# Carbon Markets, Tokenization and the Enterprise Data Challenge

What you need to know about voluntary carbon markets and how to get started

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# Contents

| Foreword   | 4  |
|--|----|
| Executive summary  | 7  |
| 1. The ESG ratings challenge   |    |
| 2. Mandatory "climate-risk related" disclosure                         |    |
| Proposed "climate-related risk" reporting requirements                 |    |
| Disclosure of internal carbon pricing and use of carbon credit offsets | 15 |
| Structured data reporting requirement ('Inline XBRL')                  |    |
| Enterprise climate-related data infrastructure needs                   | 17 |
| 3. Carbon markets  |    |
| Role of carbon markets and carbon price mechanism                      |    |
| Compliance markets   |    |
| Voluntary carbon markets   |    |
| Size of voluntary carbon markets                                       |    |
| VCM market trade by project type                                       | 21 |
| VCM price dynamics – Australia's case study                            |    |
| Scrutiny of carbon credit offsets                                      |    |
| The use of low-cost international offsets in the voluntary market      |    |
| Double counting of carbon credits                                      |    |
| Supply of carbon credit assets   | 27 |
| Development of voluntary market infrastructure                         |    |
| Market infrastructure—registries                                       |    |
| Market infrastructure – spot and futures exchanges                     |    |
| Tokenization   |    |
| Flowcarbon   |    |

| Carbonplace  |    |
|--|----|
| VCM registries exploring Tokenization                      |    |
| Digital measurement, reporting and verification (DMRV)     | 39 |
| The Guardian platform                                      | 39 |
| 4. How Trustury can help B2C enterprises net zero mandates | 43 |
| Meeco infrastructure for tokenised services                | 45 |
| 5. Recommendations   |    |
| Acknowledgements   | 50 |
| Glossary   | 50 |



### Foreword

This report is published at a time when our collective responsibility is crucial to addressing the real and significant risks of climate change. Our shared challenge is how to make net zero commitments both transparent and measurable.

When Meeco was founded, we set out with a guiding principle to enable everyone on the planet to get equity and value in exchange for the data they share. Little did we know a decade ago how vital access to verified data would be to contribute to the management of climate change.

Whilst there's a growing sector of voluntary reporting and carbon schemes, voluntary carbon credit volume will need to grow by up to 15 times by 2030 to help drive the necessary investment needed to deliver a 1.5-2.0 °C pathway.

Given the significant increase required, we need to do more to help voluntary markets capture and report in standardised and measurable ways. Specifically, by supporting Environmental Management Systems (EMSs) for climate-risk data management.

In the wake of proposed regulatory changes and market developments, we anticipate increased demand for emissions reduction technology, including managing carbon market offsets. There's also likely to be regulatory changes requiring mandatory climate-related risk disclosure.

Avoiding double-counting is critical. Therefore, technologies that provide policy transparency and governance are foundational to solving the problem. Because most corporates fall outside the compliance sector, this report focuses mainly on private and NGO-led voluntary carbon market developments and infrastructure.

The aim of this report is to provide a snapshot of the current landscape, outline some of the regulatory drivers that may determine the type of reporting required in the near future, and present practical steps that can be taken now to implement climate data management.

I'd especially like to acknowledge and thank Dr Luke Deer for his extensive research and authorship of this report.



This report was also made possible through the support of the HBAR Foundation, in particular with the help of Wes Geisenberger and Rob Allen. The combination of research and funding contribute to the necessary transparency required to make evidence-based decisions towards actions that matter.

Our hope for readers of this report is that you will find at least one idea that sparks action towards better climate data capture and reporting. It is our collective efforts that will make the most difference.

On behalf of all of us at Meeco, we hope you are inspired to join this effort.

Katryna Dow CEO & Founder, Meeco Brussels, November 2022





Mandatory disclosure will force companies to internalise and publicly report their climate-risk assessment, including their use of internal carbon prices. It will lead to an increased search for corporations' climate-risk solutions, including tooling for using carbon credit offsets

## **Executive summary**

This Meeco report looks at what enterprises, like banks, brands, and retailers, need to know about carbon markets and how they can get involved in bringing about a lower-carbon world. Importantly, it also considers how consumer-facing businesses can make their net zero pledges transparent.

The demand for Environmental, Social and Governance (ESG)/sustainability assets and carbon offset credits hinges on the desire by corporates, investors, and consumers to reduce and offset greenhouse gas (GHG) emissions towards net zero emissions—to limit global warming to 1.5 - 2.0 °C of pre-industrial levels.

Carbon pricing initiatives are critical to broader emissions reduction strategies pursued by governments. They aim to impose an economic cost on GHG emissions and incentivise investment in low-carbon technologies. Carbon pricing initiatives include using fixed carbon prices, i.e., a tax per ton of GHG emissions or a marketdetermined price based on the demand and supply of emissions quotas (credits) under Emissions Cap-and-Trade Schemes (ETSs).

Carbon pricing initiatives are critical to broader emissions reduction strategies pursued by governments Global carbon prices are currently well under those needed to meet net zero by 2050. The World Bank estimates that "the carbon price needs to be in the USD\$50-100/tCO2e range by 2030 to keep global heating to 2°C."<sup>1</sup>

The prevailing view is that a combination of higher fixed carbon pricing, steeper cuts to baseline emissions in ETS carbon markets and

mandatory climate-risk disclosure for public companies, financial institutions and medium and large private companies is needed to raise the price of carbon.

Critically, in March 2022, the US Securities and Exchange Commission (SEC), under the Biden Administration, proposed *Rules to Enhance and Standardise Climate-Related Disclosures for Investors*, which includes mandatory climate-risk disclosure for public companies, financial institutions, and some private companies.

Should the US SEC's proposed rule changes be adopted, there will be increased demand for GHG emissions reduction technologies, including managing carbon credit offsets. There is also likely to be regulatory momentum for mandatory climate-related risk disclosure in countries with voluntary regimes elsewhere over the next five to ten years.



Mandatory disclosure will force companies to internalise and publicly report their climate-risk assessment, including their use of internal carbon prices. It will lead to an increased search for corporations' climate-risk solutions, including tooling for using carbon credit offsets.

Tokenization can make carbon assets discoverable, traceable, and tradeable via tokenization and identity management More broadly, irrespective of whether the SEC's proposed rules are adopted, they provide a valuable blueprint for organisations in this space, addressing much needed transparency and standardisation.

Use of blockchain/Distributed Ledger Technology (DLT) for carbon management, as discussed in this report, has the potential to lower the cost of tracking GHG emissions and carbon credit creation. Tokenization can make

carbon assets discoverable, traceable, and tradeable via Tokenization and identity management. And as a corollary, it is also anticipated that the value of these tokenised assets, compared with those that lack transparency and auditability, will also be greater.

To make their net-zero claims transparent, enterprises need a data infrastructure framework that gives stakeholders the power to view and access sustainability tokens.

This report discusses some of the key concepts and available tools and is intended as stimulus for enterprises starting down this path.



As of 31 March 2021, 3404 investors with USD\$121 trillion of assets under management have signed commitments to integrate ESG information into their investment decisions. At least one-third of managed funds will be under ESG mandates by 2025

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# **1. The ESG ratings challenge**

Corporations are under increasing pressure from investors, regulators, and consumers to integrate ESG considerations into their business decisions or investment fund mandates.<sup>2</sup>

ESG ratings which are 'also referred to as sustainability ratings or corporate sustainability ratings'<sup>3</sup> represent a concerted effort by ESG rating agencies to measure corporate performance in and across environmental, social and governance criteria.

Given this pressure, there has been rising demand from investors and funds with ESG investment overlays to invest in companies listed in ESG rating indexes. As of 31 March 2021, 3404 investors with USD\$121 trillion of assets under management have signed commitments to integrate ESG information into their investment decisions.<sup>4</sup> At least one-third of managed funds will be under ESG mandates by 2025.<sup>5</sup>

ESG indexes are like traditional market indices, which form the basis for investment portfolio allocations across industries. However, ESG index inclusion depends on meeting ESG performance criteria. Even then, a company's inclusion in an ESG index is not automatic but depends on the company's position relative to peers in the same industry.

For instance, under the S&P 500 ESG index, public companies whose ESG performance ranks in the bottom 25% of their industry sector peers are excluded from the index.<sup>6</sup> The result is increasing reputational and funding pressure on corporates to meet improved levels of environmental, social and governance performance relative to their industry peers.

In addition to reputational pressure, there is ongoing regulatory action against corporates and managed funds involved in ESG 'greenwashing'. Greenwashing is the potential for companies or funds "to overrepresent the extent to which their practices are environmentally friendly, sustainable or ethical."<sup>7</sup>

More data availability has led to a broader divergence in ESG rating performance The recent resignation of the chief executive of Germany's top asset management firm, DWS Group, after police raided the company's Frankfurt headquarters following allegations of 'greenwashing' suggests further regulatory action against greenwashing in many jurisdictions.<sup>8</sup>



ESG rating decisions are a source of controversy.<sup>9</sup> A key challenge for corporates is the lack of a common ESG performance rating framework across ESG rating agencies.<sup>10</sup> Despite overlap around the three main sustainability pillars, ESG rating agencies use different methodologies to evaluate ESG performance.

Rating agencies have different theories regarding what to include and various input measures. The result is low "commensurability" of ESG ratings.<sup>11</sup> As a result, companies have been included in one index at certain times and then excluded from another simultaneously. And while data transparency should in theory reduce ESG measurement performance differences, the opposite has turned out to be the case in some instances.<sup>12</sup>

While these discrepancies appear unsurprising, given the relative early phase of the market, they are a driver for regulatory initiatives aimed at standardising climate-risk disclosure.



Are companies using cheap and low-quality offsets in place of actual emissions and energy use reduction, thereby avoiding action on GHG emissions?

