

IETA DIGITAL WORKING GROUP

BUYERS' GUIDE TO DIGITAL MRV



WHAT IS MRV?

MONITORING, REPORTING, AND VERIFICATION (MRV) IS THE THREE-STEP PROCESS UNDERPINNING ANY CARBON CREDIT. IT ESTABLISHES THAT A TONNE OF CARBON DIOXIDE EQUIVALENT HAS BEEN REMOVED OR REDUCED.

- M:** the quantification of emissions reduced or removed by a project with sampling and data collection
- R:** the compilation of measured data into a structured document according to the rules of each methodology at the programme level
- V:** an independent third party (known as a Validation/Verification Body [VVB]) audits the report and conducts a site visit to confirm that claimed emission reductions or removals comply with the methodology

While effective and meticulous, traditional MRV uses static reports, periodic data collection, and manual processes. It can experience bottlenecks and run into issues with inconsistent data quality or human error. Data collection and analysis for some methodologies are often manual, periodic, retrospective, and labour- and cost-intensive. Verification processes are linear; each step is sequential and waits for the preceding one.

Crediting programmes set the standards and determine whether a given digital approach is acceptable. Project developers design and run the project and are accountable for the claims they make. Data providers supply the underlying observations and are responsible for the quality, provenance, and documented limitations of their data. MRV platforms process and analyse data, and often generate outputs such as maps, estimates, and monitoring reports. VVBs, approved under the relevant programme, assess whether the project design conforms to the methodology and programme rules, and whether reported monitoring results are accurate and conform to the monitoring plan.



THE DIGITAL SHIFT

Digital MRV (dMRV) is an end-to-end approach covering data collection, calculations, reporting, verification, auditability, and issuance.

In general, traditional MRV is a snapshot taken at the end of each monitoring period. dMRV moves towards continuous data streams. "Near-real-time" data collection and project monitoring describes how current data is relative to the current time. Continuous monitoring is not necessarily digital, and not all dMRV runs in near-real-time.

While traditional MRV sometimes relies on manual data entry and PDF reports, dMRV automates various elements of data capture and transfer, with data in some cases flowing directly via API to a crediting programme. It reduces the number of manual handoffs, thereby diminishing the potential for error and delay. This allows for improved, scalable data-gathering techniques that can quantify carbon removals and reductions using remote sensing, LiDAR, spectral scanners, direct metering/measurement, and a variety of sensors, analysers, and other cutting-edge tools. Most

