IETA

THE DIGITAL TRANSFORMATION OF CARBON MARKETS

SUMMARY

TRADITIONALLY, THE CARBON CREDIT MARKET HAS BEEN DOMINATED BY ANA-LOGUE PROCESSES, WITH DATA EXCHANGED BETWEEN ENTITIES IN A MANUAL OR SEMI-AUTOMATED MANNER. WHILE THERE HAVE BEEN SOME DIGITAL ADVANCES, OVERALL, THE CARBON MARKET HAS GENERALLY BEEN SLOW TO FULLY EMBRACE TECHNOLOGICAL INNOVATION.

However, the market is on the brink of an exciting transformation. While challenges around transparency and trust have previously hindered its growth, a powerful shift is now underway. Innovative market forces are converging, paving the way for a full digital transformation that has the potential to revolutionize every stage of the carbon value chain. This shift promises to dramatically enhance transparency and accessibility, rebuilding trust and unlocking new opportunities for expansion.

To fully realize these benefits, market players must come together, invest in the future, and embrace innovation. With the right collaboration and commitment, the market is poised for unprecedented growth and success.
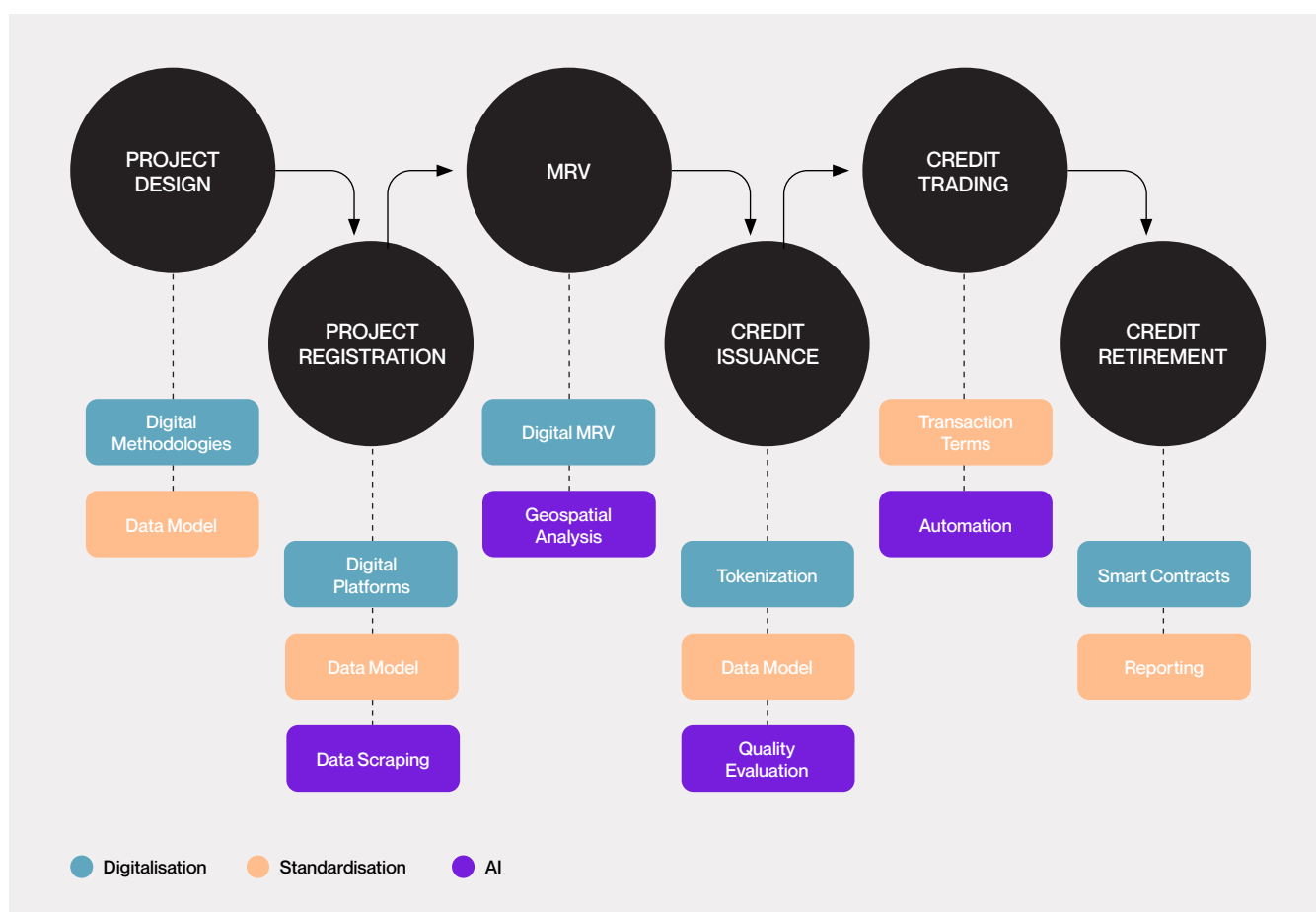
In this paper we outline IETA's vision of what a digitally transformed carbon market could look like. In particular we focus on three enablers of the transformation; **digitalisation, standardisation and Artificial Intelligence (AI).**