# 2. Mandatory "climate-risk related" disclosure

There is a growing global regulatory trend for public companies, financial institutions, and some private companies to mandatorily disclose their climate risks and responses to those risks. While reporting requirements differ by jurisdiction, regulatory disclosure efforts are broadly aligned around the Task Force on Climate-Related Financial Disclosures (TCFD) recommendations.<sup>13</sup>

As of 2021, TCFD-aligned official, i.e., mandatory climate-risk disclosure reporting requirements, had been legislated in eight countries, including Brazil, the European Union, Hong Kong, Japan, New Zealand, Singapore, and the United Kingdom.<sup>14</sup>



The TCFD recommends "that preparers of climate-related financial disclosures provide such disclosures in their *mainstream* (i.e., public) annual financial filings."<sup>15</sup>

The rationale for climate-related disclosures to be included in mainstream company annual reports is to limit the ability of corporates to engage in greenwashing and to enable investor decisions by making climate-risk disclosures commensurable across investment portfolios.

This contrasts with the current voluntary climate-risk disclosure practices in many countries, where climate claims, if they appear at all, appear as largely unattested claims on corporate and fund websites and prospectuses.

Critically, in March 2022, the US Securities and Exchange Commission (SEC), under the Biden Administration, proposed a set of *Rules to Enhance and Standardise* 



*Climate-Related Disclosures for Investors*, which incorporates and extends the TCFD recommendations.<sup>16</sup> It is worth looking at the detail of the SEC proposed rules for climate-risk disclosure which in addition to the TCFD recommendations proposes more stringent requirements than some weaker implementations.

The US SEC proposed rule change would include climate-related information in registrants' *Form 10-K* (used for annual reports by publicly traded companies) or registration statement (set of documents that must be filed with SEC before proceeding with public offering). Further, the SEC proposal notes that including climate-related disclosure in public reports includes liability, which is absent from information presented outside of SEC filings.<sup>17</sup>

Moreover, the scope of SEC proposed rule changes includes domestic and foreign private issuers. Foreign private issuers are defined as issuers that are principally administered in the US, issuers with more than 50 per cent of shareholders resident in the US, or issuers with more than 50 per cent of assets in the US.<sup>18</sup>

Importantly for non-US entities, foreign private issuers seeking to list on US markets, whether from China, Europe or Australia, and foreign private issuers with large share-ownership exposure to US markets, will likely also be subject to US domestic climate-risk disclosure requirements. Because of this, and the well-established practice of regulators learning from one another, we examine the implications of the proposed US rules in reasonable detail.

#### Proposed "climate-related risk" reporting requirements

The SEC proposal defines "climate-related risks" as "the actual or potential negative impacts of climate-related conditions and events on a registrant's consolidated financial statements, business operations, or value chains, as a whole." Under the proposal, registrants would be required to disclose information about their governance, assessment, and response to climate risks or likely risks on the registrant's strategy and business model outlook.

Following the TCFD recommendations, the SEC proposal would require that registrants disclose their: "governance of climate-related risks; any material climate-related impacts on its strategy, business model, and outlook; climate-related risk management; GHG emissions metrics; and climate-related targets and goals, if any."<sup>19</sup>



Like the TCFD recommendations, the US SEC proposal would require registered entities "to disclose metrics on their entire GHG emissions in their operations and in their value chains as a whole". For large publicly registered companies, the proposed disclosure metrics include direct (Scope 1) and indirect (Scope 2, i.e., upstream and if material, Scope 3, i.e., downstream) GHG emissions and metrics on emissions intensity (for instance, CO<sub>2</sub> or equivalent per ton of output).<sup>20</sup>

In effect, the SEC proposal extends mandatory GHG disclosure rules from corporates in the compliance market to most large public companies, including banks, insurers, and investment funds, as well as to some smaller private companies (SPCs). In addition to reporting the full scope of their GHG emissions, registrants would be required to include their climate-related targets and goals or transition plan.

Further, under the SEC proposal, separately disclosed metrics on Scope 1, 2, and where material, Scope 3 emissions and energy use data would require an attestation report by an attestation service provider. This attestation report would be required to provide 'limited assurance' of the reported data. While the attestation service provider does not need to be an accounting firm, it The SEC proposal extends mandatory GHG disclosure rules from corporates in the compliance market to most large public companies, including banks, insurers, and investment funds, as well as to some smaller private companies

would need to be an accredited attestation service provider. In this respect, the SEC's proposed requirement for an assurance report goes further than the UK's reporting requirements, which recommend independent assurance as best practice but do not mandate it.

#### Disclosure of internal carbon pricing and use of carbon credit offsets

The US SEC proposal also extends the TCFD recommendations around disclosure of maintained internal carbon pricing and disclosure of the use of carbon offsets and Renewable Energy Certificates (also known as Renewable Energy Credits or RECs)

The SEC's proposal requires registrants to disclose any use of estimated internal carbon prices by registrants for planning purposes, including: "currency reporting metric per ton [sic], how the price is estimated to change over time, and rationale for selecting the internal price applied."

Further, the US SEC proposal would require disclosure of the use of carbon offsets. The use of 'carbon offsets' is the subject of increased scrutiny over questions about the environmental integrity or quality of 'offset' projects and because of the lack of disclosure about the role of 'offsets' in corporate emissions and energy use plans.



Are companies using cheap and low-quality offsets in place of actual emissions and energy use reduction, thereby avoiding action on GHG emissions?

The SEC's proposal would require the disclosure of the use of carbon offsets and "the role they play in registrants' climate-related business strategy, including how resilient it is to changes in costs or the availability or value of offsets or RECs over the short, medium and long-term." Similarly, corporate purchases, rationales, and use of RECs to address companies' indirect emissions would also need to be disclosed.

Understanding to what extent and why companies are using carbon offsets or RECs, i.e., their climate-related business role in relation to science-based and operational targets is key. This includes whether offsets are used for residual or primary emissions—which is crucial to bringing integrity to carbon offset markets and corporate climate disclosures.

#### Structured data reporting requirement ('Inline XBRL')

Compared to the SEC proposal, a shortcoming of the TCFD and the UK climate-risk disclosure rules is their approach to technology requirements around digital reporting for climate-related disclosures. Both the TCFD and UK frameworks are implicitly, if not explicitly, technology-neutral when implementing data reporting regimes.

The SEC's proposal, however, includes a structured data reporting requirement for climate-related disclosure that: "would require a registrant to tag the proposed climate-related disclosures in a structured, machine-readable data language, specifically tagging climate-related disclosures in Inline extensible Business Reporting Language ('Inline XBRL')."

This structured data requirement would enable "automated extraction and analysis of climate-related disclosures, allowing investors and other market participants to more efficiently perform large-scale analysis and comparison of climate-related disclosures across companies and time periods."

The case for principles-based approaches to regulation, rather than mandating specific and potentially ineffective technology solutions, is usually sound. But when it comes to bringing transparency to climate-related financial data, not requiring structured data reporting limits the ability to aggregate, compare and filter data for analysis and decision-making.



#### Enterprise climate-related data infrastructure needs

The broader point is that the effectiveness of principles-based regulation in areas like climate-related disclosure also depends on the development and industry adoption of open data technology solutions that bring transparency and trust to the market.

Mandatory disclosure will force companies to internalise and publicly report their climaterisk assessment, including if they use an internal carbon price. This will lead to corporations' increased search for climate-risk solutions, including the search for offset solutions Mandatory disclosure will force companies to internalise and publicly report their climate-risk assessment, including if they use an internal carbon price. This will lead to corporations' increased search for climate-risk solutions, including the search for offset solutions.

Data and analytics on climate-related risks will become increasingly central to corporates with requirements for mandatory climate-risk disclosure.

This will encourage using Environmental Management Systems (EMSs) for climate-risk data management.

Should the SEC's proposed rule changes be adopted, there will be increased demand for emissions reduction technology, including managing carbon market offsets.

There is also likely to be regulatory momentum for mandatory climate-related risk disclosure in countries with voluntary regimes elsewhere.



The World Bank estimates that "the carbon price needs to be in the USD\$50-100/tCO2e range by 2030 to keep global heating to 2°C"

# **3. Carbon markets**

Role of carbon markets and carbon price mechanism

Carbon markets include nationally regulated compliance markets and the voluntary carbon market. There is an overlap between the compliance market and voluntary carbon market, particularly spillovers from the regulated sector to the voluntary sector. There are also common criticisms over the use and integrity of carbon offset credits, but these criticisms are sharpest in the voluntary market. Because most corporates fall outside the compliance sector, this report focuses mainly on private / NGO-led voluntary carbon market developments and infrastructure.

Carbon pricing initiatives are critical to broader emissions reduction strategies pursued by governments. Carbon price initiatives aim to impose an internal economic cost on GHG emissions and incentivise investment in low-carbon technologies. Carbon pricing initiatives include using fixed carbon prices, i.e., a tax per ton of GHG emissions or a market-determined price based on the demand and supply of emissions quotas (credits) under Emissions Cap-and-Trade Schemes (ETSs). Global carbon prices are currently well under those needed to meet net zero by 2050. The World Bank estimates that "the carbon price needs to be in the USD\$50-100/tCO2e range by 2030 to keep global heating to 2°C."<sup>21</sup>

A combination of higher fixed carbon pricing, steeper cuts to baseline emissions in ETS carbon markets and mandatory climate-risk disclosure for public companies, financial institutions and medium and large private companies is needed to raise the price of carbon emissions.

#### Compliance markets

The nationally regulated, or compliance carbon markets as they are known, include corporate entities that exceed specific GHG emission, energy production or energy consumption thresholds. Compliance market entities must disclose detailed metrics about current emissions, target-based plans to reduce emissions, and the GHG intensity of their production or consumption. Emission quotas in the compliance markets are capped at national baselines and ideally subject to steady reductions. In turn, entities in the compliance market receive GHG emissions quotas, which are also reduced over time to meet those targets.

Entities in the compliance market that come in below their mandated emissions targets may sell their surplus carbon credits in secondary markets—for instance, to buyers in the compliance market who are above their quotas and need to offset their emissions.

To reach their emissions reduction targets, entities in the compliance markets may also buy "carbon offsets" from "offset projects" or purchase Renewable Energy



Certificates (RECs), to offset emissions at the site of operations. A carbon credit represents one cubic ton of CO2e emissions (also called GHG emissions) that have been removed from the atmosphere or avoided being released.

Because compliance carbon markets are publicly regulated, including through regulation of the use of carbon "offset projects" and RECs, carbon credit prices in the compliance market have been substantially higher than those in the voluntary markets.<sup>22</sup>

#### Voluntary carbon markets

While the voluntary carbon market sits in parallel to the compliance market internationally, developments in the compliance markets directly impact the supply and demand in the voluntary carbon market. For corporate entities outside of the compliance market, reducing emissions and adopting a goal of carbon neutrality, i.e., net-zero emissions, remains voluntary.

