OPEN COLLABORATION DIGITAL MRV WG REFERENCE LIST

CONTENT

List of Websites, Reports, Standards, Guidance, Case Studies, Posts

Open Collaboration White Paper, November 2021

World Bank Climate Warehouse

- Digital MRV report June 2022

EBRD Protocol for Digitised MRV (D-MRV Protocol), December 2020

Climate Ledger Initiative

- Digital MRV report July 2022
- Principles for Best-Practice Digital Verification
- Several reports relating to DMRV (e.g., case studies) and other digital for climate

UNEP Blockchain for Sustainable Energy and Climate in the Global South, January 2022

WBCSD PACT

- Technical specifications for Pathfinder Network, June 2022

— Several documents (e.g., guidance, vision) relating to digital and data for carbon accounting

UNEP

— Coalition for Digital Environmental Sustainability (CODES) Action Plan
— Digital Transformation: Becoming an Innovative, Agile and Collaborative Organization, Fit for Purpose in the Digital Age 2022

UN Global Digital Compact

Global e-Sustainability Initiative (GeSI)

— Using ICT to Raise Ambitions on Climate Action in Low- and Middle- Income Countries

Climate Chain Coalition

— 360+ organizations relating to digital for climate, including DMRV
— LinkedIn group

Hyperledger Climate Action and Accounting Special Interest Group (SIG)

Blockchain Digital MRV Architecture for Existing Building Energy Performance

Verra DMRV WG

IETA Digital Task Force

— Guiding Principles

InterWork Alliance

— Digital MRV Framework

Open Earth Foundation

— Open Climate White Paper

ISEAL Alliance

- Core Metadata Set Specification

MRV Collective

OS-Climate

- OS-Climate Community Hub (on Github)
- OS-C Data Commons Architecture Blueprint

Carbon-ML (Markup Language)

- White Paper July 2022

Climate Collective Web3 Climate Map

Google Earth Engine

Infrastructure for Article 6 MRV and transfers – the potential of blockchain- based technologies

Reneum digital certification methodology

Green Software Foundation

DigitalMRV for Climate

Gold Standard for the Global Goals

- Gold Standard Site Visit and Remote Audit Requirements and Procedures
- Digitising MRV

Asian Development Bank Digital Technologies for Climate Action, Disaster Resilience, and Environmental Sustainability

ITU Focus Group on Environmental Efficiency for Artificial Intelligence and other Emerging Technologies (FG-AI4EE)

- Working Group 1: Requirements of AI and other Emerging Technologies to Ensure Environmental Efficiency

- Working Group 2: Assessment and Measurement of the Environmental Efficiency of AI and Emerging Technologies
- Working Group 3: Implementation Guidelines of AI and Emerging Technologies for Environmental Efficiency

ITU-T, Environment, Climate Change and Circular Economy

- Green ICT Standards and Supplements

ICTFootprint.eu

- SDOs for ICT Standards
- Map of ICT Methodologies
- GHG Protocol - Software
- GHG Protocol - Hardware

Crypto Climate Accord Guidance for Accounting and Reporting Electricity Use and Carbon Emissions from Cryptocurrency

UNFCCC - The Good, The Bad and The Blockchain

The Carbon Footprint of Bitcoin

Cambridge Bitcoin Electricity Consumption Index

The Digiconomist

Energy Consumption of Cryptocurrencies Beyond Bitcoin

Ripple XRP Ledger Methodology

UCL Centre for Blockchain Technologies - DLT Environmental Impact: What is the energy consumption of the leading PoS DLTs?

Ethereum Climate Platform

Ethereum Energy Consumption

TechCrunch - Crypto and blockchain must accept they have a problem then lead in sustainability

Algorand - Sustainable Blockchain: Estimating the Carbon Footprint of Algorand's Pure Proof-of-Stake

Tezos - An Energy-Efficient Blockchain

Polygon - The Eco-Friendly Blockchain Scaling Ethereum

IOTA - Energy Benchmarks for the IOTA network

Harvard Business Review - How much energy does Bitcoin actually consume?

Reuters - Factbox: How big is Bitcoin's carbon footprint?

Forbes - Blockchain and Sustainability: Oxymoron or Panacea?

Fast Company - Why NFTs have such a massive carbon footprint

Investopedia - What's the Environmental Impact of Cryptocurrency?