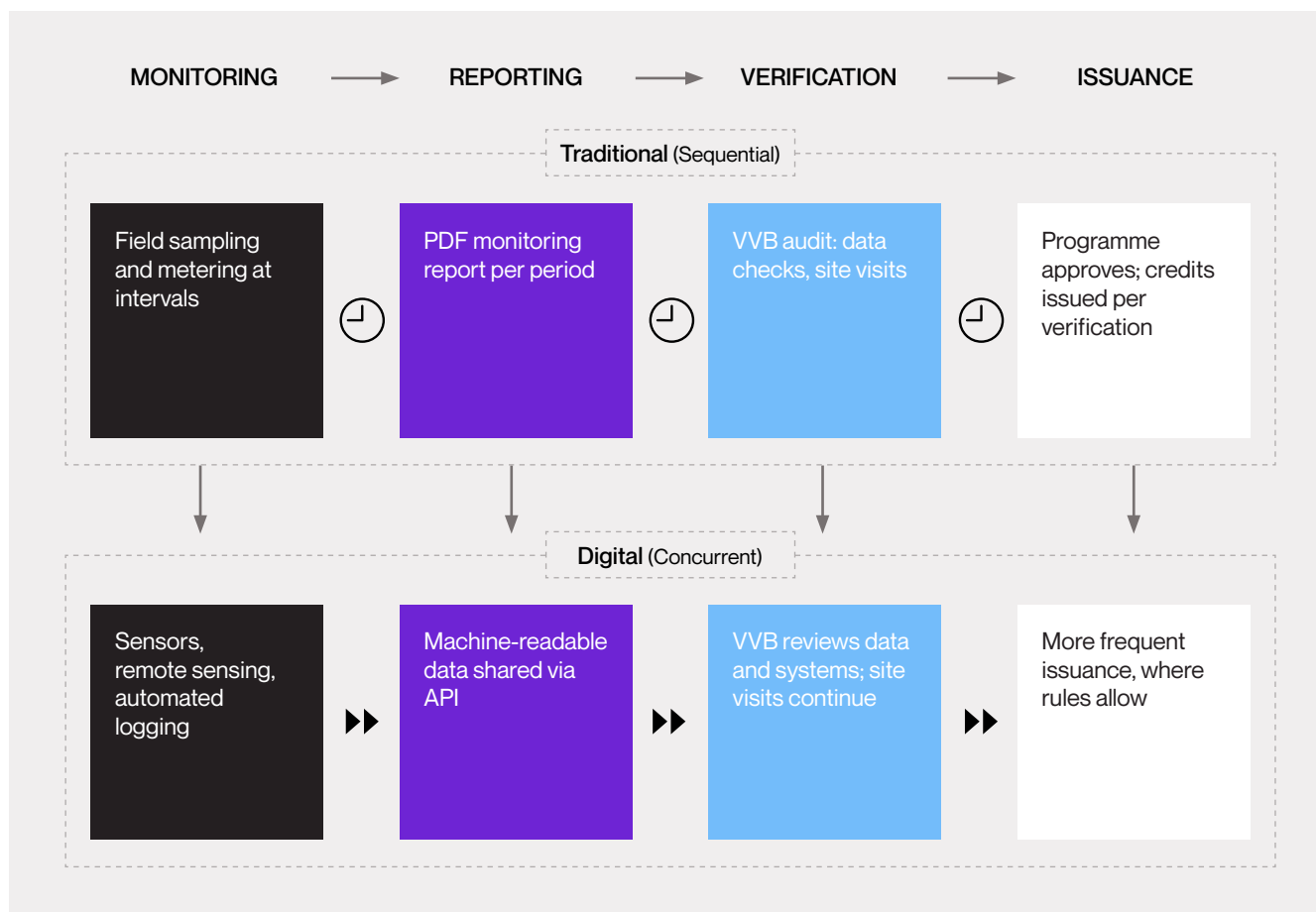
projects will likely use a mix of digital tools, field measurements, sampling, and expert review.

dMRV narrows the time it takes to verify reductions or removals, generating time-stamped data from measurement instruments. Verification can happen much sooner after an activity occurs, depending on programme rules, which makes higher-frequency credit issuance feasible.

Because data flows continuously, dMRV can detect risks as they occur (leakage, land-use change, natural disasters), rather than discovering them during a periodic audit. This changes the function of MRV from a compliance checkpoint to an ongoing project monitor.

The diagram below illustrates how the migration from traditional to digital MRV affects each stage and the benefits they bring to a new end-to-end process.

DMRV IS AN
END-TO-END
APPROACH
COVERING DATA
COLLECTION,
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ISSUANCE



INTEGRATION & STANDARDISATION

This transition marks a turning point for carbon markets, allowing for the modernisation of MRV processes to support the implementation of Article 6, the voluntary carbon market, and emissions trading systems.

dMRV may shift some assurance activities towards reviewing systems, controls, models, and data pipelines, while periodic project-level verification activities such as site visits will still be required for things that cannot be done remotely.

The work of standardising dMRV requirements across crediting programmes and jurisdictions has been taken on by bodies such as the World Bank Carbon Markets Infrastructure Working Group, the ICVCM Continuous Improvement Work Programmes, and ISO Technical Committee 207. Standardisation initiatives are working to reduce current fragmentation risks, so that each crediting programme's dMRV requirements are consistent for a given methodology.

Pilots run by independent crediting programmes aim to integrate dMRV into their issuance processes at the project level to accomplish multiple goals such as; reduction of cost and labour intensity, streamlining of verification and validation, increase in issuance frequency, faster detection and management of risk, stronger market credibility, and, finally, greater access to institutional finance. The following is a non-exhaustive list of ongoing initiatives to integrate digital MRV into the crediting process of various independent programmes:

- i. Verra's pilot programme aims to propose workable dMRV solutions for each methodology, identify challenges, constraints, and risks, demonstrate efficiency gains, and identify internal changes needed for the transition.
- ii. Gold Standard's pilot programme will integrate dMRV into its certification framework. The two-year pilot programme will conclude in late 2026. It marks the next step towards an integrated end-to-end digital system.
- iii. Global Carbon Council is actively establishing an ecosystem to enable dMRV integration into carbon mitigation projects under its programme. It is developing a dedicated standard for dMRV-enabled projects, establishing a validation/verification standard, re-approving VVBs, creating protocols to accept and integrate dMRV systems, and launching an approval procedure for dMRV solution providers.
- iv. Isometric released a dMRV platform to accelerate the verification and issuance of carbon removal credits. It offers buyers, suppliers, and verifiers complete traceability and moves towards monthly credit issuance.
- v. Puro.earth has launched dMRV Connect, a digital integration connecting dMRV platforms directly to its certification platform. Puro.earth aims to help strengthen data quality and trust while allowing supply to scale efficiently.
- vi. BioCarbon Standard launched a dMRV Working Group to assess current MRV practices, evaluate emerging technologies, define risks and mitigation strategies, and develop a phased roadmap for full integration in its crediting programmes.

THE WORK OF
STANDARDISING
DMRV
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SUCH AS THE
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AND ISO

Some national and multinational jurisdictions have also begun to develop robust dMRV requirements and infrastructure. Notably, Japan's domestic J-Credit scheme has is building dMRV systems with several implementing partners. It currently covers one solar methodology, with future expansion plans. The Singapore Carbon Markets Programme, a partnership with the World Bank, also includes support for dMRV.

PILOTS RUN BY INDEPENDENT
CREDITING PROGRAMMES AIM
TO INTEGRATE DIGITAL MRV INTO
THEIR ISSUANCE PROCESSES AT
THE PROJECT LEVEL



HOW IT AFFECTS AN INVESTMENT

Currently, a credit is purchased based on a verification report written well after the project activity took place. dMRV, as it moves towards continuous, near-real-time verification, changes credits from a batch product to something like a metered commodity. Some ratings agencies are using dMRV capabilities as a lens through which to make more frequent credit quality assessments.

Continuous monitoring can identify issues such as leakage, reversal risks, equipment failures, or data anomalies sooner. If these issues are caught early, the project may be able to take corrective action before they become more serious, helping protect project performance, credit integrity, and investors' interests. dMRV is a data layer that can make non-permanence protections such as buffer pool contributions and insurance products more precise for nature-based risks such as wildfire, windstorm, land-use change, deforestation, etc.

Traditional MRV reports are often lengthy PDF documents based on templates provided by independent crediting programmes. Part of the case for digital, machine-readable datasets is that industry-wide standards would improve accessibility and interoperability in reporting across crediting programmes and registries. This could also reduce labour intensity and lead to a reduction in cost.

A growing number of corporate buyers are including dMRV quality on due-diligence checklists. Buyers may begin to describe approaches to dMRV when disclosing project quality.

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HIGH-FREQUENCY ISSUANCE

- i. High-frequency credit issuance can be achieved with automated data pipelines and increased verification frequency. This depends on the methodology, assurance process, governance, and programme rules.
- ii. High-frequency issuance is likely to change settlement and portfolio mechanics. Faster issuance cycles mean tighter feedback loops on supply and less vintage-lag risk (caused by the time delay between reduction/removal activities and the issuance of the corresponding carbon credit).
- iii. Standardised contracting clauses may need to be amended to reflect changes brought about by high frequency issuance. New terms may be required to define delivery in rolling batches and to allocate liability among stakeholders in the development, monitoring, validation, and crediting processes.



POTENTIAL FOR NEW RISKS

dMRV may introduce dependency on specific measurement tools, models, platforms, and data pipelines. If a tool or platform fails, is discontinued, or changes its API unexpectedly, projects relying on that infrastructure could face a risk of disruption that was not so concentrated under traditional MRV. Models trained on past data can “drift” as conditions change, and other mistakes can arise. Digital chains of custody can also be attacked or manipulated at several points, potentially creating new cybersecurity and tampering risks.

If there were a shift from project-level to system-level validation, efficiencies would result, but risk would be concentrated. One flaw or failure could impact many projects and credits simultaneously, rather than being confined, as before, to a single audited project. As previously highlighted, independent crediting programmes are developing dMRV requirements under different pilot programmes.

Continuous data streams raise the question of who owns the raw data: is it the project developer, the MRV provider (if one is used), or the crediting programme? On what terms can it be accessed, licensed, or transferred? MRV credibility depends on

the ability of independent reviewers to understand and assess how results are generated. Transparency regarding algorithms, datasets, assumptions, model inputs, version control, and analytical methods can be particularly important where outcomes rely on complex data models, remote-sensing products, or third-party processing.