A growing minority of corporates in developed markets have adopted voluntary netzero pledges. As with the compliance market, corporates in the voluntary market may reduce their avoidable emissions directly by switching to less carbon-intensive production while seeking to offset their unavoidable emissions by purchasing carbon offset credits.

While voluntary market offsets in most jurisdictions cannot be used in the compliance market to meet Kyoto Protocol compliance regimes, international compliance market offsets, called Certified Emissions Reduction Units (CERs), and voluntary market offsets, can be used by companies to offset their emissions voluntarily.<sup>23</sup>

#### Size of voluntary carbon markets

The size of the voluntary carbon market can be measured by its total trade value. The value of the voluntary carbon market (VCM) hit over USD\$2 billion in 2021—the first time in its 16-year history of being tracked.<sup>24</sup>

By contrast, the cumulative value of voluntary carbon credits traded between the pre-2006 period and mid-August 2021 was USD\$6.7 billion. This points to a recent inflection in demand for voluntary market offset credits, primarily driven by corporate demand.

The voluntary carbon market is also expected to scale in volume —with each carbon offset certificate measuring a metric ton of CO2e. The carbon equivalent volume of voluntary carbon credits traded in 2021 was over 597 mn equivalent (MtCO2e).<sup>25</sup> However, the almost six hundred MtCO2e in the volume of carbon credits traded in 2021 was less than 2% of global emissions of 36 bn tonnes.<sup>26</sup>



Further, the Taskforce on Scaling Voluntary Carbon Markets (TSVCM) estimates that "voluntary carbon credit volume would need to grow by up to 15 times by 2030" to help drive the investment needed to deliver a 1.5°C to 2°C pathway.<sup>27</sup> This would require a massive investment in carbon offset projects. A 15-fold increase in the volume of six hundred mn tonnes of CO2e traded in 2021 would require an annual volume of 9 bn tonnes of CO2e of voluntary carbon credits traded in 2030.

The potential value of the VCM as a commodity market is also expected to rise alongside its volume. At the current weighted average price of voluntary carbon credits of USD\$4.00 per unit of CO2e,<sup>28</sup> a 15-fold increase in the value of VCM by 2030 would result in a USD\$15 billion market value. Assuming real price scenarios of USD\$25, \$50, or \$100 per tCO2e, the total VCM value could be anywhere between USD\$225 bn to USD\$900 bn in 2030—money which would be used to finance investment in voluntary carbon removal projects.

# Table 1. The estimated value of the Voluntary Carbon Market in 2030 by pricescenario

|          | Year | Price<br>(USD) | Volume<br>(MtCO2e) | Value (USD) |
|----------|------|----------------|--------------------|-------------|
| Baseline | 2021 | \$4.00         | 600                | \$2B        |
|          | 2030 | \$25.00        | 9000               | \$225B      |
|          | 2030 | \$50.00        | 9000               | \$450B      |
|          | 2030 | \$100.00       | 9000               | \$900B      |

Source: Author's estimates based on rounded values for the EM's 2021 volume and value of the VCM market based on the TSVCM's assumption of a 15-fold increase in CO2e offset volume by 2030.

#### VCM market trade by project type

Table 2 below shows a summary of VCM transaction volume, price, and value by category for 2020 and 2021.<sup>29</sup> Agriculture, forestry and other land use (AFOLU) credits (67% of value traded) and Renewable Energy Credits (24% of value traded) dominated the trade volume in 2021.<sup>30</sup> After agriculture projects, sole benefit AFOLU projects attracted the highest average price at \$5.80 per tCO2e.

It is worth noting that projects with "accompanying co-benefits ... fetched a higher average weighted price ..."<sup>31</sup> Multi or co-benefit projects, such as those that sequester carbon and preserve biodiversity, often have higher environmental integrity. As a result, they are also more highly valued.



|  | 2020               |                |                | 2021               |                |                |
|--|--------------------|----------------|----------------|--------------------|----------------|----------------|
| Category   | Volume<br>(MtCO2e) | Price<br>(USD) | Value<br>(USD) | Volume<br>(MtCO2e) | Price<br>(USD) | Value<br>(USD) |
| Forestry and land use                            | 57.8M              | \$5.40         | \$315.4M       | 227.7M             | \$5.80         | \$1,327.5M     |
| Renewable energy                                 | 93.8M              | \$1.08         | \$101.5M       | 211.4M             | \$2.26         | \$479.1M       |
| Chemical processes /<br>Industrial manufacturing | 1.8M               | \$2.15         | \$3.9M         | 17.3M              | \$3.12         | \$53.9M        |
| Waste disposal                                   | 8.5M               | \$2.69         | \$22.8M        | 11.4M              | \$3.62         | \$41.2M        |
| Energy efficiency / fuel<br>switching            | 30.9M              | \$0.98         | \$30.4M        | 10.9M              | \$1.99         | \$21.9M        |
| Household / community<br>devices                 | 8.3M               | \$4.34         | \$36.24M       | 8.0M               | \$5.36         | \$43.3M        |
| Transportation                                   | 1.1M               | \$0.64         | \$0.7M         | 5.4M               | \$1.16         | \$6.3M         |
| Agriculture                                      | 0.5M               | \$10.38        | \$4.7M         | 1.0M               | \$8.81         | \$8.7M         |

# Table 2. Voluntary Carbon Transaction Volumes, Prices, and Values byCategory, 2020-2021

Source: Forrest Trends Ecosystem Marketplace, 2022, p.8

#### VCM price dynamics – Australia's case study

The average weighted price of voluntary carbon credits (VCCs) traded in 2021 was USD\$4.00.<sup>32</sup> The fundamental reason for such a low average VCM price is the lack of demand from corporations for carbon offsets relative to the existing supply of offsets available in compliance and voluntary markets—including a large pool of low-quality international offsets.

In many jurisdictions, there is an excess of offset supply over demand in the compliance markets. Australia provides an interesting case study here; the gap between demand for Australian Carbon Credit Units (ACCUs) from corporates in the compliance and the voluntary market relative to supply is worth examining.

#### In many jurisdictions, there is an excess of offset supply over demand in the compliance markets

According to the Australian Clean Energy Regulator (CER), the projected supply of ACCUs in the Australian compliance market was about twenty-nine million ACCUs in 2022, of which 12 million were carried over from previous years, and the new Q1 supply was 3 million.<sup>33</sup> In contrast, the estimated demand

was about 12.5 million ACCUs—or a third of the total supply.<sup>34</sup>

Moreover, over ten million ACCUs of that demand were scheduled deliveries of ACCU supply to the compliance market under the fixed delivery commonwealth government contract milestones to the Emissions Reduction Fund (ERF), which does not mean they were end-buyers for those ACCUs.



Voluntary demand for ACCUs was estimated to be less than one million ACCUs, while the net balance of ACCUs (supply over demand) was 12.92 million ACCUs in Q1 2022. Most of the excess ACCU supply volume was held on the books of project proponents, with the remainder, about a quarter, held between market intermediaries or business and government holders.<sup>35</sup>

The supply of ACCUs provides a measure of carbon offsets that would otherwise be in the atmosphere. At the same time, the lack of effective demand from either compliance or voluntary market participants in Australia or internationally is a critical reason that carbon market prices - including for VCM offsets, remain so low internationally.

With current and proposed legislative plans for mandatory climate disclosure in key international markets (see earlier section), this pricing and demand gap could narrow over the next decade. Even then, it would require steep reductions in national emissions quotas and fixed carbon pricing in many jurisdictions to meet the environmental and financing goals.

Corporates in the voluntary market can choose to buy higher-priced offsets from the compliance market or buy cheaper offsets in the voluntary market—and many prefer the cheapest path to offset their emissions by buying low-cost international offsets. This trend can be seen in the Australian carbon market for voluntary emissions reductions. Regulated Australian compliance offsets, ACCUs, sit at a long-term average of around \$24 per ACCU.

At these prices, there is a clear preference for corporates in the voluntary market in Australia to buy low-cost international compliance offsets, Certified Emissions Reduction Units (CERs) rather than ACCUs.<sup>36</sup> While 283,000 ACCUs were voluntarily cancelled in Q1 2021, voluntary international reduction unit cancellations increased from 1.6 million units in Q1 2021 to 2.6 million units in Q1 2022.

CERs are international compliance carbon offsets issued in developing countries where environmental commodity prices are usually lower. In principle, if they offset a ton of CO2e, it should not matter if they are lower priced than ACCUs—however, not all carbon offsets are real or of equal quality. For this reason, compliance market entities are not allowed to use CERs as offsets.



Voluntary corporate cancellations of offsets produced in developing countries can be counted toward national emissions reduction targets in developed countries and by corporations in developed countries against their emissions

#### Scrutiny of carbon credit offsets

There is ongoing criticism about the environmental integrity of carbon credit offset programs and scrutiny of their use in the compliance and voluntary carbon markets. Carbon offset credits represent a ton of CO2<sub>e</sub> carbon emissions that have been avoided, captured, or sequestered via various industrial, energy, agriculture, land use and forestry projects. Each carbon credit potentially can "offset" a ton of CO2e pollution produced at another entity's site of operations. The sale of carbon offset credits generates revenue for those projects, i.e., carbon finance, that can be used to invest in existing and new carbon removal projects that offset emissions elsewhere.

This market-based approach to carbon finance plays a key role in compliance markets and is the central idea behind the voluntary carbon market. Yet, the environmental integrity of carbon credit offset use is the subject of intense criticism and scrutiny.

The main criticism of the use of carbon offset programs is environmental—specifically that the claimed avoidance, capture or sequestration of a ton of carbon through Carbon offset credits represent a ton of C02e carbon emissions that have been avoided, captured, or sequestered via various industrial, energy, agriculture, land use and forestry projects

carbon offset programs is not real, or it does not actually offset a ton of CO2<sub>e</sub> emissions released into the atmosphere from burning fossil fuels.

