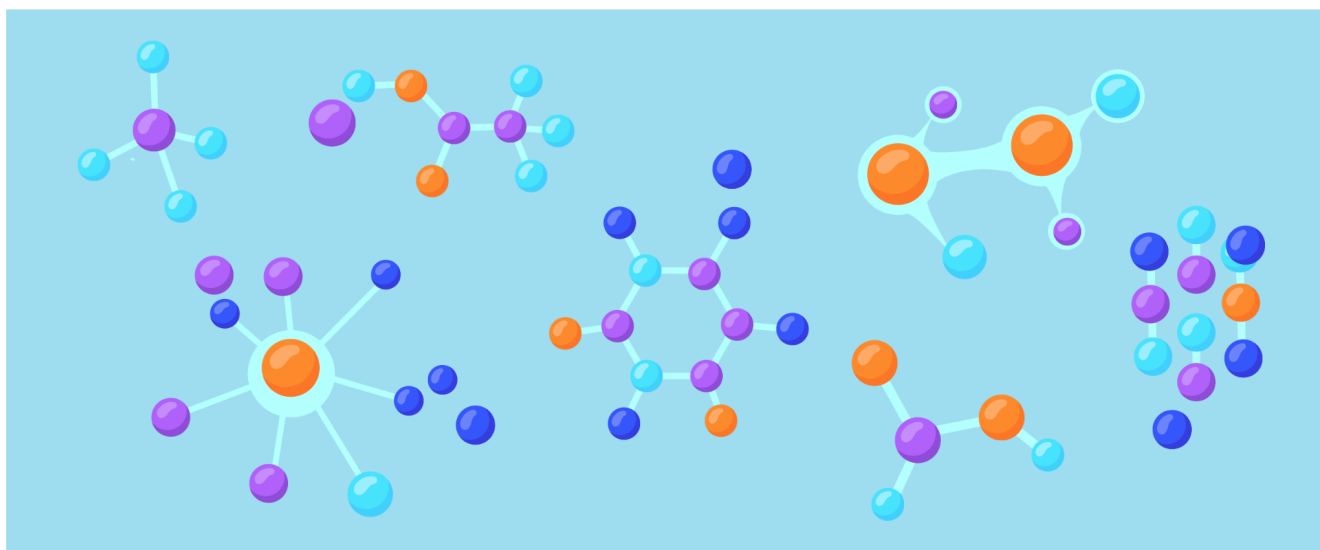


Figure 19 - The Insblue Platform supports ESG company profiling based on real-time data and to drive ESG improvement programs www.insblue.com.cn (Insblue, 2022)

EMERGING SUSTAINABILITY DATA ECOSYSTEMS AND THE INTERNET OF SUSTAINABILITY DATA

No one organization can solve the regulatory and sustainability challenges alone. One of the key issues restricting transparency and improvement in ESG performance is the lack of standardized, efficient and broadly accepted communication between supply chain actors. Powerful companies request their suppliers to communicate with proprietary customer portals, which means that customers have to adapt to the different standards and formats of each portal for every customer. Supply chain platform providers standardize the communication for companies, but they are centrally organized, proprietary and only have a limited reach.



The ideal solution would be a global, decentralized and open network for all companies where ESG data could be seamlessly shared between participants. Take the Internet as an example: You just choose a browser and you can seamlessly access everything available to you, without having to worry about interfaces and data structures. So what we would need is an Internet for sustainability data! And actually, there are a number of initiatives starting to do exactly that. Companies are joining forces to work collaboratively in various consortia, networks, and associations to achieve such solutions. Let's take a closer look at four examples: IMDS, WBCSD PACT, Catena-X and Estainium.

With the International Material Data System (IMDS), the automotive industry has played a pioneering role with regard to collaboration. With its centralized structure, it is not however meeting the new requirements for decentralized data exchange in an open network. Hence, there are some gaps in real-time data integration.

Company



Figure 20 - IMDS system architecture (IMDS, 2022)

Jointly developed by OEMs (Original Equipment Manufacturer) Audi, BMW, Daimler, Ford, Opel, Porsche, VW and Volvo, with technology partner EDS (now DXC Technology), this data reporting tool was launched to meet the requirements of the EU's End of Life Vehicles (ELV) Directive which came into force in September 2000. The Directive aimed to make the dismantling and recycling of end-of-life vehicles more environmentally friendly. Since its launch it has incorporated several new regulations, such as the EU Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulation, the US Toxic Substances Control Act (TSCA) and California Proposition 65. IMDS today is the leading automotive industry data collection and management tool. It is used by over 120,000 all-tier suppliers worldwide and sponsored by approximately 40 global automotive OEMs. In 2009, China launched its own version, CAMDS (China Automotive Material Data System), with 15 OEMs on the steering committee.

Before the EU ELV Directive, due to the lack of standard industry solutions, many OEMs developed their own tools to meet the requirements of the ever-growing body of regulations. When ELV appeared on the horizon in 1997, the above-mentioned OEMs came together to discuss how they could meet the ELV requirements. They decided to go with a centralized approach and all agreed to jointly invest in order to develop the system. However, they faced the initial challenge of getting everyone on board to put data into the system. To encourage participation, the OEMs decided to let suppliers use the system for free. Despite this fact, it took a while for the system to become widely accepted in the automotive industry.

In the beginning, many suppliers had the attitude: If you want data from me, you have to pay me. The OEMs spent a few years educating the suppliers in this respect. Now, more than 20 years later, it is safe to say that a majority of suppliers have recognized that having and utilizing this data not only helps them with external requirements, but also with their own internal processes, such as product design.

Several factors contributed to the industry-wide success of IMDS:

- Everyone involved in its development put cooperation first and cast competitiveness aside
- A challenge affecting an entire sector drove major industry players to join forces to achieve a common goal, that is, finding a way to comply with an upcoming law
- Major players agreed to one aligned process to make it easier for the supply chain
- The cost was distributed fairly between these players
- The automotive industry is very homogeneous, with a limited number of global vehicle manufacturers
- The OEMs could build on their influence and good cooperation with the global supply chain.

The World Business Council For Sustainable Development's (WBCSD) Pathfinder Initiative, launched in March 2021, and the related WBCSD-hosted Partnership for Carbon Transparency (PACT), is another collaborative initiative dedicated to enabling the wide scale exchange of sustainability-related data. Set up with an ecosystem approach, PACT brings together stakeholders from across value chains and industries, industry-focused initiatives, standard-setting organizations, leading technology companies, reporting entities and regulators to leverage synergies and to combine expertise towards a common objective: accelerate decarbonization by enabling the standardized exchange of carbon emissions data. The Pathfinder Network set up by PACT follows a solution-agnostic approach, focused on creating interoperability to ensure that all organizations and value chains can connect and have access to the primary emissions data associated with their products.