KEY MESSAGES

01 The near-term focus of the digital transformation should be on digitalisation and standardisation of the Design, Registration and Measurement, Reporting and Verification (MRV) stages of the carbon credit value chain. Progress here is the foundation of a more quantified and digitalised downstream market.

02 Crediting programmes and Registries are therefore key stakeholders that are able to drive the digitalisation of methodologies, the integration of digital MRV and the enhancements of registry systems and procedures. Their digital transformation will serve as a catalyst for further advances across and down the value chain.

03 To complement the Digitalisation process the market must adopt data standardisation practices. This will increase the accessibility of market data, enabling a range of service providers to help unlock additional market value. But it will also create a framework to ease the future integration of new data sources into the carbon credit generation process to help drive continuous improvement.

04 A more digitised and standardised market will enhance the trust underpinning data-driven AI, enabling it to play a more integrated role. It can then be deployed in a range of applications to help scale projects, improve credit integrity, lower costs and speed up credit issuance.

05 To capture the full benefits of the digital transformation, progress is needed in all stages of the value chain across all three enablers, starting with digitalisation, followed by standardisation and then AI. This will require investment, coordination, collaboration and a willingness to adopt innovation.

OVERVIEW OF CURRENT MARKET ARRANGEMENTS

FIGURE 1 SHOWS THE MAIN STAGES OF THE CARBON MARKET VALUE CHAIN. EACH OF THESE PROCESSES INVOLVES A CERTAIN AMOUNT OF DATA GATHERING, TRANSFER AND COMMUNICATION, WHICH HAS TRADITIONALLY OCCURRED IN AN ANALOGUE AND MANUAL FASHION. WHILST FUNCTIONAL, THESE MARKET ARRANGEMENTS HAVE COME WITH A NUMBER OF DRAWBACKS:

Slow: It can take many years to progress through the stages of the value chain. This can make it difficult to attract finance as investors are wary about the length of time between project design (when costs start to occur) and credit issuance (when monetisation becomes possible).

Expensive: Inevitably, the longer these processes take, the more opportunity there is to incur costs. This, combined with the generally manual nature of the processes, means that it can be very costly to progress a project to credit issuance.

Small: A number factors, such as simplified data systems, has meant that in the past it has generally been challenging to deliver projects or programmes at a large scale.

Fragmented: the analogue nature of many of the systems underpinning the market has made it difficult to integrate them. This has contributed to the market being fragmented and opaque.

However, digital innovation offers the prospect of solving many of these issues and delivering a transformed market which enables climate action at a faster speed, for lower cost, at larger scale and in a much more integrated fashion.