There are several reasons that claimed reductions and removals might not be real. These include claimed reductions for which the credits issued were not additional or new reductions but would have happened anyway; the program was based on faulty environmental methodology; the claims were never realised or overestimated; or external factors, such as climate change, droughts, and fires, led to reversal and the offsets should have been cancelled.<sup>37</sup>

In principle, the "quality carbon offset credits must be associated with GHG reductions or removals that are:

- Additional
- Not overestimated
- Permanent
- Not claimed by another entity
- Not associated with significant social or environmental harms."<sup>38</sup>

The permanence or durability of offset program claims, particularly of agriculture, forestry, and land use claims, remains a major issue of contention.



Further, the development of long term CO2<sub>e</sub> capture and storage technologies is currently too costly to scale. Hence, corporates pursuing net-zero claims should seek to reduce direct and indirect emissions before offsetting unavoidable emissions. Even then, the use of offsets requires extensive due diligence.

#### The use of low-cost international offsets in the voluntary market

Over the past several years, corporates in developed countries have been able to purchase low-cost international offsets (CERs) from developing countries for voluntary offset cancellations. CER (Certified Emissions Reduction) units were created under the Clean Development Mechanism (CDM) of the Kyoto Protocol and are administered by the United Nations. Developing countries have predominantly issued CERs for renewable and other energy projects.

There are also regulatory reasons that corporates in developed countries have been encouraged to make voluntary purchases of CERs, and this is that: "CERs can be used by industrialised countries to offset part of their emissions reductions targets under the Kyoto Protocol." In other words, voluntary corporate cancellations of offsets produced in developing countries can be counted toward national emissions reduction targets in developed countries and by corporations in developed countries against their emissions. This raises the issue of double counting offsets explored below.

The environmental integrity of the offsets sold under the CDM has been widely questioned. For example, "studies of the world's two largest offset programs – the CDM and Joint Implementation (JI), both administered by the United Nations under the Kyoto Protocol—suggest that up to 60-70% of their offset credits may not represent valid GHG reductions."<sup>39</sup>

For this reason, offsets issued under these programs, which are widely used in the voluntary market, "have been banned in the compliance market for most of the past decade."<sup>40</sup>

#### Double counting of carbon credits

The potential for the double-counting of carbon credits involves three sets of issues—double issuance, double claiming, and double use; when one country transfers and sells emissions reductions to another, both are counted as emissions reductions. These forms of double counting have been defined as follows:

"Double issuance can occur if more than one offset is issued for the same GHG reduction."<sup>41</sup>



- "Double use occurs if two different parties count the same offset credit towards their GHG reduction claims," and,
- "Doubling claiming can happen if offset credits are issued to a project, but another entity (e.g., a government or private company) counts the same GHG reductions towards its own GHG reduction goal."

These double-counting issues can be partly addressed through program and project governance mechanisms, registry systems and policy deliberation. Double issuance is primarily avoided by verifying individual offset program claims, cross-checking before issuance, and actively monitoring project registrations.<sup>42</sup>

The double-counting issues can be partly addressed through program and project governance mechanisms, registry systems and policy deliberation Of relevance to efforts to tokenise offsets are the measures to avoid double use, which is "avoided primarily through registry systems that assign unique serial numbers to individual offset credits, track their transfer and ownership, and record the purpose of their use and retirement."<sup>43</sup>

Double claiming can be partially avoided by excluding certain project types for GHG

reduction schemes and requiring exclusive use of legal attestations from project developers to cover buyers of offset credits.

Internationally, there are ongoing discussions around the issue of double claiming between developing country governments that may issue an offset credit and developed country governments, who may also seek to claim that credit towards their emissions reduction targets. The problem of international double claiming requires policy agreement and will not be solved through tokenising assets.

#### Supply of carbon credit assets

There has been a sharp increase in new venture investments that seek to solve the supply of ESG sustainability assets, primarily by selling carbon credits into voluntary carbon markets.

From VC to private equity funds, private venture funds specialising in clean tech investment are now in the 10s of billions. Since the start of 2021 alone, "72 climate venture funds totalling USD\$13 bn and six growth funds totalling USD\$24B have been announced." <sup>44</sup>



Carbon markets, tokenization, and the enterprise data challenge

New and earlier private commitments include:



While climate tech venture funds target multiple verticals, the individual ventures they invest in target carbon solutions in a single vertical, such as forestry and land use. These will sell to end-buyers directly or to a broker who may sell credits on market exchange.

🛞 Pachama

Pachama, for instance, is a forestry and land use venture with a recent USD\$50 million Series B round and total funding of USD\$78M <sup>45</sup> that sells directly to end enterprise buyers,<sup>46</sup> including

Microsoft, Shopify, Softbank and Flexport. Pachama also offers live project



visualisation (via Satellite feeds) and project data monitoring for buyers via its web 2.0 stack.

Given the level of venture funding, the number of these ventures targeting key verticals, selling directly to end-buyers, and listing assets on exchanges via brokers is set to increase. Intermediaries are also entering the market with advisory and carbon management services for companies pursuing net-zero emissions targets.



CarbonDirect, for instance, offers an end-to-end service, from carbon removal advisory and platform management for endbuyers to investing in the supply of carbon removal via growth

companies along target verticals. CarbonDirect manages Microsoft, Shopify, and Alaska Airline's carbon removal programs.

#### Development of voluntary market infrastructure

When buyers of carbon offsets say there is a lack of market liquidity, they are dealing with relatively illiquid assets that require extensive due diligence on a per-project basis. The over-the-counter (OTC) sales process for carbon credits is also fragmented.

The two critical parts of carbon market infrastructure are offset project registries and market exchanges, and both parts of these infrastructures are undergoing rapid development, particularly in the voluntary market. Buyers searching for carbon credit offsets can search online standards registry databases directly. If they are large enough, they can function as a wholesale buyer to use an account on an open-market exchange or buy from a market intermediary.

Specialised intermediaries—agents, brokers, funds, and commodities trading houses—also play a crucial role in carbon markets, which are introduced below.

#### Market infrastructure—registries

Compliance and voluntary market carbon offset programs have their own respective standards and offset credit registries. Government regulatory agencies run compliance market programs and registries, and non-governmental organisations run voluntary market program registries.

Voluntary offset program registries include the American Carbon Registry, Climate Action Reserve (CAR), Gold Standard, Plan Vivo and Verra. There are now some 15 registries specialising in voluntary carbon offset credits and related ESG assets.<sup>47</sup>



Carbon offset programs provide project validation and verification assurance methodologies, a register of individual offset programs and their verification documents and they track offset credits certificates issued by those projects.

Crucially, registry systems provide a measure of trust in their programs and their offset credits by assigning unique serial numbers to individual offset credits, tracking their transfer and ownership, and recording their purpose of use and retirement.<sup>48</sup> Verra and Gold Standard are two of the most well-known VCM offset programs and registries with international coverage.

#### Verified Carbon Standard / Verra (VCS/VCU)

Standard

Verified Carbon Standard (VCS) is the most widely Verified Carbon used voluntary carbon standard and it has the most projects in reforestation/afforestation and

renewable energy. Since 2020 Verra's Verified Carbon Standard Registry has offered an online searchable registry of planned projects under comment and discussion, and registered projects under the Verra VCS.

Verra registry search filters for each project are available by project type, methodology, status, country, region, and crediting period.<sup>49</sup> Each project provides a publicly available location map and a project summary, including the name and contact details of the project proponent and details of the project status, estimated emissions reductions, methodology and validator. All the documents for each VCS project, including Pipeline Documents, Registration Documents, and Issuance Documents, are publicly available for download as PDFs with the most dates available.

VCS Verified Carbon Units (VCUs) are also traceable via the VCS VCU registry. Each VCU is linked to a project ID and is searchable via its tagged project metadata, e.g., project type, country, additional certification, issuance status, issuance dates, and unique serial number. VCS also provides a buffer pool VCU registry-for use in case the initial offset credits issued are invalidated.

#### Gold Standard

Gold Standard carbon offsets contribute to UN **Gold Standard** Sustainable Development Goals (SDGs). Voluntary Emissions Reduction (VER) and Certified Emissions Reduction (CER) units can attain Gold Standard Certification. Gold Standard has similar international geographical coverage to Verra and provides a similar online project registry. Gold Standard has a broader scope of offerings, including a wide range of environmental project standards and enterprise emissions reduction frameworks, and provides a marketplace for buyers.



Carbon offset programs provide project validation and verification assurance methods, register offset programs, their verification documents, and track offset credits certificates issued by those projects

#### Carbon Meta-Registry



In October 2021, IHS Markit (NYSE: INFO), which S&P HS Markit<sup>®</sup> Global now owns, announced the launch of the Carbon Meta Registry (CMR). The CMR is an online platform

that currently connects eight registry systems worldwide and national, sub-national, and domestic voluntary programs.

These include: "Acre Carbon Standard, Global Carbon Council, Gold Standard, Plan Vivo Foundation, Papua New Guinea, UK Peatland Code, UK Woodland Carbon Code and Verra." IHS Markit states, "In early 2022, the Meta-Registry will expand to offer exchange connectivity to connected programs and standards." 50

The meta registry is accessible at: https://metaregistry.ihsmarkit.com/

Initial press releases said the meta-registry would "leverage distributed ledger technology to enable companies, governments, traders, and brokers to access information on projects and credits across jurisdictions, programs, and standards."51

The World Bank is participating on the Advisory Board as an observer. The advisory board of the CMR includes representatives from nearly all the main voluntary, national and sub-national programs, including: "Global Carbon Council, Gold Standard, Plan Vivo Foundation, REDD Plus, UK Peatland Code, UK Woodland Carbon Code and Verra." and governments, "Acre (Brazil), British Columbia (Canada), Jalisco (Mexico) and Peru." 52



Private sector advisory board members include major investment banks, carbon market exchanges, commodity funds, investment funds and major corporates: "Abaxx Exchange, Bank of America, Bluesource, CBL Markets, Chevron, DBS Bank, Equinor, Goldman Sachs, Hartree Partners, Ludovino Lopes Advogados, Macquarie Group, MEXICO2, Microsoft, Standard Chartered Bank, TD Bank, Temasek and TMX Group."<sup>53</sup>



#### Market infrastructure – spot and futures exchanges

Most international carbon credit offset transactions are OTC transactions rather than spot market transactions on exchanges. Secondary market trade volume is several times report spot volumes.<sup>54</sup>

The predominance of OTC transactions means that most end buyers of carbon credit offsets rely on relationships with retailers, which typically include advisory services and broking to access carbon credits. These retailers account for a large share of the spot transactions in the wholesale market.