Counter Punch - Crypto's Heavy Carbon Footprint

EDMCouncil

— ESG Data Management Asset Owners

Roadmap for Open ICT Ecosystems

European Commission Rolling Plan for ICT Standardization

OECD Digital

- The OECD Going Digital Measurement Roadmap
- OECD AI Policy Observatory

OECD Artificial Intelligence

- OECD Measuring the environmental impacts of artificial intelligence compute and applications
- OECD Framework for the Classification of AI Systems
- Tools for Trustworthy AI
- State of Implementation of the OECD AI Principles

EU Blockchain Observatory and Forum

- Tokenization of physical assets and the impact of IoT and AI

Linux Foundation (LF) Edge Project Alvarium

- Data Confidence Fabric

AIOTI

- AIOTI Guidance for the Integration of IoT and Edge Computing in Data Spaces

- IEEE Academy on Artificial Intelligence

IEEE Standards Association - Raising the Standards in Artificial Intelligence Systems (AIS)
IEEE CertifAIEd

IEEE Blockchain Initiative

IEEE Technology Roadmaps

Blockchain Research Institute

Global Blockchain Business Council (GBBC)

- Global Standards Mapping Initiative

— Taxonomy

European Committee for Standardization (CEN CENELEC)

— Smart Standards

ISO Smart Standards

Smart Contract Security Alliance

Ethereum Smart Contract Auditor Roadmap

International Auditing and Assurance Standards Board (IAASB)

— IAASB Technology Focus Area
— Exploring the Growing Use of Technology in the Audit, with a Focus on Data Analytics
— Technology Workstream Plan (Post June 2019)
— Audit Planning When Using Automated Tools and Techniques
— Using Automated Tools and Techniques When Identifying Risks of Material Misstatement in Accordance with ISA 315 (Revised)
— Addressing Risk of Overreliance on Technology Arising from the use of Automated Tools and Techniques and from Information Produced by an Entity's Systems
— Using Automated Tools and Techniques in Performing Audit Procedures
— Audit Documentation When Using Automated Tools and Techniques
— Technology Disruption in Audit and Assurance

IAASB International Standard on Assurance Engagements (ISAE) 3000 (Revised) Assurance Engagements Other than Audits or Reviews of Historical Financial Information; International Framework for Assurance Engagements and Related Conforming Amendments

Non-Authoritative Guidance on Applying ISAE 3000 (Revised) to Sustainability and Other Extended External Reporting Assurance Engagements

— Non-Authoritative Guidance on Applying ISAE 3000 (Revised) to Sustainability and Other Extended External Reporting (EER) Assurance Engagements

- Non-Authoritative Support Material: Credibility and Trust Model Relating to Sustainability and Other Extended External Reporting (EER)
- Non-Authoritative Support Material: Illustrative Examples of Selected Aspects of Sustainability and Other Extended External Reporting (EER) Assurance Engagements

International Ethics Standards Board for Accountants (IESBA)

- IESBA Technology Initiative - Technology Working Group Phase 1 Report
- IESBA Technology Working Group Phase 2 Final Report

International Accounting Education Standards Board (IAESB)

- ICT Skills Development
- The Digital Age and Opportunities for Accountants

Association of Chartered Certified Accountants (ACCA)

- ACCA Audit and Technology

Institute of Chartered Accountants in England and Wales (ICAEW)

- ICAEW Audit and Technology
- ICAEW Tech Hub

International Organization for Standardization (ISO) TC 207 SC 7 Greenhouse gas and climate change management and related activities

- ISO 14064-3 Specification with guidance for the verification and validation of greenhouse gas statements
- ISO 14065 General principles and requirements for bodies validating and verifying environmental information
- ISO 14066 Competence requirements for teams (including technical experts), and independent reviewers involved in the validation and verification of environmental information

ISO/TC 207/SC 2 Environmental auditing and related environmental investigations

- ISO/AWI PAS 14018 Guidelines for the Remote Auditing of Environmental Management Systems

ISO/IEC JTC 1/SC 39 Sustainability, IT and data centres

- ISO/IEC TR 30132-1:2016 Information technology — Information technology sustainability — Energy efficient computing models — Part 1: Guidelines for energy effectiveness evaluation

