UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

SUSTAINABLE DEVELOPMENT GOALS

TACKLING CLIMATE CHANGE

Fostering trust in climate action through quality and standards

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FOREWORD

Climate Change is the greatest threat which humanity is facing today. The world urgently needs a decisive change of course in sustainable resource management, the preservation of ecosystems and biodiversity, and in increasing communities' capability and resilience supporting them to adapt to and mitigate climate change. Setting, implementing and enforcing standards necessary to guide this development. This includes proof of compliance with sustainability certification schemes such as deforestation-free products, the carbon border adjustment mechanism and supply chain due diligence requirements. Measuring compliance with standards must be built on trust and shared purpose, and the accuracy of such measurements needs be independently verified. Inclusive and sustainable industrial development requires deploying innovative technologies and solutions to address environmental degradation and climate change while supporting economic growth to lift people out of poverty and reduce hunger.

With rightful concerns about the disastrous effects of climate change, countries aiming to succeed in global markets must adhere to increasingly stringent environmental and social standards. Effectively implementing these necessary changes means that we need to develop robust services to assess and ensure conformity with those standards, namely quality infrastructure systems. These are made up of public and private organizations, policies, relevant legal and regulatory frameworks, and ultimately the actual practices that support and enhance the quality, safety and environmental soundness of goods and services.

The urgent calls for climate action that define our times underline the importance of quality infrastructure as a critical tool for promoting environmental sustainability and fostering the transition towards vibrant green economies. Traditionally rooted in economic development, market access and consumer protection, quality infrastructure is now seen as a key driver of sustainable development. A well-implemented quality infrastructure system makes a core contribution to governmental policy objectives in areas including sustainable industrial development, efficient resource use, food safety, health, circular economy, and other critical issues that form the 2030 Agenda for Sustainable Development and Sustainable Development Goals – the contract for the future that the international community has given itself.

In this spirit, we at UNIDO reiterate our commitment to empowering communities, nations and regions on their path to sustainable economic and industrial development and re-establishing harmony with the interconnected environment that we all share, with a prosperous future for the benefit of all.

Gerd Müller

Director General, UNIDO

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DISCLAIMER

EXECUTIVE SUMMARY

Climate change is the biggest challenge of our times. From shifting weather patterns that threaten human health, to rising sea levels that increase the risk of catastrophic flooding, the impacts of climate change are global in scope and unprecedented in scale. The 2030 Agenda for Sustainable Development, adopted by the United Nations in 2015, emphasizes the importance of the "5 Ps" of sustainable development: people, planet, prosperity, peace, and partnerships. Climate change presents multifaceted challenges across these pillars.

Today, there is no doubt that Quality Infrastructure (QI) plays a crucial role in supporting climate action, particularly in promoting environmental sustainability and a green economy. Despite the traditional QI's roots in trade facilitation and economic development, there are now many ways in which it is linked to environmental topics such as energy efficiency, renewable energy integration, waste management, water management, eco-friendly construction, biodiversity conservation and climate resilience.

An effective National Quality Infrastructure has therefore become a key consideration for businesses, governments and consumers when there is a need to demonstrate compliance with environmental commitments, when organizations decide to analyze their environmental impact and define environmental strategies, or even when a financial credit is required and the investors need to have valid data to help them to understand the environmental impact of any associated project.

This document describes how QI can be used to support and promote climate action initiatives. It is structured as follows:

PART 1

describes the reasons why climate change and associated adaptation and mitigation initiatives have become a strategic imperative in recent years to support inclusive and sustainable industrial development.

PART 2

considers how the concepts of "quality" and "quality infrastructure" have evolved in recent years from an almost exclusive traditional focus on "product and service" to include social, environmental and other aspects that relate to the ways in which those products and services are provided.

PART 3

explains what is meant by a Quality Infrastructure System (QIS) and how it can support global initiatives such as the UN's 2030 Sustainable Development Goals (SDGs), particularly SDG 13 ("Climate action"). It explains each of the key components of a QIS and how these can contribute to climate action initiatives. These include metrology, standardization/technical regulations, accreditation, conformity assessment and market surveillance. The importance of establishing a sound quality culture to support each of these components is also explained.

PART 4

describes how individual enterprises can make use of the QIS to support their climate adaptation and mitigation initiatives.

PART 5

examines how countries—particularly developing countries—can transition towards a more sustainable QIS and outlines a set of key takeaways for future QI development.