Specialised OTC platforms, such as <u>Macht Trading</u> (UK) CORE Markets and Renewable Energy Workbench (Australia) and Carbon Streaming (US) have emerged to help wholesale market participants, including retailers and end-buyers understand price data, offset availability, and provide transaction services.









#### Spot market exchanges

Several spot-market exchanges for carbon offsets have emerged since 2019, which have increased market infrastructure and added to the demand for market transparency.



The largest voluntary spot market for net-zero promises globally is run by Xpansiv Market CBL, based in Sydney, Australia. Xpansiv Market CBL offers deep links to the

registries, project-by-project-based selection, and ESG asset bidding for investors across regions, technologies, and vintages.<sup>55</sup> Xpansiv filed for an IPO on the Australian Stock Exchange (ASX) in May 2022. The expected "float" has been revised upwards from AUD\$500 million in January 2021 to over AUD\$2 billion in the second half of 2022 or early 2023.<sup>56</sup>



Singapore is emerging as a regional carbon trading hub, with the Singaporean government actively establishing market infrastructure. The Singapore carbon market exchange, Climate Impact X (CIX) is a joint venture of

the Singapore Exchange (SGX), DBS Group, Standard Chartered Bank and Temasek, Singapore's sovereign wealth fund.<sup>57</sup>







TEMASEK



Other carbon market exchanges include the Carbon Trade Exchange in London and Sydney and the AirCarbon Exchange in Singapore.<sup>58</sup> The Saudi Arabian Public Investment Fund and Stock Exchange have recently announced a planned voluntary exchange in Riyadh for the Middle East and North Africa (MENA) region.

#### Futures market exchanges

Futures markets for voluntary credits have also emerged. Xpansiv Market CBL introduced standardised futures contracts in 2020 and partnered with the CME Group to launch carbon offset futures trading in March 2021 through CME Global Emissions Offsets Futures.<sup>59</sup>

The development of futures markets for offsets has allowed forward price discovery, which has led to higher prices increasing transaction volume and liquidity. There has also been increased demand for more market transparency, including reporting from rating agencies.<sup>60</sup>



The development of open spot and futures exchanges has encouraged commodity trading houses (Hartree Partners, Mecuria Energy Americas, and Vitol SA) and specialised funds (Andurand Climate and Energy Transition Fund) with bank counterparties (Macquarie) to enter the voluntary carbon market as investors.<sup>61</sup>



#### Tokenization

Many new entrants to the carbon market space want to create tokenised digital representations of carbon credit assets. The potential benefits of tokenising carbon assets are many. These include digital interoperability and efficiencies in standards governance, digital monitoring, reporting and verification (DMRV) models, data security, emissions and offset tracking, market access and project financing, trading efficiencies and analytics.

Several blockchain or distributed ledger technology (DLT) market infrastructure ventures have announced plans to enter the market exchange space. In contrast, others focus on developing DMRV platforms that generate tokenised assets. Voluntary market registries are also exploring the issues around Tokenization. New entrants to the market exchange space include Flowcarbon and CarbonPlace.

#### Flowcarbon



Flowcarbon is a pioneering climate technology company that brings carbon credits onto the blockchain and facilitates the

creation and financing of new, high-integrity carbon reduction and removal projects. Its mission is to make carbon markets accessible and transparent, enabling the efficient and early flow of capital to be invested directly into projects that combat climate change.

Andreessen Horowitz (a16z) led a \$32 million funding round that included contributions from Samsung Next and Invesco. Another \$38 million came from the sale of its Goddess Nature Token (GNT).



#### Carbonplace

Carbonplace Carbonplace Carbonplace was announced in May 2022 and is being developed by National Australia Bank, VISA and several other international financial institutions, including BNP Paribas, CIBC, Itaú Unibanco, NatWest Group, Standard Chartered, and UBS.



Carbonplace is described as a "carbon credit settlement platform" to "enable the reliable, secure, and scalable execution of voluntary carbon credit transactions, ensuring robust reporting and traceability, while offering records of ownership and a digital wallet for customers to store credits." <sup>62</sup> Carbonplace is being built as a private Ethereum platform with technology provider ConsenSys and is seeking EOIs from potential customers, carbon credit suppliers and potential partners.



Tokenization advantages include digital interoperability, efficiencies in standards governance, digital monitoring, reporting and verification, data security, emissions and offset tracking, market access and project financing Carbon markets, tokenization, and the enterprise data challenge

#### VCM registries exploring Tokenization



The two largest voluntary market registries, Verra and Gold Standard, have convened public consultations and stakeholder working groups to explore Tokenization issues.

A barrier to recent attempts to tokenise Verra's Verified Carbon Units (VCUs) is the requirement that "ownership of VCUs can only be transferred between Verra Registry accounts. VCUs cannot be transferred to other databases or traded as report certificates." <sup>63</sup>

Several DLT start-ups had recently sought to tokenise existing registry assets from Verra with the aim of retiring old lower-quality carbon offset credits. This resulted in the rapid price appreciation of those offsets and extensive trading activity. Verra responded by reiterating its ban on the Tokenization of its registry assets. Following this, Verra has opened a public consultation to explore its approach to third-party crypto instruments and Tokenization of Verra registry assets.<sup>64</sup>

Gold Standard has also announced its intention to engage with carbon market stakeholders to develop standards and prototypes around digital monitoring, reporting and verification (DMRV), and Tokenization for tracking, trading, and interoperability purposes.<sup>65</sup>

The World Bank's Climate Warehouse Initiative is also prototyping using blockchain/DLT technology to develop a carbon meta-registry.<sup>66</sup>

Several ventures are building specialist ledgers to supply, register, and exchange carbon credits in voluntary carbon markets. These include the US-based Regen Ledger, Nori, and MintCarbon. These ventures target AFOLU carbon offset programs while also serving as registries and marketplaces for those assets.<sup>67</sup> These ventures are potentially scalable to any number of offset projects across AFOLU use cases.<sup>68</sup>





#### Digital measurement, reporting and verification (DMRV)

Credible ecological benefit projects, including carbon offset credit programs, require independently assessed measurement, reporting and verification (MRV) processes. MRV processes include data collection, processing, calculations, reporting and verification according to standards-based methodologies and the specific project environment needs. MRV processes have been largely manual to date, even if digital tooling is used for some individual steps. Companies are developing digital MRV (DMRV) tooling to automatically collect, report and verify project data.

DMRV tooling may include hardware sensors, such as IoT devices, for measuring and feeding project data into software applications for verification and reporting. DMRV processes may also include emissions reporting and/or automated generation of carbon credits. DMRV applications are being developed on a broad range of software, including distributed ledgers.

#### The Guardian platform

**Hedera** The Hedera network is the most innovative, sustainable, enterprise-grade public ledger for the decentralized economy. The platform is governed by a globally diverse council of

industry leading organizations, including abrdn, Avery Dennison, Boeing, Chainlink Labs, Dentons, Deutsche Telekom, DLA Piper, EDF (Électricité de France), eftpos, FIS (WorldPay), Google, IBM, the Indian Institute of Technology (IIT), LG Electronics, Magalu, Nomura Holdings, ServiceNow, Shinhan Bank, Standard Bank Group, Swirlds, Tata Communications, Ubisoft, University College London (UCL), Wipro, and Zain Group.

# FOUNDATION

The HBAR Foundation is a quartet of web3 accelerator funds launched at the end of 2021 to support growth and adoption of Hedera Hashgraph, a sustainable proof-of-

stake public distributed ledger network differentiated by ultra-low energy requirements and carbon negativity, high speed and throughput, highest-grade security (e.g., ABFT), and low fees.

The Sustainable Impact Fund (SIF) is the Foundation's climate-action focused USD\$100M fund dedicated to accelerating development and deployment of innovative sustainability and ESG solutions built on and enabled by distributed ledger technology (DLT), with particular emphasis on transformative climate finance, carbon accounting, emissions management, ESG reporting, and environmental project integrity solutions enabled by Hedera.

Its mission is to use targeted investments in DLT-enabled climate tech, sustainable finance, and ESG disclosure products to bring the balance sheet of the planet to the public ledger.



Guardian is a SIF-funded decentralized, open-source sustainability token issuance platform built on the public Hedera network.

Guardian combines a customisable DMRV workflow engine and a Tokenization service. Guardian uses the public distributed ledger, Hedera Hashgraph, to write project data and issue tokens using the Hedera Token Service.<sup>69</sup>



Envision built the open-source Guardian platform and maintains the repository. Their mission is to reshape and align today's systems allowing

organisations to recognise the new value in tomorrow's Industry Vertical Solutions. Some examples of Envision's Web3 services include Zero-Knowledge Proofs, Tokenization, API Development, System Integration, and Mobile & Web UI/UX Development. They focus on guiding organisations through 3 major milestones on their Web3 journey: Use Case Analysis, Proof of Concept Development, and Scaled Deployments.

Guardian is being used for sustainability projects by companies internationally, including the ASX-listed TYMLEZ, DOVU based in the UK, KrypC based in India and Tamuwa/cynk.io based in Kenya.

TYMLEZ (ASX: TYM) is a pioneer in the development and delivery of carbon reporting and guarantee of origin solutions built using blockchain technology. TYMLEZ provides companies across the globe with world-class solutions designed to empower them in their decarbonisation journeys. As part of TYMLEZ's commitment to Open Source and the Hedera community, they announced in October 2022 the release of two of their core policies to open-source.

As part of TYMLEZ's commitment to Open Source and the Hedera community, they announced in October 2022 the release of two of their core policies to open-source<sup>70</sup>.

**DOVU**, is accelerating net zero by empowering the transparent digitisation and trading of carbon at scale and at speed. Dovu has created an end-to-end platform for scaling voluntary carbon offsetting solutions, empowering carbon sequestration projects for the benefit of both people and planet. Most significantly, Dovu is supporting corporations and countries to fulfill their net zero targets by 2050

KrypC is a global technology company automating carbon offset creation and distribution with its newly launched platform, CarbonCore. KrypC helps empower enterprises with the project registration, development, monitoring, reporting, validation, and overall project management for



the carbon listing process to enhance the credibility and verification of the data. Simply, CarbonCore is a solution running on the carbon-negative Hedera network that aims to make carbon trading markets more reliable, efficient, and inclusive. The application can be integrated with existing platforms to allow carbon emitters to easily purchase carbon offsets, and enables environmental projects to provide carbon credits to the market through a streamlined tokenization and minting process.