While dMRV has the potential to improve the timeliness and scalability of project monitoring, it is important for buyers to understand how uncertainty is quantified, reported, and incorporated into project accounting. This is particularly relevant for AFOLU projects, where uncertainty can materially affect credit issuance and where digital approaches increasingly rely on remote-sensing data, modelling assumptions, and automated analytical processes.

Automation bias could cause market stakeholders to accept findings based on their apparent objectivity and technological sophistication. Manual review, site visits, and spot checks remain necessary, and VVBs must have access to underlying inputs.

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KEY TAKEAWAYS

- A. DMRV IS AN END-TO-END SHIFT. IN SOME CASES, IT AUTOMATES THE CAPTURE AND FLOW OF DATA VIA API BETWEEN PROJECT DEVELOPERS, VVBS, AND CREDITING PROGRAMMES. EACH STEP IN THE PROCESS NEED NOT WAIT FOR THE PREVIOUS STEP TO BE COMPLETE.

- B. THE PRIMARY BENEFITS INCLUDE SPEED, COST-EFFICIENCY, EARLIER RISK DETECTION, INTEROPERABILITY OF DATA, AND AUDITABILITY. IT INTRODUCES NEW POTENTIAL TO SCALE MARKETS AND ISSUE CREDITS MORE FREQUENTLY.

- C. THE MARKET IS STILL IN A PILOT PHASE, BETWEEN INTEGRATION WORK PROGRAMMES AT VARIOUS CREDITING PROGRAMMES AND STANDARDISATION INITIATIVES AT WORLD BANK, ICVCM, AND ISO. THE MARKET WOULD BENEFIT FROM STANDARD DMRV REQUIREMENTS ACROSS CREDITING PROGRAMMES AND JURISDICTIONS.

- D. DMRV IS ALLOWING BUYERS TO PURCHASE CREDITS BACKED BY A CONTINUOUS, AUDITABLE DATA RECORD, AND RATINGS AGENCIES TO REASSESS CREDIT QUALITY MORE OFTEN AND WITH MORE PRECISE RISK DATA.

- E. DMRV INTRODUCES NEW RISKS THAT NEED GOVERNANCE, INCLUDING DEPENDENCY ON SPECIFIC TOOLS AND PLATFORMS, CYBERSECURITY, AND MORE. DMRV WORKS BEST INSIDE A BROADER GOVERNANCE FRAMEWORK.

DMRV WORKS BEST AS PART OF A BROADER GOVERNANCE AND ASSURANCE FRAMEWORK. ITS MAIN VALUE IS IN IMPROVING TRACEABILITY, CONSISTENCY, AUDITABILITY, INTEROPERABILITY, SCALABILITY, AND EARLY RISK DETECTION

CONCLUSION

- a. dMRV has the potential to deliver many benefits including:
 - i. reducing the cost of the MRV process
 - ii. increasing interoperability between methodologies and crediting programmes
 - iii. increasing the frequency of credit issuance
 - iv. improving data transparency and auditability of project performance
 - v. improving the ability to detect risks with project activity ongoing
- b. It is a whole-system benefit that can create a variety of positive feedback loops, such as improving project financing, scalability, and confidence of buyers, regulators, ratings agencies, insurers, and more. dMRV works best as part of a broader governance and assurance framework, and can contribute to improving market integrity and quality.
- c. The integration of dMRV could also introduce new risks that will need to be managed and mitigated collaboratively. Otherwise, dMRV will not deliver its full benefits. Those risks include concentrated technological dependency at different points in the supply chain, and fragmentation of dMRV requirements and specifications across crediting programmes. The standardisation of requirements, and the mitigation of other emerging risks, will require industry-wide collaboration among stakeholders across the carbon credit value chain.
- d. For the innovations and integration of dMRV to have their maximum impact, its implications must be understood more widely across the market, beyond the highly specialised pilot programmes and working groups currently involved in this transformation. We hope to see dMRV open the door to even more robust and dynamic carbon markets.



DIGITAL MRV OPENS THE
DOOR TO CARBON MARKETS
THAT ARE MORE ROBUST
AND MORE DYNAMIC.



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