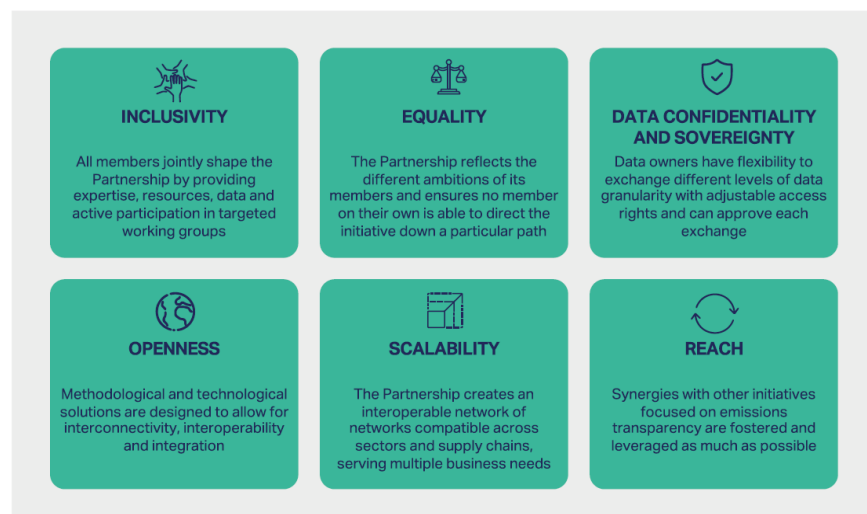


Figure 21 - Key values of the Carbon Transparency Partnership (PACT, 2021)

The outcomes are developed in a co-creative, community-focused approach driven by different stakeholders – including technology companies and start-ups such as IBM, SAP, Siemens and CircularTree as well as businesses from different industries and perspectives. PACT is also closely aligning with a range of global industry-specific initiatives, disclosure organizations, standard-setting bodies, and regulators with the intention of ensuring a joined-up ecosystem and connecting technology solutions as well as industry platforms and networks which share the PACT principles. At the COP27, PACT announced a breakthrough in value chain data exchange where seven businesses successfully operationalized standardized data exchange across different technology solutions. Amongst the companies were Aptar, BASF, Chevron, Solvay, Unilever and solution providers SAP and CircularTree.

The Catena-X Automotive Network, initiated by BMW AG, Mercedes Benz AG, Deutsche Telekom AG, Robert Bosch GmbH, SAP SE, Siemens AG and ZF Friedrichshafen AG, was founded in May 2021. The network's members come from a broad spectrum of company sizes and are active as providers and users in the automotive value chain. Catena-X strives to build a global data space that can host the automotive industry and to create the first data driven value chain incorporating all participants via interoperable and trusted solutions.

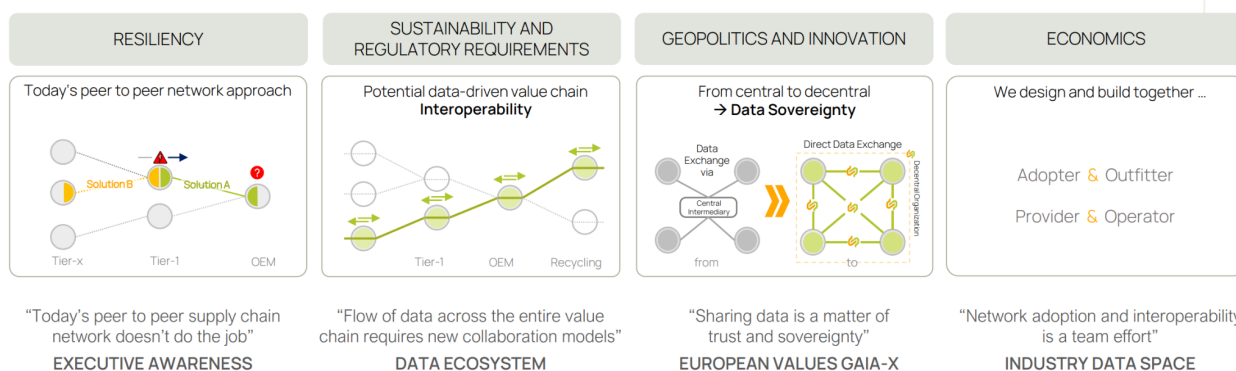


Figure 22 - Catena-X Motivation (Catena-X, 2022)

The companies involved want to increase the automotive industry's competitiveness, improve efficiency through industry-specific cooperation, and accelerate company processes through standardization and access to information and data in the automotive value chain. Among other things, this can support the monitoring of compliance with climate protection regulations.

Estainium was established in May 2022 by initiator Siemens and 14 further founding members: Merck Group, NTT Data, Weidmüller, WTS Global, ATS Automation Tooling Systems, TÜV SÜD, Bison Forest, CircularTree GmbH, ecobrain AG, Faber-Castell, Ferdinand Steinbeis Institut, Friedrich Alexander University of Erlangen Nürnberg, Sustainaccount, and the University of Technology in Sydney. It is an open, cross-organization cooperation network for exchanging

climate-relevant data via a decentralized approach with encrypted and verifiable certificates to guarantee the trustworthiness of the data and the confidentiality of the supply chain.



The term “coopetition” – a portmanteau of cooperation and competition – comes to mind in the context of these and other initiatives that bring together experts from a range of often competing organizations to develop a solution they can share in order to advance sustainability, foster transparent supply chains and new business models such as the circular economy.

For Blockhouse founder Arie Levy Cohen, “coopetition comes from the concept that we need to ensure that the planet survives so that we can all have the chance to compete with each other in whatever ways we want.” According to Levy-Cohen, we need coopetition “so that all of the best minds can come together to create a brand new economy around what actually unites people. (...) Cooperating first means that you can compete later to build the best applications on top of it” (Levy Cohen, SingularDTV, 2022). What all these coopetitive consortia, networks, and initiatives have in common is the initiators’ drive to develop and provide open, supply-chain-wide solutions for the exchange of sustainability-related data. By harnessing the power of collaboration, digitalization and data, these initiatives can contribute to accelerating the transition to a more sustainable, circular economy.

FAST EMERGING MARKETS

- CARBON, CIRCULAR ECONOMY AND ESG

The Data Opportunity in Carbon Management, the Circular Economy and ESG

Even if some carbon-belching companies can get away with polluting today, many firms and investors expect that tighter regulation of carbon emissions will eventually come, forcing them to measure their risks and ultimately adapt their business models.

Today, pricing schemes cover 23% of global emissions, about double the level of five years ago (The Economist, 2022). As a further positive signal, more countries continue to explore options to introduce a carbon price, including low- and middle-income countries. In 2021, higher carbon prices, revenue from new instruments, and increased auctioning in emissions trading systems resulted in a record USD 84 billion of global carbon pricing revenue, around 60% higher than in 2020. Such an impressive increase highlights carbon pricing's burgeoning potential to reshape incentives and investment towards deep decarbonization (World Bank, 2022).