**CTANUUG** Tamuwa is the leading renewable biomass briquette producer in Kenya, specialising in the conversion of agri waste into renewable alternative fuel sources. These untapped resources once converted into renewable biomass fuels reduce the burning of wood for energy, which in turn reduces deforestation. Tamuwa is launching Cynk.io which aims to digitise voluntary carbon markets to provide high quality, transparent carbon credits whilst directly connecting sellers to buyers on the Hedera Network.

The HBAR Foundation's Sustainable Impact Fund (SIF) is investing USD\$100m in 2022 to develop Guardian and support the development of individual projects.<sup>71</sup> Guardian sustainability project use cases include:

- Supply chain or energy management businesses focused on DMRV data around GHG emissions.
- Renewable energy credit (REC) projects that require, for instance, DMRV data from solar inverter devices.
- Projects seeking to use DMRV data for carbon offset credit projects, including sequestration and captured emissions.

Core features of Guardian include:

- A Policy Workflow Engine (PWE) that enables requirements-based Tokenization for sustainability projects according to customisable DMRV workflows. The PWE executes a workflow in accordance with the requirements expressed as a Guardian policy document. As part of this workflow a series of verifiable documents is produced, which record relevant information leading to the final stage of minting of the token using Hedera Token Service.
- **Decentralised identity management**. The Guardian uses W3C decentralised identifiers (DIDs) to enable verifiable decentralised digital identity for any entity, such as an organisation, an individual device, or a person involved in the policy workflow.<sup>72</sup>
- **Auditability**. Tokens created by Guardian instances on Hedera maintain an auditable link to all the project data called a 'trust chain', which includes all the



actors, entities, and events involved in creating that asset.<sup>73</sup> This digital MRV process produces an auditable framework for buyers, internal and external stakeholders, and service providers to digitally audit the provenance of an asset and its data.

• **Discoverability of assets**. Tokens will be flagged with a memo that allows people or entities to subscribe to as a consensus topic on Hedera. This topic could be a particular type of ESG token, such as a carbon offset for a carbon removal unit. Not only will individual assets or projects be discoverable, but people will be able to search and filter by attributes across hundreds or thousands of projects using Hedera service providers.



Ledger Works provides an interesting example of this in practice; in addition to high availability Hedera mirror and event notification services, their ESG domain data APIs support the discovery of Standard Registries, Guardian policies, and carbon offset and emissions tokens, with the ability to search by specific offset

attributes such as methodology, vintage or location.

• **Selective Disclosure.** The Guardian community is evaluating methods to enable selective disclosure. This approach will help in reconciling the tension between necessary transparency and desired confidentiality for ESG markets.



A major gap in the ESG market is transparency around corporate carbon offsetting programs for regulators, investors and customers

5

# **4. How Trustury can help B2C enterprises net zero mandates**



#### Trust and provenance for sustainability tokens

Enterprises face the challenge of how to make their net zero commitments transparent. A major gap in the ESG market is transparency around corporate carbon offsetting programs for regulators, investors, and customers. This is especially the case for customer-facing enterprises like banks, brands, and retailers.

Airlines, for instance, encourage their customers to pay to offset their emissions mileage without traceability over those purchases. With this challenge in mind, Meeco has developed a way for enterprises to allow their customers to view and track detailed information about individual carbon credits used to offset their purchases.

To bring transparency to their net-zero claims, enterprises need a data infrastructure framework that gives their customers the power to view and access individual tokenised assets.

Meeco has developed a visualisation application called **Trustury** that allows people to view detailed provenance and lifecycle information about individual carbon credit offsets that have been tokenised.

Meeco developed Trustury with the support of the HBAR Foundation's Sustainable Impact Fund to provide a visualisation layer for Hedera's token ecosystem.<sup>74</sup>

- By using tokenised representations of carbon credit offsets, Trustury allows customers to view and track detailed information about the assets used to offset their purchases.
- Trustury's integration with the sustainability businesses that supply carbon credits means that Meeco can bring end-to-end transparency to enterprises' carbon offset commitments for customers.
- Trustury can be used to visualise individual sustainability tokens, such as carbon offset credit tokens, minted by the Guardian platform on the Hedera ledger.
- Where enterprises have carbon offset programs in place, Trustury can be deployed to enable customers to view tokenised carbon credit offsets from existing registry programs.



Carbon markets, tokenization, and the enterprise data challenge

- Trustury can be integrated into existing customer wallet applications, or Meeco can provide the customer identify framework and digital wallet that includes Trustury.
- Trustury will enable an interface for a user to request selective disclosure, enabling disclosing parties to progressively share information with a third party, for example, an ESG auditor.

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#### Meeco infrastructure for tokenised services

Meeco's platform Secure Value Exchange (SVX) provides a suite of enterprise infrastructure tools that are needed by consumer-facing brands to securely implement tokenised services for their customers at scale—for instance, by linking sustainability tokens to customer digital wallet applications.

Meeco's digital tools provide a secure and trusted decentralised identity management ecosystem for customer-facing brands. While Trustury provides a visualisation layer for sustainability tokens, SVX includes:

 Verifiable Credentials Management, a service that supports the issuance, request, verification, and revocation of W3C verifiable credentials, enabling all parties in a trusted ecosystem to come together to exchange and verify information,



Carbon markets, tokenization, and the enterprise data challenge

- A Multipurpose Wallet. Meeco's Multipurpose wallet supports decentralised identity, verifiable credentials, micropayments, and tokens.
- A Secure Data Vault. The Meeco Vault is a secure data enclave that allows access, control, and exchange of all kinds of data, including credentials, documents, and media.

Enterprises can use these tools to implement tokenised services for their customers, including issuing sustainability tokens purchased from carbon offset registries.

Meeco's platform is Privacy-by-Design and Security-by-Design, which minimises data use and protects data (based on explicit consent) while providing for audit and compliance whilst leveraging progressive disclosure.



Whilst ESG and carbon tokenization methodologies will mature over the next decade, it is critical to identify ways to implement tracking and reporting in order to enable transparency and trust

# **5. Recommendations**

As this report has uncovered, this is an emerging market, and one in which uncertainty and opportunity can appear equally matched. Notwithstanding the apparent grey areas, such as evolving regulation and the maturing policy debate, our view is that there is sufficient stability - and of course opportunity - to warrant immediate further exploration by organisations with retail customers.

To a large degree our view is shaped by the maturity and flexibility of available technology, and growing customer demand. For example,

- 1. The core components required to demonstrate to customers that the premium paid for carbon offset travel has contributed to a travel operator's ESG targets, and crucially the reduction in GHGs, can be implemented today.
- 2. Similarly, it is technically feasible for customers to scan a QR code label on a sweater claiming to be woven from low carbon impact wool, verify that claim on their phone and then be rewarded with points for "buying green".
- 3. And importantly, the focus on distributed ledger technology as part of the enablement layer means that increasingly these claims and assertions are publicly auditable.

The interdependence of innovation and regulation is a constant focus for technologists and policy makers, with both parties eager to avoid missteps that hamper progress. Helpfully, in this instance, the SEC has laid out a series of rules that offer a practical blueprint for getting started. We invite commercial entities to project a couple of years from now and imagine how they would demonstrate achievement of ESG targets in their annual report, based on SEC guidance.

As with everything at Meeco, we strongly recommend starting with the customer value proposition and experience. On that basis, we offer some prompts to get you started and an open invitation to get in touch if you'd like to start experimenting today.

- Thinking about your customers, which segment is most motivated by the topic of ESG, perhaps evidenced in the products and services they buy today?
- What behaviour do they display and is this behaviour transferable to other customers?
- Is there a product or service line that has a lower carbon footprint than others and can be promoted to appeal to a wider set of customers?



Carbon markets, tokenization, and the enterprise data challenge

- Are suppliers in your supply chain focused on their carbon footprint, and could you partner with them?
- Focusing on your ESG targets, which of your products or services most easily lend themselves to audit experimentation? Do your policies for some products or services map easily to initiatives such as Verra and Gold Standard?
- If you already work with ESG auditors, could you simplify their audit process and lower your operating costs by introducing progressive disclosure?

Contact us if you'd like support mapping out the roles and needs of the various actors, together with creating demonstrators that you can put in the hands of your customers and other stakeholders.

We'd like to be part of your ESG journey.



# Acknowledgements

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### Glossary

| ESG: Environmental, Social and Governance               | EMSs: Environmental Management Systems               |  |  |  |
|---|--|--|--|--|
| GHG: Greenhouse Gases                                   | CERs: Certified Emissions Reduction Units            |  |  |  |
| REC: Renewable Energy Certificate                       | CDM: Clean Development Mechanism                     |  |  |  |
| ETSs: Emissions Cap-and-Trade Scheme                    | OTC: Over the counter                                |  |  |  |
| TCFD: Task Force on Climate-Related Financial           | CAR: Climate Action Reserve                          |  |  |  |
|   | VCS: Verified Carbon Standard                        |  |  |  |
| SEC: US Securities and Exchange Commission              | VCUs: Verified Carbon Units                          |  |  |  |
| SPCs: Smaller Private Companies                         |  |  |  |  |
| VCM: Voluntary Carbon Market                            | SDGs: UN Sustainable Development Goals               |  |  |  |
|   | DMRV: Digital Monitoring, Reporting and Verification |  |  |  |
| TSVCM: Taskforce on Scaling Voluntary Carbon<br>Markets | DLT: Distributed Ledger Technology                   |  |  |  |
| ACCUs: Australian Carbon Credit Units                   | AFOLU: Agriculture, Forestry, and Other Land Use     |  |  |  |
| CER: Australian Clean Energy Regulator                  | PWE: Policy Workflow Engine                          |  |  |  |
|   |  |  |  |  |

Meeco

ERF: Emissions Reduction Fund

<sup>3</sup> Berg, Florian, Julian F Kölbel, and Roberto Rigobon. 2022. 'Aggregate Confusion: The Divergence of ESG Rating'. *Review of Finance*, May, rfac033. <u>https://doi.org/10.1093/rof/rfac033</u>, p. 2.