ISO TC 176 Quality Management and Quality Assurance (ISO 9000)

- ISO 9001:2015 Quality management systems — Requirements
- ISO 9001 Auditing Practices Group Guidance on Remote Audits
- ISO 9001 Auditing Practices Group Guidance on Auditing Digital Processes

ISO/IEC JTC 1/SC 41 Internet of Things and Digital Twin

- Strategic Business Plan
- ISO/IEC 30141:2018 Internet of Things (IoT) — Reference Architecture
- ISO/IEC 30147:2021 Information technology — Internet of things — Methodology for trustworthiness of IoT system/service
- ISO/IEC 30161:2020 Internet of Things (IoT) — Requirements of IoT data exchange platform for various IoT services
- ISO/IEC 30165:2021 Internet of Things (IoT) — Real-time IoT framework
- ISO/IEC TR 30176:2021 Internet of Things (IoT) —- Integration of IoT and DLT/blockchain: Use cases
- ISO/IEC 30147:2021 Information technology — Internet of things — Methodology for trustworthiness of IoT system/service
- ISO/IEC 20924:2021 Information technology — Internet of Things (IoT) — Vocabulary

Digital Twin Consortium

- Digital Twin Capabilities Periodic Table User Guide

International Telecommunications Union (ITU) Standards Landscape

- IoT Standards

- IoT and Smart Sustainable Cities Standards
- ICT Security Standards

ISO/IEC JTC 1/SC 42 Artificial intelligence

- ISO/IEC 22989:2022 Information technology — Artificial intelligence — Artificial intelligence concepts and terminology
- ISO/IEC 23053:2022 Framework for Artificial Intelligence (AI) Systems Using Machine Learning (ML)
- ISO/IEC TR 20547-1:2020 Information technology — Big data reference architecture — Part 1: Framework and application process
- ISO/IEC 20547-3:2020 Information technology — Big data reference architecture — Part 3: Reference architecture
- ISO/IEC 20546:2019 Information technology — Big data — Overview and vocabulary
- ISO/IEC TS 4213:2022 Information technology — Artificial intelligence — Assessment of machine learning classification performance
- ISO/IEC 24668:2022 Information technology — Artificial intelligence — Process management framework for big data analytics
- ISO/IEC DIS 42001 Information technology — Artificial intelligence — Management system
- ISO/IEC 38507:2022 Information technology — Governance of IT — Governance implications of the use of artificial intelligence by organizations
- ISO/IEC DIS 25059 Software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — Quality model for AI systems
- ISO/IEC AWI TS 25058 Software and systems engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — Guidance for quality evaluation of AI systems
- ISO/IEC TR 24028:2020 Information technology — Artificial intelligence — Overview of trustworthiness in artificial intelligence
- ISO/IEC DIS 5392 Information technology — Artificial intelligence — Reference architecture of knowledge engineering
- ISO/IEC DIS 5338 Information technology — Artificial intelligence — AI system life cycle processes
- ISO/IEC DIS 8183 Information technology — Artificial intelligence — Data life cycle framework

- ISO/IEC AWI 12792 Information technology — Artificial intelligence — Transparency taxonomy of AI systems
- ISO/IEC AWI TS 17847 Information technology — Artificial intelligence — Verification and validation analysis of AI systems
- ISO/IEC AWI TR 20226 Information technology — Artificial intelligence — Environmental sustainability aspects of AI systems

ISO TC 307 Blockchain and Distributed Ledger Technologies

- Strategic Business Plan
- ISO/TR 23455:2019 Blockchain and distributed ledger technologies — Overview of and interactions between smart contracts in blockchain and distributed ledger technology systems
- ISO/TS 23635:2022 Blockchain and distributed ledger technologies — Guidelines for governance
- ISO/DIS 22739 Blockchain and distributed ledger technologies — Vocabulary
- ISO/TR 23249:2022 Blockchain and distributed ledger technologies – Overview of existing DLT systems for identity management
- ISO 23257:2022 Blockchain and distributed ledger technologies — Reference architecture
- ISO/TS 23258:2021 Blockchain and distributed ledger technologies — Taxonomy and Ontology