Worldwide, 68 carbon pricing instruments (CPIs), including taxes and emissions trading systems (ETS), are currently in existence. Three more are scheduled for implementation. Cross-border approaches for carbon pricing and international cooperation are making significant strides forward - sending a clear signal that we are in the connecting and streamlining phase. And one could rightfully say that a true global carbon trading system is slowly taking off alongside the already established regional versions.

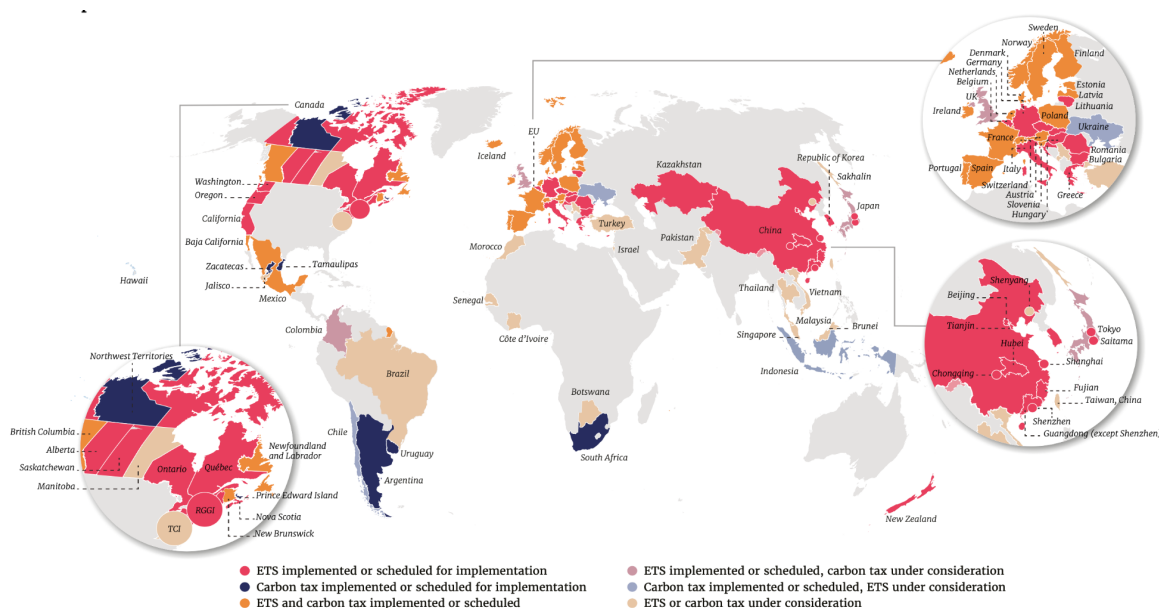
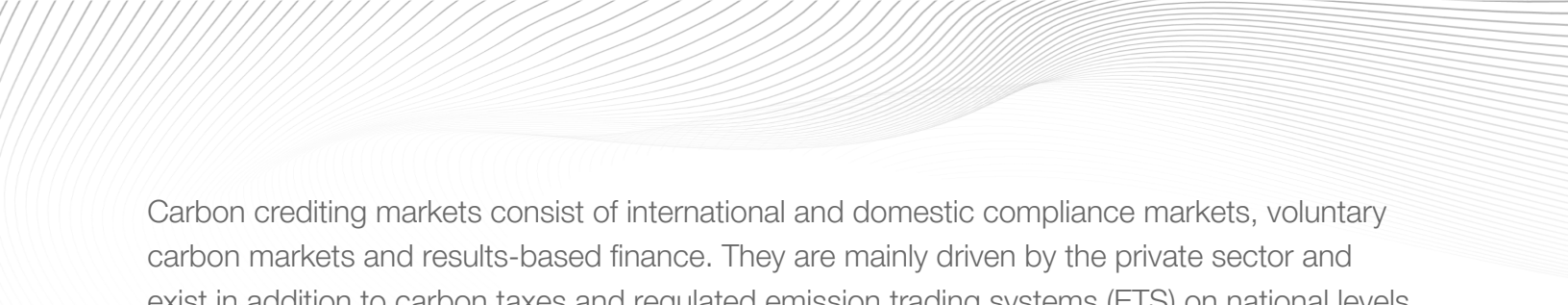


Figure 23 - Map of carbon taxes and ETs (World Bank, 2022)



Carbon crediting markets consist of international and domestic compliance markets, voluntary carbon markets and results-based finance. They are mainly driven by the private sector and exist in addition to carbon taxes and regulated emission trading systems (ETS) on national levels.

The annual voluntary carbon market value exceeded USD 1 billion for the first time, driven by corporate commitments (World Bank, 2022). Compliance and science-based standardization are key in this market. This holds true for both the carbon offset registries as well as for the voluntary carbon market itself. Therefore, the new rules for international carbon markets under Article 6 of the Paris Agreement which provide clarity need to be applied fast. Only trustability based on data accuracy and verifiability will allow this market to be an effective decarbonization tool.

While carbon emissions spearhead the sustainable business transformation due to the extreme urgency of the global climate crisis, the circular economy (CE) follows close behind. New regulations in the EU and China require data capture and transparent reporting while sustainability data ecosystems include these circular data sets. Though still at an infant stage, circular markets are also slowly but surely evolving, following the example of the global carbon market. In the CE context, the journey continues from “product as a service” all the way to “material as a service”, which presents enormous potential for circularity markets.

In respect to ESG, a major reset is needed to restore trust. The ISSB is working on a standardized “global baseline” of ESG metrics which cover double materiality - meaning the “outside-in” view (being affected by externalities) as well as the “inside-out” (affecting externalities) view. This is also referred to as double materiality. Politics has to ensure that greenwashing and social washing are a thing of the past. Again, data ecosystems already include ESG metrics and will include even more of them going forward. Along with carbon and circularity data, this will feed the emerging Internet of Sustainability Data. Ultimately, this will then allow for compliant reporting and for providing trustable, cross-comparable information to the ESG investment community. Reliable data has value.

Fintech and the Internet of Sustainability Data will be the key drivers for the accelerated growth and convergence of these fast emerging markets.

SYSTEMIC CHANGE IN BUSINESS

Opportunity through Convergence: Changing the Game

Contemplating the current pitfalls of sustainable business transformation in combination with the fast evolving global mega-trends of **tighter political regulation, a higher overall standardization level and emerging sustainability data ecosystems**, one can feel hope and **opportunity from the convergence of these three transformational key elements**.

Looking at it through a systems change lens, this development is actually following a well-known pattern that we have seen several times before in world history. This **systems change** pattern consists of **two major phases**. At the start, there is **co-emergence of many approaches** to solve the problem, both in regulation and the private sector, which leads to a myriad of different independent solutions - all featuring their own rules, metrics, and incentive and sanction systems. The second phase is the **connecting and streamlining phase**, in which the different nodes reach out to one another and adopt **one operating system under which they can all collaborate**.