<sup>4</sup> For the Principles for Responsible Investment (PRI) see, 'What Are the Principles for Responsible Investment?' PRI. Accessed 7 June 2022. <u>https://www.unpri.org/about-us/what-are-the-principles-for-responsible-investment</u>. For PRI data cited in this section, see the Paris-aligned Investment Initiative. 2021. 'Paris Aligned Investment Initiative – Investing for a Net Zero Future'. Paris Aligned Investment Initiative. <u>https://www.parisalignedinvestment.org/</u>.

<sup>5</sup> Bloomberg Intelligence. 2021. 'ESG Assets May Hit \$53 Trillion by 2025, a Third of Global AUM'. *Bloomberg Professional Services*, 23 February 2021, sec. Research and Analysis. <u>https://www.bloomberg.com/professional/blog/esg-assets-may-hit-53-trillion-by-2025-a-third-of-global-aum/</u>.

<sup>6</sup> This is one of the reasons that Telsa was recently dropped from the S&P 500 ESG Index. Dorn, Margaret. 2022. 'The (Re)Balancing Act of the S&P 500 ESG Index'. *Indexology Blog, S&P Dow Jones Indices* (blog). 17 May 2022. <u>https://www.indexologyblog.com/2022/05/17/the-rebalancing-act-of-the-sp-500-esg-index/</u>.

<sup>8</sup> Langley, William. 2022. 'DWS Chief Resigns after Police Raid over Greenwashing Claims'. *Financial Times*, 1 June 2022. <u>https://www.ft.com/content/50f5c4a1-5ebe-40cc-a89f-2952f58ba324</u>.

<sup>9</sup> Recent ESG rating controversies include the decision by S&P to remove Tesla from the S&P 500 ESG index. S&P's decision hinged on Tesla's alleged performance shortfalls in environmental, social and governance areas—specifically S&P claimed that Tesla lacks a low carbon strategy and performed poorly on codes of business conduct. See, Dorn, Margaret. 2022. 'The (Re)Balancing Act

of the S&P 500 ESG Index'. Indexology Blog, S&P Dow Jones Indices.

<sup>10</sup> Berg, Florian, Julian F Kölbel, and Roberto Rigobon. 2022. 'Aggregate Confusion: The Divergence of ESG Rating'. *Review of Finance*, May, rfac033. <u>https://doi.org/10.1093/rof/rfac033</u>.

<sup>11</sup> Chatterji, Aaron K., Rodolphe Durand, David I. Levine, and Samuel Touboul. 2016. 'Do Ratings of Firms Converge? Implications for Managers, Investors and Strategy Researchers'. *Strategic Management Journal* 37 (8): 1597–1614. <u>https://doi.org/10.1002/smj.2407</u>.

<sup>12</sup> Gibson Brandon, Rajna, Philipp Krueger, and Peter Steffen Schmidt. 2021. 'ESG Rating Disagreement and Stock Returns'. *Financial Analysts Journal* 77 (4): 104–27. https://doi.org/10.1080/0015198X.2021.1963186.

<sup>13</sup> This TCFD recommendations have been incorporated into climate-risk disclosure standards being developed by the International Sustainability Standards Board, (ISSB). See the 'Exposure Draft IFRS S2 Climate-Related Disclosures'. Exposure Draft ED/2022/S2. IFRS Foundation.

https://www.ifrs.org/content/dam/ifrs/project/climate-related-disclosures/issb-exposure-draft-2022-2climate-related-disclosures.pdf.

<sup>14</sup> See, Task Force on Climate-related Financial Disclosures (TCFD). 2021. 'Task Force on Climate-Related Financial Disclosures: 2021 Status Report'. Status Report. Task Force on Climate-related Financial Disclosures (TCFD).

<sup>15</sup> Task Force on Climate-related Financial Disclosures (TCFD). 2017. 'Recommendations of the Task Force on Climate-Related Financial Disclosures'.

<sup>16</sup> See, US Securities and Exchange Commission (SEC). 2022. 'SEC Proposes Rules to Enhance and Standardize Climate-Related Disclosures for Investors'. SEC.Gov. 21 March 2022. <u>https://www.sec.gov/news/press-release/2022-46</u>.



<sup>&</sup>lt;sup>1</sup> World Bank. 2022. 'State and Trends of Carbon Pricing 2022'. International Bank for Reconstruction and Development / The World Bank. <u>http://hdl.handle.net/10986/37455</u>, p.12

<sup>&</sup>lt;sup>2</sup> The term ESG was coined by a UN Global Compact Initiative report, "Who Cares Wins" that was published in 2004. ESG was an attempt to incorporate earlier approaches to ethical finance, such as corporate social responsibility (CSR), into a new sustainability framework around the ethical pillars or environmental, social and governance. See, Billio, Monica, Michele Costola, Iva Hristova, Carmelo Latino, and Loriana Pelizzon. 2021. 'Inside the ESG Ratings: (Dis)Agreement and Performance'. *Corporate Social Responsibility and Environmental Management* 28 (5): 1426–45. https://doi.org/10.1002/csr.2177. p. 1427.

<sup>&</sup>lt;sup>7</sup> Armour, Cathie. 2021. 'What Is "Greenwashing" and What Are Its Potential Threats?' *Company Director*, 1 July 2021. <u>https://aicd.companydirectors.com.au/membership/company-director-magazine/2021-back-editions/july/the-regulator</u>.

<sup>17</sup> See, the US Securities and Exchange Commission (SEC). 2022. '33-11042 The Enhancement and Standardization of Climate-Related Disclosures for Investors'. US Securities and Exchange Commission (SEC). https://www.sec.gov/rules/proposed/2022/33-11042.pdf, p.22.

<sup>18</sup> See, the US Securities and Exchange Commission (SEC). 2022, '33-11042 The Enhancement and Standardization of Climate-Related Disclosures for Investors'.

https://www.sec.gov/rules/proposed/2022/33-11042.pdf., p. 43.

<sup>19</sup> See, the US SEC. 2022. '33-11042 The Enhancement and Standardization of Climate-Related Disclosures for Investors'. p.25.

<sup>20</sup> Upstream activities include Scope 2 GHG emissions from activities "by a party other than the registrant that relate to the initial stages of a registrant's production of a good or service (e.g., materials sourcing, materials processing, and supplier activities)", while downstream activities include Scope 3 emissions, "by a party other than the registrant that relate to processing materials into a finished product and delivering it or providing a service to the end user (e.g., transportation and distribution, processing of sold products, use of sold products, end of life treatment of sold products, and investments)." See, the US SEC. 2022. '33-11042 The Enhancement and Standardization of Climate-Related Disclosures for Investors'. p.57.

Note, the SEC proposed rules exclude smaller reporting companies (SRCs) from Scope 3 GHG emissions metrics reporting. SRC's are defined as, "an issuer that is not an investment company, an asset-backed issuer, or a majority-owned subsidiary of a parent that is not a smaller reporting company and that: (1) had a public float of less than \$250 million; or (2) had annual revenues of less than \$100 million and either: (i) no public float; or (ii) a public float of less than \$700 million." See, the US SEC, 2022, '33-11042 The Enhancement and Standardization of Climate-Related Disclosures for Investors'. p. 41.

<sup>21</sup> World Bank. 2022. 'State and Trends of Carbon Pricing 2022'. International Bank for Reconstruction and Development / The World Bank. <u>http://hdl.handle.net/10986/37455</u>, p.12
 <sup>22</sup> Carbon credits in the compliance markets are priced at an order of magnitude higher than those in the voluntary markets, for instance, \$25 per cubic ton of CO<sub>2</sub>e rather than \$2.50.

<sup>23</sup> See, the Clean Energy Regulator, Australia Government. 2020. 'Certified Emission Reduction Units'. 17 September 2020. <u>http://www.cleanenergyregulator.gov.au/OSR/ANREU/types-of-emissions-units/certified-emission-reduction-units</u>.

<sup>24</sup> Data on the volume and value of voluntary carbon market trade is available from Ecosystem Marketplace (EM). EM's 2021 data is based on survey data from 180 entity respondents, including data from 14 carbon standards' registries. Forrest Trends Ecosystem Marketplace. 2021. 'Voluntary Carbon Markets Top \$1 Billion in 2021 with Newly Reported Trades, a Special Ecosystem Marketplace COP26 Bulletin'. Ecosystem Marketplace (blog). 10 November 2021.

https://www.ecosystemmarketplace.com/articles/voluntary-carbon-markets-top-1-billion-in-2021-withnewly-reported-trades-special-ecosystem-marketplace-cop26-bulletin/

<sup>25</sup> Forrest Trends Ecosystem Marketplace. 2021. 'Voluntary Carbon Markets Top \$1 Billion in 2021 with Newly Reported Trades, a Special Ecosystem Marketplace COP26 Bulletin'.

<sup>26</sup> Hale, Thomas. 2022. 'The Carbon Offset Market Is Falling Short. Here's How to Fix It'. *Financial Times*, 5 May 2022.

<sup>27</sup> "Data on the value of voluntary carbon market trade is available from Forrest Trends Ecosystem Marketplace (EM). EM's 2021 data is based on survey data from 180 entity respondents, including data from 14 carbon standards' registries. Forrest Trends reports that VCM trade volume reached over US \$2 billion in 2021. Trade volume is distinct from the notional value of the total of voluntary carbon offsets. Forrest Trends Ecosystem Marketplace. 2022. 'The Art of Integrity: State of the Voluntary Carbon Markets 2022 Q3'. State of the Voluntary Carbon Markets. Washington, DC: Forest Trends Association. <a href="https://www.ecosystemmarketplace.com/publications/state-of-the-voluntary-carbonmarkets-2022/">https://www.ecosystemmarketplace.com/publications/state-of-the-voluntary-carbonmarkets-2022/</a> p.2"

<sup>28</sup> Forrest Trends Ecosystem Marketplace. 2022. 'The Art of Integrity: State of the Voluntary Carbon Markets 2022 Q3'. State of the Voluntary Carbon Markets. Washington, DC: Forest Trends Association. <u>https://www.ecosystemmarketplace.com/publications/state-of-the-voluntary-carbon-markets-2022/</u>., p.7

<sup>29</sup> The Art of Integrity: State of the Voluntary Carbon Markets 2022 Q3, p. 7

<sup>30</sup> Author's estimates based on 2021 VCM data in 'The Art of Integrity: State of the Voluntary Carbon Markets 2022 Q3', p.8

<sup>31</sup> See, 'State of the Voluntary Carbon Markets 2021: Instalment 1'.