ISO/IEC JTC 1/SC 27 Information Security Management

- ISO/IEC 27000:2018 Information technology — Security techniques — Information security management systems — Overview and vocabulary
- ISO/IEC 27001:2022 Information security, cybersecurity and privacy protection — Information security management systems - Requirements
- ISO/IEC 27006:2015 Information technology — Security techniques — Requirements for bodies providing audit and certification of information security management systems
- ISO/IEC 27007:2020 Information security, cybersecurity and privacy protection — Guidelines for information security management systems auditing
- ISO/IEC TS 27008:2019 Information technology — Security techniques — Guidelines for the assessment of information security controls

International Accreditation Forum

- IAF MD 4:2022 IAF Mandatory Document for the Use of Information and Communication Technology (ICT) for Auditing/Assessment Purposes
- IAF ID 12:2015 Principles on Remote Assessment
- IAF MD14:2014 Application of ISO/IEC 17011 in Greenhouse Gas Validation and Verification (ISO 14065:2013)

European Union Emission Trading System (EU ETS)

EU ETS Monitoring, Reporting and Verification (MRV)

- Monitoring and Reporting Regulation
- Verification and Accreditation Regulation
- Quick Guide for Verifiers
- Quick Guide for National Accreditation Bodies
- EU ETS Accreditation and Verification Regulation - Explanatory Guidance
- EU ETS compilation on the monitoring and reporting of greenhouse gas emissions
- EU ETS compilation on the verification of data and on the accreditation of verifiers
- Overview of the EU ETS Reporting Language (XETL)

UNFCCC CDM Standards

- CDM accreditation standard Version 07.0
- CDM validation and verification standard for project activities Version 03.0
- CDM validation and verification standard for programmes of activities Version 03.0
- CDM methodology for determining coverage of data and validity of standardized baselines Version 03.0
- CDM methodology for establishment of sector-specific standardized baselines Version 01.0
- CDM project standard for project activities Version 03.0
- CDM project standard for programmes of activities Version 03.0

Intergovernmental Panel on Climate Change

- IPCC Guidelines for National GHG Inventories

WRI WBCSD GHG Protocol

— Standards
— Guidance

Examples / Case Studies of Audit Software:

— IBM OnePages with Watson
— SAP Audit Management
— Deloitte Omnia (ESG Module)
— EY Digital Audit
— EY Canvas
— PwC Audit Revolution
— KPMG Global IT internal audit outlook
— Forbes KPMG Future-Proofed
— Accenture Internal Audit
— Bureau Veritas Clarity
— DNV GL Boost My Audit
— SGS Digital Trust Label Certification
— SCS Global Services Flexible Auditing Solutions
— LRQA Remote
— Q-Aud
— Intelex
— Auditboard
— SustainCERT
— MRV DCS opsealog
— Upstream Tech DMRV for Forest Carbon Projects
— DigitalMRV (ClimateCHECK IOTA)
— Hummingbird Technologies
— Ucrop.it
— Fix6

Principles for Digital Development

Online Posts

— What is Digital MRV?

Standards, Frameworks and Guidance for Digital Technologies

Digital Technology	Reference	Reference	Reference	Reference 4 (Environmental Footprint)
IoT	ISO 29182	ISO 30141	ISA-95	
DLT	ISO 23257	IEEE P2418.5	ASC X9 TR 54-2021	ITU FG-AI4EE D.WG2-05 Crypto Climate Accord Guidance
Identity	ISO 23249	W3C DID	NIST Digital Signature Standard	
AI	ISO 24028	IIoT AI Framework	Spatio Temporal Asset Catalogue Specifications	ITU FG-AI4EE D,WG2-03 ITU FG-AI4EE D.WG3-01 OECD AI
ML	IBM Machine Learning Framework	ISO 23053	Parquet for ML	ITU FG-AI4EE D.WG3-07
Smart Contracts	ISO 23455	ERC 721	Oracles	
Digital Twins	Periodic Table	Interoperability	Apollo Protocol	
Cyber Security	ISO 27000	IEC 62443-2-1	NIST Cybersecurity Framework	
Remote Sensing				
Other… (e.g., drones, data, data management, data centers)	Data Confidence Fabric			Energy Star ITU FG-AI4EE D.WG2-02 ITU FG-AI4EE D.WG2-06 ITU FG-AI4EE D.WG3-03 EPEAT Registry