A systemic change example in the realms of business comes from the reporting world. In the US of the 1920s, there was no formal way of recording and reporting business results. This led to a great lack of transparency and prevented benchmarking. As a result, many companies were hugely overvalued. In 1929, on the legendary Black Monday, stock markets around the world collapsed, leading to the Great Depression. In the aftermath of this global economic tragedy, economists and politicians jointly analyzed the causes for the stock market crash.

In response, the US administration introduced the General Accepted Accounting Principles (GAAP) in the early 1930s, based on income statement, balance sheet and cash flow statement - the key financial statements as we know them to this day. The GAAP principles in variations and adapted versions have become the global standard and allow analysts to cross-compare companies from a financial health point of view. We are at the brink of a similar systemic shift today when it comes to the standardized reporting of metrics referring to people and planet - which equates to the “environmental”, “social” and “governance” aspects in the ESG concept.

What this **systems change** example shows, is a **point in time where politics, regulatory bodies, the technological world and the business sector connected the dots on all levels to move forward with a sensible streamlined solution**.

In the sustainable **global business transformation**, we have just entered the **connecting and streamlining phase** which holds **immense opportunity for innovation and green growth**.

CONCLUSION

A new Mindset for Sustainable Business Change

*As in life, also in this case there is no simple and single solution to such a complex problem. Instead, we must **pursue several parallel paths at the same time to reach the speed we need for a drastic system change.***

Initiatives such as The European Commission's New Circular Economy Action Plan, Japan's Circular Economy Vision 2020, and China's 14th Five-Year Plan for Circular Economy Development create the political and regulatory framework. Without any doubt, combining incentives with regulatory pressure will be a strong motivator for many decision makers to try new approaches.

But external motivation is a weak basis for sustained progress towards the kind of **“coopetition”** which is necessary for the future circular economy. Regulation can work short-term for singular measures. However, on a second parallel path **decision makers will have to change their mindset on how to lead a company** in these times. Keeping and protecting your intellectual property, trade secrets and specialized know-how in your company will always be a valid interest and an important factor for entrepreneurial success. And current developments such as glocalization, accelerated innovation cycles, the breakthrough of business models such as “X-as-a-service” and of course the ultimately necessary **transformation of our economy from linear to circular requires more from leaders than just walling in their castle:** Today, it is a matter of weighing up what to keep to yourself and where to **open up to others in order to tackle the great challenges of our time together.**

This is easier said than done. Even with the best intentions to cooperate, there is still the question of the practical implementation. IT platforms as presented above are the backbone for a fast transition. We need **trusted and verified data for higher levels of automation and interoperability** between the platforms to build fluid organizational structures. If these **new “fluid multi-partner organization modes”** start thinking in a product centric way, assuming full responsibility over the product lifecycle and the associated new digital copy of their products in the form of **product passports**, we will reach a different speed of change and coopetition. **Real-time, fully sustainable product data will help all organizations to create competitive products and packaging** in shorter time frames - with the lowest environmental impact for the overall product cycle. That is what we need to move to - net zero.

Unfortunately, there is a lot of mistrust and conflict in the world. Instead, in times like these, we need to come together to solve some of the most dangerous crises humankind has ever faced – climate change and resource scarcity. Regulation is urgently needed and it will come. Again, it

will only take us so far. If the transformation to the circular economy is to succeed, **we must accept the concept of coopetition**. The good thing is that **technology is available to realize this concept easily and safely**.

The Sweet Spot is here, the Tipping Point is near

*Here is the good news: The parts are connecting - that is the sweet spot. As outlined in this paper, politics, business and technology are moving towards each other to **accelerate the sustainable business transformation**. A key tenet is “to measure less, better” (Ken Pucker, Tufts University) in standardized ways in order to **instill trust and allow for cross-comparability**. International organizations, politics and business are working on **streamlining the process**. The old adage “**What gets measured, gets done**” still holds true. The business world needs to embrace the mindset of coopetition - meaning **to collaborate on innovation while competing in the marketplace**. Only collaboration will lead to the creation of new software tools, interoperable sustainability **data ecosystems, carbon and circularity marketplaces and ultimately, the Internet of sustainability data in Web 3.0**.*

Carbon technology and solution providers that facilitate carbon reduction in this ecosystem will help reap the benefits of generating the carbon credits. These carbon reduction companies are well-placed to grow exponentially, neither limited by resources nor by financing, similar to the Uber model. Uber sells transport, engaging private drivers to use their own cars. These **new carbon companies will sell carbon reduction, engaging companies to decarbonize their operations and supply chains**.

Carbon markets turn these challenges into opportunities. Fintech and the Internet of Sustainability Data enable us to work together across regions and industries, as an ecosystem. Carbon could well become the first common denominator for us to collaborate across regions and across industries. Only Collaborative Systemic Innovation will get us, and our children, through this.

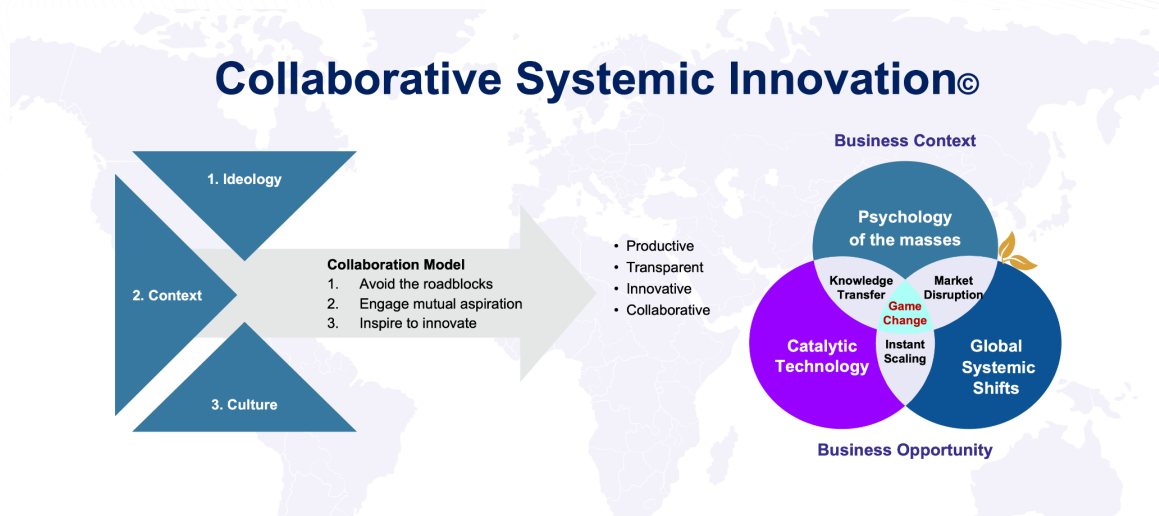


Figure 24 - Collaborative Systemic Innovation Model to Capture Business Opportunities (Johnny Browaeys, 2021)