<sup>32</sup> Forrest Trends Ecosystem Marketplace. 2022. 'The Art of Integrity: State of the Voluntary Carbon Markets 2022 Q3'. State of the Voluntary Carbon Markets. Washington, DC: Forest Trends Association. <u>https://www.ecosystemmarketplace.com/publications/state-of-the-voluntary-carbon-markets-2022/</u>, p.7

<sup>34</sup> See, CER 2022. 'Quarterly Carbon Market Report - March Quarter 2022'. pp.3-4 for all data in this section.

<sup>35</sup> CER 2022. 'Quarterly Carbon Market Report - March Quarter 2022'. p.14

<sup>36</sup> CER (Certified Emissions Reduction) units are created under the Clean Development Mechanism (CDM) of the Kyoto Protocol and are administered by the United Nations. "The majority of CERs are related to renewable and other energy projects predominantly in developing countries. CERs can be used by industrialised countries to offset part of their emissions reduction targets under the Kyoto Protocol." See, Renewable Energy Hub. 2022. 'Carbon Units 101'. *Renewable Energy Hub* (blog). 8 February 2022. https://www.renewableenergyhub.com.au/carbon-units-101/.

<sup>37</sup> 'UNDP High Integrity Voluntary Carbon Markets: Emerging Issues in Forest Countries'. V2. p.18
 <sup>38</sup> Broekhoff, et.al. 2019. 'Securing Climate Benefit: A Guide to Using Carbon Offsets'. p.18

<sup>39</sup> See, Broekhoff, Derik, Michael Gillenwater, Tani Colbert-Sangree, and Patrick Cage. 2019. 'Securing Climate Benefit: A Guide to Using Carbon Offsets'. Stockholm Environment Institute & Greenhouse Gas Management Institute. <u>Offsetguide.org/pdf-download/</u>. p.17.

<sup>40</sup> See, Wettengel, Julian. 2021. 'Old Discredited Carbon Offsets Sold to German Companies – Media Report'. Clean Energy Wire. 24 March 2021. <u>https://www.cleanenergywire.org/news/old-discredited-carbon-offsets-sold-german-companies-media-report</u>.

<sup>41</sup> For instance, the same reduction is claimed by different overlapping programs leading to the double issuance of offsets for a given unit of emissions. See, Broekhoff, et.al. 2019. 'Securing Climate Benefit: A Guide to Using Carbon Offsets'. p. 28.

<sup>42</sup> See, Broekhoff, et.al. 2019. 'Securing Climate Benefit: A Guide to Using Carbon Offsets'. p.29. <sup>43</sup> See, Broekhoff, et.al. 2019. 'Securing Climate Benefit: A Guide to Using Carbon Offsets'. p. 29.

<sup>44</sup> See, Zou, Sophie Purdom and Kim. 2022. ' Dry Powder for Climate Tech Remains #106'. Substack newsletter. *Climate Tech VC* (blog). 21 June 2022. <u>https://climatetechvc.substack.com/p/-</u> <u>dry-powder-for-climate-tech-remains</u>.

<sup>45</sup> Pachama. 2022. 'Nature-Based Carbon Credit Platform Secures \$55M in New Funding Round, Led by Future Positive'. GlobalNewswire. <u>https://www.globenewswire.com/news-</u>

release/2022/05/05/2437236/0/en/Nature-based-carbon-credit-platform-secures-55M-in-new-funding-round-led-by-Future-Positive.html.

<sup>46</sup> Pachama. 2022. 'Pachama'. Pachama. 2022. https://pachama.com/enterprise.

<sup>47</sup> Ecosystem Marketplace. 2022. 'EM Data Intelligence & Analytics Dashboard - Public Version 1.0 - Ecosystem Marketplace'. Ecosystem Marketplace.

 <sup>48</sup> See, Broekhoff, Derik, Michael Gillenwater, Tani Colbert-Sangree, and Patrick Cage. 2019.
 'Securing Climate Benefit: A Guide to Using Carbon Offsets'. Stockholm: Stockholm Environment Institute & Greenhouse Gas Management Institute. <u>Offsetguide.org/pdf-download/</u>. p. 29.
 <sup>49</sup> See, VERRA (2022). 'Verified Carbon Standard Registry'.

https://registry.verra.org/app/search/VCS/Registered

<sup>50</sup> IHS Market Newsroom. 2021. 'First Global Carbon Credit Meta-Registry Launches'. IHS Market. 28 October 2021. <u>https://news.ihsmarkit.com/prviewer/release\_only/slug/2021-10-28-first-global-carbon-credit-meta-registry-launches</u>.

<sup>51</sup> Saliyid, Amena. 2021. 'IHS Markit to Launch Meta-Registry for Global Carbon Credits'. IHS Markit. 9 March 2021. <u>https://cleanenergynews.ihsmarkit.com/research-analysis/ihs-markit-to-launch-onestop-registry-for-global-carbon-credit.html</u>.

<sup>52</sup> IHS Market Newsroom. 2021. 'First Global Carbon Credit Meta-Registry Launches'.

<sup>53</sup> IHS Market Newsroom. 2021. 'First Global Carbon Credit Meta-Registry Launches'.

<sup>54</sup> ACCU spot trades, for instance, are between 5-10% of total ACCU transactions reported in the Australian National Registry of Emissions Units (ANREU). Further, on average, secondary market trade volume is seven times the reported ACCU spot volumes. Clean Energy Regulator, Australia Government. 2022. 'Quarterly Carbon Market Report - March Quarter 2022'. Quarterly Carbon Market Report. Canberra, ACT: Clean Energy Regulator, Australian Government, pp.7-8.

<sup>55</sup> 'Voluntary Markets for Carbon Offsets: Evolution and Lessons for the LNG Market', p. 12

<sup>&</sup>lt;sup>33</sup> Clean Energy Regulator (CER), Australia Government. 2022. 'Quarterly Carbon Market Report -March Quarter 2022'. Canberra, ACT, p. 3

<sup>56</sup> See, Macdonald, Anthony, Sarah Thompson, and Kanika Sood. 2022. 'Xpansiv IPO Ready to Go'. *Australian Financial Review*, 1 May 2022, <u>https://www.afr.com/street-talk/xpansiv-ipo-ready-to-go-20220501-p5ahin</u>, and Chanticleer. 2022. 'World's Hottest Commodity Market Heads for ASX Listing'. *Australian Financial Review*, 31 January 2022, sec. chanticleer.

https://www.afr.com/chanticleer/world-s-hottest-commodity-market-heads-for-asx-listing-20220130p59sbf.

<sup>57</sup> Climate Impact X (CIX). 2022. https://www.climateimpactx.com/about.

<sup>58</sup> 'Voluntary Markets for Carbon Offsets: Evolution and Lessons for the LNG Market', p. 12

<sup>59</sup> 'Voluntary Markets for Carbon Offsets: Evolution and Lessons for the LNG Market', p. 15

<sup>60</sup> 'Voluntary Markets for Carbon Offsets: Evolution and Lessons for the LNG Market', p. 24

<sup>61</sup> Voluntary Markets for Carbon Offsets: Evolution and Lessons for the LNG Market', p. 15. <sup>62</sup> NAB. 2022. 'Carbonplace, NAB and Visa Team Up for Carbon Credit Transfer'. NAB News. https://news.nab.com.au/news/carbonplace-transfer/.

<sup>63</sup> See, 'Verra - Verified Carbon Units (VCUs)'. Verra. Accessed 27 June 2022. https://verra.org/project/vcs-program/verified-carbon-units-vcus/.

<sup>64</sup> Verra. 2022. 'Verra - Public Consultation: Verra's Approach to Third-Party Crypto Instruments and Tokens'. 3 August 2022. <u>https://verra.org/public-consultation-verras-approach-to-third-party-crypto-instruments-and-tokens/</u>.

<sup>65</sup> Gold Standard. 2022. 'Digitising MRV'. https://www.goldstandard.org/our-story/digitising-mrv
 <sup>66</sup> World Bank. 2022. 'State and Trends of Carbon Pricing 2022'. International Bank for

Reconstruction and Development / The World Bank. <u>http://hdl.handle.net/10986/37455</u>. p.47 <sup>67</sup> See, for example: the US based climate-related NFT projects, Regen Ledger

https://www.regen.network/, Nori https://nori.com/ and the Canadian-based, MintCarbon, https://www.mintcarbon.io/

<sup>68</sup> Agriculture, Forestry and Other Land Use (AFOLU) is a term that is used in 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines which describes the anthropogenic GHG emissions from two distinct sectors: Agriculture and LULUCF (Land Use, Land Use Change and Forestry).

<sup>69</sup> Hedera is an enterprise-grade public blockchain that uses a proof of stake rather than a proof of work algorithm to reach consensus around the state of any transaction, whether minting of a token or around the state of a particular set of data. Because of its use of proof of stake, Hedera is a low carbon footprint ledger.

<sup>70</sup> https://medium.com/tymlez/tymlez-releases-2-open-source-guardian-policies-in-time-for-cop27-29f9f931be33

<sup>71</sup> Geisenberger, Wes. 2022. 'Building on the SIF Ecosystem'. *The HBAR Foundation* (blog). 10 March 2022. https://www.hbarfoundation.org/blog-post/building-on-the-sif-ecosystem.

<sup>72</sup> W3C Verifiable Credentials (VC) allow the identity (in this case, the DIDs) to have verifiable credentials based on attributes to that identity, and Verifiable Presentations, which bundle more than one Verifiable Credential (and therefore identify attributes, MRV data, and policy information) into a Verifiable Presentation for, say, a particular Policy that is required for tokenization.

<sup>73</sup> In principle the digital MRV process produces an auditable framework for buyers, internal and external stakeholders, and service providers to digitally audit the provenance of an asset and its data.
 <sup>74</sup> Meeco. 2022. 'Trust Visualised; Built on Hedera by Meeco with Support from the HBAR Foundation'. Meeco Blog (blog). 25 March 2022. <u>https://www.meeco.me/blog/trust-visualised</u>.





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