ENABLERS OF THE DIGITAL TRANSFORMATION

IN THIS NEXT SECTION WE FOCUS ON THREE ENABLERS TO HELP DELIVER THE DIGITAL TRANSFORMATION; (01) DIGITALISATION, (02) STANDARDISATION AND (03) ARTIFICIAL INTELLIGENCE (AI). APPLICATIONS OF THESE ENABLERS ARE ALSO SHOWN IN THE VARIOUS STAGES OF THE VALUE CHAIN IN FIGURE 1.

DIGITALISATION   01

DIGITAL TECHNOLOGIES ARE BEING APPLIED TO MANY STAGES OF THE VALUE CHAIN TO IMPROVE MARKET EFFICIENCY, TRANSPARENCY, AND ACCESSIBILITY.

These include:

- **Digital methodologies:** The evolution of methodologies from PDFs to digital formats brings many benefits, such as:
  - Making it easier to evaluate the potential of a project and choose the best methodology
  - Simplifying the development of the Project's Data management plan and quantification methodology. For instance, data values and sources need only be inputted once, at which point they are validated with calculations being automated and checked
  - Limiting subjective and unrelated information
  - Enabling benchmark between multiple projects in different crediting programmes.

- **Digital platforms:** Many of the major crediting programmes, project developers and 3rd party portfolio management stakeholders are moving to a system of digital platforms to communicate and receive data to and from their clients. This helps create a seamless, digital workflow between stakeholders, which speeds up the project cycle and enables much higher volumes of data to be integrated throughout the market.

- **Digital Measurement, Reporting and Verification (DMRV):** transitioning MRV from a manual, in-field exercise to a digitalised and automated process can greatly increase accuracy, scale and frequency of data gathering, transformation and auditability. It will enable the efficient monitoring of much larger projects, at much higher temporal and spatial resolution and at much lower cost. It will also improve the transparency of projects, decrease the time between project design and issuance and enable high frequency issuance.

- **Digital assets:** Some crediting programmes enable the generation of carbon credits as digital assets, either by native tokenisation on-chain, or by allowing traditional credits to be transferred onto the blockchain via carbon bridges. If done right, tokenization can bring benefits such as increasing market access, improving transparency and reducing trading friction.

Digitalisation is occurring throughout the value chain, but at different speeds. To capture the full benefits, an end-to-end digital ecosystem is needed. This will mean that more digital, accurate and automated data is generated upstream. This will then flow into the downstream stages, which in turn need to be equipped with the necessary infrastructure to use that information to generate insight and value.

THE DIGITAL TRANSFORMATION WILL GENERATE INCREASING VOLUMES OF QUANTIFIED DATA, WHICH WILL BE AUGMENTED BY MARKET GROWTH AND NEW REQUIREMENTS FROM MARKET OVERSIGHT BODIES SUCH AS THE ICVCM AND PRI.

Simultaneously, the market will continue to experience a proliferation of new crediting programmes and associated registries, which will accelerate as Article 6 is operationalised. In general, these developments should be welcomed, but this growth in data will only be manageable if it is standardised using common market approaches. Without greater standardisation the market will become more fragmented and the increasing variation of data will become a barrier to growth.

Similar to Digitalisation, Standardisation needs to occur in multiple stages of the value chain:

- **Project Design:** The number of methodologies available in the market has greatly increased in recent years as new crediting programmes have emerged and new activities have been considered for crediting. But the proliferation of methodologies has increased market complexity and fragmentation, making it harder for new participants to enter. Greater standardisation of how data sources are presented and managed across methodologies would help simplify the market and increase accessibility.

- **Project Registration:** A lot of data is needed to register a project with a crediting programme. However, currently there is a lack of consistency across programmes about what data is needed and how it is structured. Valuable information is then scattered through multiple PDFs, making it hard to access and difficult to evaluate. Common reportable project design metrics will ensure that similar data is required and structured across crediting programmes, greatly increasing the transparency and accessibility of data underpinning projects.