Solution providers such as **Insblue** and **CircularTree** contribute significantly to this evolving **Internet of Sustainability Data in Web 3.0**. **Insblue** delivers the **carbon emission, circularity and ESG data for Chinese supply chains**, with China being one of the biggest single sourcing and consumer markets in the world. **CircularTree** on the other hand **ensures the transparency, traceability and interoperability of the data through its global blockchain-based approach** - enabling collaboration between companies and laying the foundation for new marketplaces. Consulting organizations such as **XSC** and **Purenessity** support companies with **systems integration and business model redesign** using the “Collaborative Systemic Innovation” framework. Not only does it help to meet new regulations and to achieve targeted certifications (i.e. B Corp, ISO standards etc.), it also enables companies to explore new innovative business opportunities, adding topline revenue to their business.

The momentum is building. The weak signals of systems change are getting clearer and stronger. The **convergence is happening** and the **tipping point is coming closer**. And it has to if we do not want to completely ruin the planet and society. There are vast opportunities in green tech and transition finance - just to mention two out of a myriad of newly evolving business fields in the broad spectrum of sustainability. **It is time to get on board now** and **seize the tremendous business opportunity** in sustainability data ecosystems, building the Internet of sustainability data in Web 3.0.

Therefore, we strongly recommend business decision makers to:

- Engage with solution providers for legal compliance
- Collaborate with solution providers for trustable ESG ratings
- Adapt a coopetition mindset
- Participate in sustainability data ecosystems for Web 3.0 to profit from opportunities
- Work with solution providers to leverage the benefits of carbon and CE markets

Opportunity through Convergence

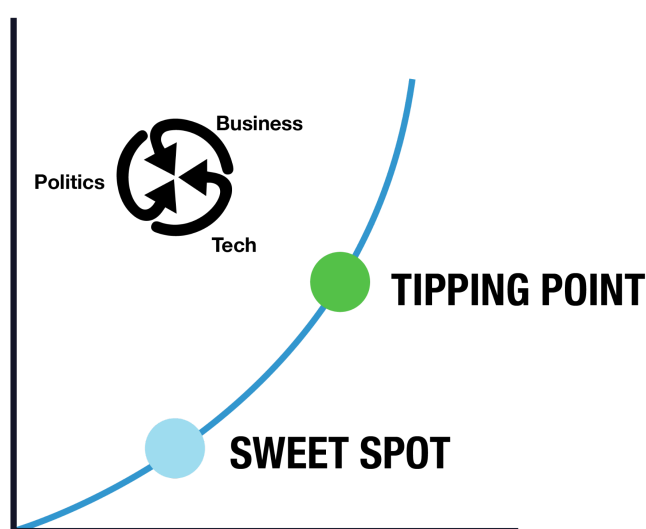


Figure 25 - Opportunity through Convergence is building at an exponential rate (Rob Gierke, 2022)

The time for sustainable business shapers and creators is now - right between the sweet spot and the tipping point!

We would like to proactively engage with the audience of this paper. Hence, if you as a reader have any comments, questions or suggestions, please contact us. Thank you in advance!

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Authors:



Johnny Browaeys

Director, International Business Insblue,
Vice Chair, European Chamber China Carbon Working Group
email: jbrowaeys@insblue.com.cn



Rob Gierke

CEO of Purenessity,
B Corp expert, Singularity University Leadership Coach
email: rob@purenessity.com



Soraya Kadra

Circular Economy Specialist,
Renewable Energy Innovative Solutions at Seeder Clean Energy
email: soraya.kadra@yahoo.fr



Gunther Walden

CEO of CircularTree
email: gunther@circulartree.com



Jörg Walden

CEO of Walden Holding, Serial Entrepreneur,
Sustainable Investor, Board Member at INATBA
email: joerg@walden-holding.de

LinkedIn: <https://www.linkedin.com/company/decarbsupplychains/>

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LIST OF ABBREVIATIONS

ABBREVIATION	FORMAL TERM	AREA / MEANING
B Corp	Benefit Corporation	Global sustainability standard and certification
BCA	Border Carbon Adjustments	Regulation to avoid the outsourcing and concealing of carbon footprint in third countries, aka carbon leakage
California Prop 65	California Proposition 65	Regulation to provide warnings about significant exposure to chemicals that cause cancer, birth defects or other reproductive harm
CAMDS	China Automotive Material Data System	Chinese Material Data System which holds recycling data for end-of-life vehicles for the Chinese market
Catena-X	Catena-X	Collaborative, open data ecosystem for the automotive industry of the future
CATI	Climate Action Transparency Index	Chinese Standard
CBAM	Carbon Border Adjustment Mechanism	European Regulation
CCER	China Certified Emission Reduction market	Voluntary greenhouse gas emission reductions recorded on the national trading registration system
CCM	Compliance carbon market	Carbon market which is regulated by national or regional jurisdiction, equivalent to ETS
CDP	Carbon Disclosure Project	Organization running global disclosure system for investors, companies, cities, states and regions to manage environmental impact
CE	Circular Economy	Sustainable business term
CEA	Credit Emission Allowance	Carbon emission allowances within the carbon emission trading system
CEAP	Circular Economy Action Plan	EU Circular Economy program
COP27	Conference of the Parties to the UN Framework Convention on Climate Change	United Nations climate change conference
CPI	Carbon Pricing Instruments	Sustainable regulation and business term
CSRC	China Securities Regulatory Commission	China Governance
CSRD	Corporate Sustainability Reporting Directive	European Regulation
DNSH	Do No Significant Harm	EU Taxonomy principle, European Regulation
DPP	Digital Product Passport	Circular Economy term
EC	European Commission	European Governance
EEA	European Environment Agency	European Governance
EFRAG	European Financial Reporting Advisory Group	European Governance

EPA	United States Environmental Protection Agency	US Governance
ESG	Environmental, Social, Governance	Global sustainable investment concept
ESTAINIUM	ESTAINIUM	Ecosystem to shape the sustainable industry of the future
ETF	Exchange-Traded Funds	Financial term
ETS	Emission Trading System	Financial term
EU	European Union	EU Governance
EU Ecolabel	European Ecolabel	European Green Label
EU ELV	EU End of Life Vehicle Directive	European Regulation to make the dismantling and recycling of end-of-life vehicles more environmentally friendly
EU Taxonomy	European Green Taxonomy	European Regulation
EUCBR	European Climate Benchmarks Regulation	European Regulation
EUGB	European Green Bond Standard	European Green Label
EUGD	European Green Deal	European Political Program
FYP	Five-Year Plan	Comprehensive policy blueprint released by China every five years to guide its overall economic and social development
GAAP	General Accepted Accounting Principles	US Accounting Standard
GHG	Greenhouse Gas Protocol	Global Sustainability Standard
HKEX	Hong Kong Exchanges and Clearing Limited	Hong Kong Stock Exchange
IFAC	International Federation of Accountants	Global Governance
IFRS	International Financial Reporting Standards	Global Reporting Standard
IMDS	International Material Data System	The automobile industry's material data system
IMF	International Monetary Fund	Global Governance
IPE	Institute of Public and Environmental Affairs	Chinese NGO
IRA	Inflation Reduction Act	US Legislation
ISSB	International Sustainability Standards Board	Global Governance
JCAS	Japanese Council for Accounting Standards	Japan Governance
MEE	Ministry of Ecology and Environment	China Governance
MRV	Measurement, Reporting, Verification	Multi-step process to measure the amount of greenhouse gas (GHG) emissions reduced by a specific mitigation activity
NFRD	Non-Financial Reporting Directive	European Regulation
NRDC	Natural Resources Defense Council	International NGO

OEM	Original Equipment Manufacturer	Organization that makes devices from component parts
PACT	Partnership for Carbon Transparency	Private initiative of stakeholders from industry, standards and regulators
PMI	Partnership for Market Implementation	Partnership for market implementation, helping countries embarking on carbon pricing to move from readiness to rollout
PRI	Principles for Responsible Investment	Global Investment Standard
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals	EU regulation regarding the production and use of chemical substances, and their potential impacts on both human health and the environment.
RGGI	Regional Greenhouse Gas Initiative	US Emission Trading System
ROHS	Restriction of Hazardous Substances Directive	EU regulation restricting the use of certain hazardous substances in electrical and electronic equipment
SBTi	Science Based Targets initiative	Global sustainability project
SCGI	Sustainable Corporate Governance Initiative	European Regulation
SDGs	Sustainable Development Goals	UN global program for sustainable development 2015-2030
SDPIs	Sustainable Development Progress Indicators	ESG Metrics consisting of a set of 61 indicators established by UNRISD to reach the SDGs
SEC	Securities and Exchange Commission	US Governance
SFDR	Sustainable Finance Disclosure Regulation	European Regulation
SMM	Sustainable Materials Management	US political program
TCFD	Task Force on Climate-Related Financial Disclosures	US private organization
TSCA	Toxic Substances Control Act	US law which regulates chemicals not regulated by other US federal statutes
UNRISD	United Nations Research Institute for Social Development	Research organization under UN umbrella
VCM	Voluntary Carbon Market	Non-regulated, private carbon market
VUCA	Volatile, Uncertain, Complex and Ambiguous	General business term
WBCSD	World Business Council for Sustainable Development	Global private alliance under UN umbrella
WCI	Western Climate Initiative	US Emission Trading System
WTO	World Trade Organization	Global Governance
Web 3.0	World Wide Web third generation	Idea for a new World Wide Web including concepts like decentralization, blockchain technologies and token-based economics.

SOURCES

EXECUTIVE SUMMARY

- MSCI (2022). *The MSCI Net-Zero Tracker – March 2022*. MSCI.
<https://www.msci.com/documents/1296102/26195050/MSCI-Net-Zero-Tracker-Mar2022.pdf>
- The Economist (2022). *A broken idea - ESG investing*.
<https://www.economist.com/special-report/2022-07-23>
- World Bank (2022). *State and Trends of Carbon Pricing 2022*.
<https://openknowledge.worldbank.org/handle/10986/37455>

INTRODUCTION

- BBC, Cabral, S. and Sherman, N. (2022). *US Climate Bill*.
<https://www.bbc.com/news/world-us-canada-62568772>
- Council on Foreign Relations, Hill, A. and Babin, M. (2022). *What the Historic U.S. Climate Bill Gets Right and Gets Wrong*.
<https://www.cfr.org/in-brief/us-climate-bill-inflation-reduction-act-gets-right-wrong-emissions>
- Day, T., Mooldijk, S., Smit, S. (2022). *Corporate Climate Responsibility Monitor 2022*. New Climate Institute.
<https://newclimate.org/2022/02/07/corporate-climate-responsibility-monitor-2022/>
- Forbes, Knapp, A. and Ohnsman, A. (2022). *Biden Signs Climate Bill, How Long-Range EVs Work And Defeating Forever Chemicals*.
<https://www.forbes.com/sites/alanohnsman/2022/08/20/biden-signs-climate-bill-how-long-range-evs-work-and-defeating-forever-chemicals/>
- *Forderung nach Harmonisierung der europäischen und internationalen Nachhaltigkeitsberichterstattung* by Prof. Dr. Stefan Müller (2022).
https://www.haufe.de/finance/jahresabschluss-bilanzierung/harmonisierung-internationale-nachhaltigkeitsberichterstattung_188_569252.html
- Friedrich Geiger (2022). *NACHHALTIGKEITSBERICHTERSTATTUNG - Weltweite Berichtsstandards verlangt*.
<https://background.tagesspiegel.de/sustainable-finance/weltweite-berichtsstandards-verlangt>
- Graphic - Bank of International Settlements - *Statistic: S&P 500 companies, mentions of “ESG” in quarterly earning calls*.
- Guan, D. (2022). *Planning For Global Carbon Neutrality: Carbon Emission Accounts & Datasets For Global Corporates*. CelPress Beijing Conference.
https://www.longfinance.net/media/documents/presentation_28-06-22-YZen_compressed.pdf

- John Oliver (2022). *Carbon Offsets: Last Week Tonight with John Oliver (HBO)* 22 Aug.
<https://www.youtube.com/watch?v=6p8zAbFKpW0>
 - Kristina Thomas (2022). Tagesspiegel Sustainable Finance - *Standards für Krypto-Emissionszertifikate*.
https://background.tagesspiegel.de/sustainable-finance/standards-fuer-krypto-emissionszertifikate?utm_source=bgsf+vorschau&utm_medium=email
 - MSC, Varsani, H.D. and Gupta, R. (2022). *Introducing the Carbon Market Age*.
<https://www.msci.com/www/blog-posts/introducing-the-carbon-market/03227158119>
 - MSCI (2022). *The MSCI Net-Zero Tracker – March 2022*. MSCI.
<https://www.msci.com/documents/1296102/26195050/MSCI-Net-Zero-Tracker-Mar2022.pdf>
 - Refinitiv, Zelljadt, E. (2022) *Carbon markets on a bull run: emissions trading gains influence*.
<https://www.refinitiv.com/perspectives/market-insights/carbon-markets-on-a-bull-run-emissions-trading-gains-influence/>
 - TechCrunch, Butcher, M. (2022). *Investing platform raises \$11M to offer climate investing from a different angle to ESG ratings*.
<https://techcrunch.com/2022/10/12/investing-platform-raises-10m-to-offer-climate-investing-from-a-different-angle-to-esg-ratings/>
 - UNRISD (2022). *Authentic Sustainability Assessment. A User Manual for the Sustainable Development Performance Indicators*.
<https://cdn.unrisd.org/assets/library/reports/2022/manual-sdpi-2022.pdf>
-