- **DMRV:** As mobile communication technology continues to advance, it creates the possibility of greatly increasing the sources of data to monitor a project and verify its outcomes. More standardisation will be required to seamlessly incorporate these growing number of data sources into the DMRV process.

- **Credit issuance:** Similar to the Project Registration stage, there is a lack of consistency in how data is structured and presented for projects which are issuing credits. This creates a number of challenges for many stakeholders in the market. Greater standardisation would help increase the transparency and accessibility of data that sit behind the credits in the market, improving confidence in credit integrity and quality.

- **Credit trading:** The majority of trading happens in Over-the-Counter markets, meaning most transactions have bespoke contracts, terms and settlement flows. This hinders market growth, for instance by creating a participation barrier for larger financial institutions. Moving to a more standardized and digitised set of trading arrangements would enable a much closer integration of carbon and financial markets.

- **Claims:** When credits are retired today on a voluntary basis, there are no common reporting requirements. This creates opacity on who is retiring credits and for what purpose, which contributes to mistrust in the market. Standardizing these reporting requirements, whilst balancing the confidentiality of commercially sensitive information, would help increase transparency and trust.

There are several initiatives underway to drive standardisation across the market. The Climate Action Data Trust (CAD Trust) was launched in 2022 as an open-source platform to link, harmonise and aggregate carbon credit data. Registries can connect to the CAD Trust platform and broadcast data on the credits they hold using a common data model. This creates a global network of connected registries, all broadcasting information using a single set of data parameters. The CAD Trust data model has also been submitted to the International Standards Organisation (ISO) with the intention of creating an international standard to harmonize data fields, formats, and models across different registries. New registries that will emerge in the future could then be built around this ISO standard, which would drive further standardisation going forward.

IN ADDITION TO CAD TRUST, THERE ARE A NUMBER OF OTHER EFFORTS UNDERWAY TO DRIVE DATA STANDARDISATION, INCLUDING:

The World Bank: has established a Carbon Markets Infrastructure Working Group to identify key bottlenecks that hinder the security, efficiency, and interoperability of carbon market infrastructure, as well as outlining priority areas for action to address these challenges.

The Integrity Council of the Voluntary Carbon Market: has established a Working Group on Market Transparency, Standardisation and Scalability as part of its Continuous Improvement Work Programs.

Carbon Data Open Protocol: is an initiative established by a group of market participants to create a common data schema, with definitions and rules that standardize data describing carbon projects and carbon credits across markets, geographies and activity types. The initiative also intends to define how the protocol will be used, updated and governed.

Initiatives like these are in their early stages, but their efforts to drive Standardisation should be embraced by the market. This work, and that of others, will be vital if the market is to manage the ongoing proliferation of crediting programmes and registries and the growing volume of data that is being generated by the digitalisation process.

THE APPLICATION OF AI TO THE CARBON MARKET IS ITS INFANCY, BUT OFFERS SEVERAL EXCITING PATHWAYS TO DRIVE GROWTH.

Currently, some applications of AI are focused on addressing various structural issues in the market, some of which are described above. For instance, several firms are using AI to scrape data from the thousands of documents that underpin projects registered across multiple programmes. By extracting and structuring this data, it is helping to increase the accessibility, transparency and value associated with these projects. This use of AI can also help inform and speed up the standardisation process as it can identify potential data structures and parameters that could become standard in the future.

AI is also being used in a variety of ways to provide market insight and advanced data analytics, for example:
- Forecasting future prices and valuing carbon credit attributes, such as sustainable development outcomes
- Assisting buyers by filtering carbon projects across the expanding range of registries to meet complex purchasing requirement criteria
- Assessing climate policies to reduce regulatory risk and identify new commercial opportunities.