EUROPE - EMERGING LEGISLATION AND REGULATIONS

- European Commission. *HOW DOES THE EU TAXONOMY FIT WITHIN THE SUSTAINABLE FINANCE FRAMEWORK?*
https://ec.europa.eu/info/sites/default/files/business_economy_euro/banking_and_finance/documents/sustainable-finance-taxonomy-factsheet_en.pdf
- European Commission. *Circular Economy Action Plan*.
https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en
- Eurostat. *Circular Economy Monitoring Framework*.
<https://ec.europa.eu/eurostat/web/circular-economy/indicators/monitoring-framework>
- European Environment Agency (2022). *Measuring Europe's circular economy*.
<https://www.eea.europa.eu/themes/waste/measuring-europes-circular-economy>
- Wikipedia. *EU Taxonomy for sustainable activities*.
https://en.wikipedia.org/wiki/EU_taxonomy_for_sustainable_activities

- Frankfurter Allgemeine Zeitung (2022). *Streitfall soziale Taxonomie*.
<https://www.faz.net/aktuell/finanzen/neue-nachhaltigkeitsregeln-streitfall-soziale-taxonomie-18277509.html>
 - *EU Taxonomy and the Future of Reporting* by Pettingale, H., Maupeou, S. and Reilly, P. (2022). Harvard Law School.
<https://corpgov.law.harvard.edu/2022/04/04/eu-taxonomy-and-the-future-of-reporting/>
 - US - Emerging Legislation and Regulations
 - Bloomberg (2022). *GOP Fury Over ESG Triggers Backlash With US Pensions at Risk*.
<https://www.bloomberg.com/news/articles/2022-08-25/esg-pros-say-republican-anti-woke-bashing-hurts-regular-savers?leadSource=uverify%20wall>
 - US Congress (2022). *H.R.5495 - Building Resilient Supply Chains Act*.
<https://www.congress.gov/bill/117th-congress/house-bill/5495/text>
 - *US-Firmen sollen Emissionen offenlegen*. Geiger, F. (2022).
<https://background.tagesspiegel.de/sustainable-finance/us-firmen-sollen-emissionen-offenlegen-1>
 - United States Environmental Protection Agency. *What is a circular economy?*
<https://www.epa.gov/recyclingstrategy/what-circular-economy>
 - United States Environmental Protection Agency. *Sustainable Materials Management*.
<https://www.epa.gov/smm>
-

CHINA - EMERGING LEGISLATION AND REGULATIONS

- CERDS (2022) *Guidance for enterprise ESG disclosure*.
<http://www.3060edu.com/static/upload/file/20220420/1650418903815960.pdf>
- Choong, D. (2022) *China to Require Mandatory Disclosure of Environmental Information*. Regulation Asia.
<https://www.regulationasia.com/china-to-require-mandatory-disclosure-of-environmental-information/>
- Chipman Koty, A. (2021) *China's Circular Economy: Understanding the New Five year plan*. China Briefing.
<https://www.china-briefing.com/news/chinas-circular-economy-understanding-the-new-five-year-plan/>
- Copley (2020) *By zeroing emissions, China could shave 11% off expected temperature rise*. SNL Energy Power Daily. Charlottesville.
<https://search-proquest-com.brad.idm.oclc.org/docview/2447148805?pq-origsite=summon>
- Davies, P. and Green, M.; P. (2022) *China to Introduce Its First ESG Disclosure Standard*. Latham & Watkins.
<https://www.lexology.com/library/detail.aspx?g=358b30e6-c7f5-45cf-8ca7-a105dca7999a>

- European Commission (2018) *Final Report of the High-Level Panel of the European Decarbonisation Pathways Initiative*. European Commission – Directorate-General for Research and Innovation, Climate Action, Environment, Resource Efficiency and Raw Materials.
https://ec.europa.eu/info/sites/default/files/research_and_innovation/research_by_area/documents/ec_rtd_d_ecarbonisation-report_112018.pdf
- Fang, Y., Côté, R.P., Qin, R. (2007) *Industrial sustainability in China: Practice and prospects for eco-industrial development*. Journal of Environmental Management 83 (2007), 315-328.
<https://www-sciencedirect-com.brad.idm.oclc.org/science/article/pii/S0301479706001216?via%3Dihub>
- Geng, Y. and Doberstein, B. (2010) *Developing the circular economy in China: Challenges and opportunities for achieving 'leapfrog development'*. International Journal of Sustainable Development and World Ecology 15, 231-239.
<https://www-tandfonline-com.brad.idm.oclc.org/doi/abs/10.3843/SusDev.15.3:6>
- Gov.cn (2022) *Work plan for improving the quality of listed companies controlled by central enterprises*.
http://www.gov.cn/xinwen/2022-05/27/content_5692621.htm
- Holzman, A. and Grünberg, N. (2021) "Greening" China – An analysis of Beijing's sustainable development strategies. Merics China Monitor.
https://merics.org/sites/default/files/2021-01/210107_MERICSCChinaMonitor_GreeningChina_0.pdf
- Huld, A. (2022) *China ESG Reporting – New Measures on Disclosure of Enterprise Environmental Information*. China Briefing.
<https://www.china-briefing.com/news/china-esg-reporting-disclosing-enterprise-environmental-information/>
- Icap (2022) *Emissions Trading Worldwide - Status Report 2022*. International Carbon Action Partnership.
- IPE (2022) Institute of Public and Environmental Affairs.
<http://www.ipe.org.cn/index.html>.
- Keyou, F.E. and Chun-Yin, L.A. (2021) *An overview of Circular Economy in China: How the Current Challenges Shape the Plans for the Future*. The Chinese Economy 2021.
<https://www-tandfonline-com.brad.idm.oclc.org/doi/pdf/10.1080/10971475.2021.1875156?needAccess=true>
- Kirchherr, J., Reike, D. and Hekkert, M. (2017) *Conceptualizing the circular economy: Analysis of 114 definitions*. Resources, Conservation and Recycling 127, 221-232.
<https://www-sciencedirect-com.brad.idm.oclc.org/science/article/pii/S0921344917302835>
- Koty, C., A. (2021) *China's Circular Economy: Understanding the New Five Year Plan*. China Briefing.
<https://www.china-briefing.com/news/chinas-circular-economy-understanding-the-new-five-year-plan/>
- KPMG (2021) *New carbon borders change the game for high carbon products and exports*. KPMG.
<https://home.kpmg/xx/en/home/insights/2021/07/new-carbon-borders-change-the-game.html>