AI and Machine Learning are also beginning to play a more fundamental role in the generation of carbon credits by helping to analyse the very large volumes of data being generated from earth observation. The ability to monitor landscapes and emissions at higher spatial and temporal resolutions is steadily increasing, driven in part by new satellites and new technologies. Consequently, the volume of data being produced is rapidly growing. At the same time, the adoption of DMRV into project methodologies is accelerating and this creates a need to generate new methods to interpret the growing volumes of data – such as computer vision – to make it useful for carbon projects. This application of AI can be used in a variety of ways, such as assessing the baseline of a project, calculating carbon stocks in biomass and estimating biodiversity changes. These techniques can help to lower costs and improve accuracy.

Going forward, this may create a virtuous circle:
- Earth observation improves our ability to accurately monitor areas at very large geographic and temporal scales.
- AI improves our ability to interpret this data and apply it usefully to carbon projects.
- This improves data transparency and helps build trust in the market, driving new demand.
- Projects grow in size, partly in response to growing demand, and partly in response to the market's ability to manage and monitor projects at ever larger scales.

This scenario could provide a template for the broader application of AI across the value chain, as a natural response to the Digitalisation and Standardisation transformations that are underway. These developments will generate data, that is harmonised, structured and accessible. This should provide the right conditions for multiple and high value applications of AI to be developed. AI may then move away from currently helping to solve some of the legacy and structural problems of the market and take on a much more integrated role. This may include being deployed to tackle some of the larger problems associated with scaling the market.

A MORE DIGITISED AND STANDARDISED MARKET WILL CREATE THE FOUNDATIONS TO UNLEASH THE POWER OF AI AND MACHINE LEARNING.

CONCLUSIONS

THE DIGITAL TRANSFORMATION CAN HELP SOLVE SOME OF THE BIG PROBLEMS THAT HAVE HINDERED CARBON MARKET GROWTH IN RECENT YEARS, NOTABLY AROUND ISSUES SUCH AS EFFICIENCY OF CREDIT GENERATION, TRANSPARENCY AND TRUST. IN THIS PAPER WE HAVE FOCUSED ON THREE KEY ENABLERS WHICH WILL HELP DRIVE THE DIGITAL TRANSFORMATION; DIGITALISATION, STANDARDISATION AND AI.

Digitalisation needs to happen across the value chain, but with efforts focused on the upstream stages. To complement this process, standardisation efforts need to accelerate and be embraced by market stakeholders, especially as the volume of data increases in response to digitalisation. Crediting programmes and registries are particularly important stakeholders given their role in the upstream stages of the market.

A more, digitalized and standardised market will bring many benefits, including:
- Enabling deeper market insight and analysis which will improve the performance of projects, enhance investor confidence and unlock new opportunities to reduce emissions and generate carbon credits.

- More commonality between registries will promote interoperability. This will make it easier for international trade of credits as more registries will be able to connect into a broader array of market infrastructure, such as exchanges and data systems. This will help create assurance that there is no double counting and facilitate fungibility between credits from different programmes. This in turn will support greater market depth and liquidity.

- Provide a stronger platform for intermediaries and service providers to engage in the market, such as insurance companies and rating agencies. These types of participants have an important role in de-risking investments, thereby helping increase finance. But to flourish, their operations require a comprehensive and standardised statistical foundation from which to build on.

Finally, a more digitised and standardised market will create the foundations to unleash the power of AI and Machine Learning. To-date, some of AI's applications in the carbon market has been to help address some of the structural and legacy issues in the market. But with much more digitised market data – that is harmonised, structured and accessible – it will create the right conditions to embed AI in a more integrated fashion. It can then be fully deployed to tackle some of the larger problems associated with scaling the market in order to deliver far greater emission reductions.

THE DIGITAL TRANSFORMATION OF CARBON MARKETS—DRIVEN BY DIGITALISATION, STANDARDISATION, AND AI—OFFERS A CLEAR PATH TO GREATER SCALE, TRUST, AND EFFICIENCY, POSITIONING THE MARKET TO MEET THE DEMANDS OF A RAPIDLY EVOLVING CLIMATE ECONOMY.

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