- Lee, S., T., T. (2022) *China Unveils ESG Reporting Program in Bid to Catch Global Peers*. Bloomberg.
<https://www.bloomberg.com/news/articles/2022-05-31/china-unveils-esg-reporting-program-in-bid-to-catch-global-peers>
- Liang, S. (2021) “Calculate” the Benefit of Circular Economy. *Technology for Circular Economy: A prologue to the 2021 Switch-Asia Leadership Academy Conference*. Switchasia.
- Liu, H., Liu, J. and You, X. (2021) Q&A: What does China’s 14th ‘five year plan’ mean for climate change? CarbonBrief.
<https://www.carbonbrief.org/qa-what-does-chinas-14th-five-year-plan-mean-for-climate-change>
- Luyue, T. (2022) *The first year of China’s national carbon market, reviewed*. China Dialogue.
<https://chinadialogue.net/en/climate/the-first-year-of-chinas-national-carbon-market-reviewed/>
- Mathews, J., A. and Tan, H. (2011) *Progress Towards a Circular Economy in China, The Drivers (and Inhibitors) of Eco-industrial Initiative*. Journal of Industrial Ecology 15(3), 435-457.
<https://onlinelibrary.wiley.com/doi/10.1111/j.1530-9290.2011.00332.x>
- Meager, E. (2022) *China’s new ESG disclosure standard “of limited use” to investors*. Capital Monitor.
<https://capitalmonitor.ai/regions/asia/china-esg-disclosure-standard-investors/>
- MEE (2022) *Notice on Issuing the Standards for the Format of Legally Disclosed Environmental Information by Enterprises*. General Office of the Ministry of Ecology and Environment.
https://www.mee.gov.cn/xxgk2018/xxgk/xxgk05/202201/t20220110_966488.html
- Neto, A.R.G., Rodrigues, R., Reis, J.Z., Raymundo, J.C. and Gonçalves, R.F. (2020) *Economy and Its Symbiosis with Circularity*. In: Lalic B., Majstorovic V., Marjanovic U., von Cieminski G., Romero D. (eds) *Advances in Production Management Systems. The Path to Digital Transformation and Innovation of Production Management Systems*. APMS 2020. IFIP Advances in Information and Communication Technology. Springer, Cham.
https://doi.org/10.1007/978-3-030-57993-7_68
- Norris, J. (2022) *Can the EU and China align their carbon markets?* China Dialogue.
<https://chinadialogue.net/en/climate/can-the-eu-and-china-align-their-carbon-markets/>
- PRI (2020) *ESG disclosure in China: Market Readiness and PRI Investor Survey*.
<https://www.unpri.org/download?ac=15582>
- Prieto-Sandoval, V., Jaca, C. and Ormazabal, M. (2018) *Towards a consensus on the circular economy*. Journal of Cleaner Production 179, 605-615.
<https://www.sciencedirect.com/science/article/pii/S0959652617332146?via%3Dihub>
- Roberts, A.; Hutchinson, G.; Ding, A. (2022) *China’s new ESG Disclosure Standards*. Sustainable Futures.
<https://sustainablefutures.linklaters.com/post/102hpkx/chinas-new-esg-disclosure-standards>

- Sha, F. (2022) *How should China improve climate disclosure in the finance sector?* China Dialogue.
<https://chinadialogue.net/en/business/how-should-china-improve-climate-disclosure-in-the-finance-sector/>
- Shi, M. (2022) *China's Environmental Regulations - Trends and Updates*. CHWMEG Seminar by EHSR EHS Risk Solutions.
https://chwmeg.org/vids/2022-03-04_China1.pdf
- Su, B., Heshmati, A., Geng, Y., Yu, X. (2013) *A review of the circular economy in China: moving from rhetoric to implementation*. Journal of Cleaner Production 42, 215-227.
<https://www.sciencedirect-com.brad.idm.oclc.org/science/article/pii/S0959652612006117?via%3Dihub>
- Verney, P. (2022) *Responsible Investor - China questions 'global baseline' of ISSB's disclosure standard*. Responsible Investor.
<https://www.responsible-investor.com/china-questions-global-baseline-status-of-issbs-disclosure-standards/>
- Xu, Y. (2022) *China uncovers fraud scheme in carbon emission reporting*. Upstream.
<https://www.upstreamonline.com/energy-transition/china-uncovers-fraud-scheme-in-carbon-emission-reporting/2-1-1184461>
- Yuan, Z., Bi, J., Moriguchi, Y. (2006) *The Circular Economy, A New Development Strategy in China*. Journal of Industrial Ecology 10, 4-8.
<https://onlinelibrary-wiley-com.brad.idm.oclc.org/doi/epdf/10.1162/108819806775545321>
- Yao, C., J. (2022) *Carbon-neutral policies in China*. Asia Business Law Journal.
<https://law.asia/carbon-neutral-policies-china/>
- Zhang, D. (2022) *China's Energy transition toward Carbon Neutrality*. CelPress Beijing Conference.
<https://cellpressbeijingconference.anruidm.com/threelive?Id=1bb85765-d608-4d49-b115-a5608cb8f441&ChannelCode=abroad0127&titleTime=0>
- Ziyang, S. (2022) *How should businesses in China react to new environmental disclosure requirements?* China Dialogue.
<https://chinadialogue.net/en/business/how-should-businesses-in-china-react-to-new-environmental-disclosure-requirements/>

EMERGING SUSTAINABILITY DATA ECOSYSTEMS & THE INTERNET OF SUSTAINABILITY DATA

- *Catena-X Motivation* (2022). Catena-X
https://catena-x.net/fileadmin/user_upload/Vereinsdokumente/Catena-X_Uebersicht.pdf

- ESTAINIUM Association (2022). *A Race we Must Win - Driving Industrial Decarbonisation Holistically*.
https://www.estainium.eco/files/media/downloads/estainium_presentation.pdf
- IMDS system architecture. DXC Technology (2022)
<https://public.mdsystem.com/en/web/imds-public-pages/imds-ai>
- *Key values of the Carbon Transparency Partnership*. WBCSD Pathfinder Framework (2022)
https://www.carbon-transparency.com/media/oymlyn4n/pathfinder-framework-version-1_final.pdf
- Press release PACT (2022). *PACT advances emissions transparency with breakthrough in value chain data exchange*.
https://www.carbon-transparency.com/media/pg0nifzp/20221111_advancing-emissions-transparency-with-breakthrough-in-value-chain-data-exchange.pdf
- Fast emerging markets - Carbon, Circular Economy & ESG
- World Bank (2022). *State and Trends of Carbon Pricing 2022*.
<https://openknowledge.worldbank.org/handle/10986/37455>
- Systemic Change in Business
- Corporate Finance Institute - GAAP (2022). *A commonly recognized set of rules and procedures governing corporate accounting and financial reporting*.
<https://corporatefinanceinstitute.com/resources/knowledge/accounting/gaap/>