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ACRONYMS

AB	Accreditation Body
AI	Artificial Intelligence
BIPM	International Bureau of Weights and Measures
CAB	Conformity Assessment Body
CB	Certification Body
CDM	Clean Development Mechanism
CES	Clean Energy Standards
CFP	Carbon Footprint of a Product
CIMO	(WMO) Commission for Instruments and Methods of Observation
COP	The United Nations Climate Change Conference, Conference of Parties
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
DCC	Climate Change Direction (Costa Rica)
DLT	Distributed Ledger Technology
DOE	Designated Operational Entity
EEG	Renewable Energy Sources Act
EF	Environmental Footprint
EnMS	Energy Management System
EPD	Environmental Product Declaration
ESG	Environmental, Social, and Governance
EU ETS	European Union Emissions Trading System
EV	Electric Vehicle
FSC	Forestry Stewardship Council
IAF	International Accreditation Forum
IEC	International Electrotechnical Commission
INetQI	International Network on Quality Infrastructure
IoT	Internet of Things
G20	Group of Twenty
GCOS	Global Climate Observing System
GLOBAC	Global Accreditation Cooperation (merger of IAF and ILAC)
GOS	Global Observing System
HMI	Human-machine Interface
IEC	International Electrotechnical Commission
IIOC	Independent International Organisation for Certification
ILAC	International Laboratory Accreditation Cooperation
IQNet	The International Certification Network
ISEAL	International Social and Environmental Accreditation and Labelling

ISO	International Organization for Standardization
ISO/CASCO	ISO Policy Committee on Conformity Assessment
IT	Information Technology
ITU	International Telecommunication Union
kW	Kilowatts
LCA	Life Cycle Assessment
LCI	Life Cycle Inventory
LCIA	Life Cycle Impact Assessment
LVDC	Low Voltage Direct Current
MINAE	Ministry of Environment and Energy (Costa Rica)
MLA	Multilateral Recognition Arrangement
MRA	Mutual Recognition Arrangement
MRV	Monitoring, Reporting, and Verification
NAB	National Accreditation Body
NDC	Nationally Determined Contribution
NGO	Non-governmental Organization
NMI	National Metrology Institute
NQP	National Quality Policy
NSB	National Standards Body
NZ ETS	New Zealand Emissions Trading Scheme
OIML	International Organization of Legal Metrology
OT	Operational Technology
PEF	Product Environmental Footprint
PEFC	Programme for the Endorsement of Forest Certification
PPCN	Carbon Neutrality Country Program (Costa Rica)
QI	Quality Infrastructure
QIS	Quality Infrastructure System
RENE	National Emissions Registry
RET	Renewable Energy Target
SDG	(UN) Sustainable Development Goal
SI	International System of Units
SME	Small and Medium-sized Enterprise
UNCTAD	United Nations Conference on Trade and Development
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
UNFSS	United Nations Forum on Sustainability Standards
UNIDO	United Nations Industrial Development Organization
V&V	Verification and Validation
VR	Virtual Reality
VSS	Voluntary Sustainability Standards
WMO	World Meteorological Organization
WSC	World Standards Cooperation
WTO	World Trade Organization

PART 1
INTRODUCTION

Climate change refers to significant and lasting changes in the Earth's climate patterns over an extended period. If they continue unabated, increases in global temperature will exacerbate rising sea levels, lead to more extreme and unpredictable weather events—such as record droughts in certain areas, massive and concentrated rainfall in others, more frequent and stronger hurricanes—and significantly alter the conditions necessary for a large number of ecosystems to thrive. The primary driver of recent climate change is widely attributed to human activities, particularly the release of greenhouse gases (GHGs) into the atmosphere. These are generated by human activity, such as burning fossil fuels to generate energy, using non-renewable energy sources for transport, industrial activities, buildings and households, as well as agriculture. It is not an over-exaggeration to say that the very survival of the world, as we know it, will depend on our collective ability to mitigate climate change and adapt to its impacts. Addressing climate change therefore requires coordinated global efforts to reduce emissions, adapt to changing conditions, and transition to sustainable practices. It involves the collaboration of governments, businesses, communities, and individuals to create a more resilient and sustainable future.

FIGURE 1: THE "5 Ps" OF SUSTAINABILITY

The "5 Ps" of sustainability—people, planet, prosperity, peace and partnerships—form the pillars of the 2030 Agenda for Sustainable Development and 17 accompanying Sustainable Development Goals (SDGs), which were adopted by the United Nations in 2015. Climate change poses numerous challenges across these pillars, increasing the need for mitigation measures.

Without adequate adaptation and disaster risk management, climate change will impact the lives of billions of people by making water scarcer and amplifying the pressure on agriculture and food production. It will also disrupt economic development, with a disproportionate impact on the most vulnerable countries due to the increased frequency of extreme weather that triggers natural disasters with associated losses and costs of recovery.

Climate resilience is essential for safeguarding the well-being of people, ecosystems, and economies in the face of climate change. Building resilience requires a multifaceted approach that integrates scientific knowledge, stakeholder engagement, and proactive policy-making. By enhancing resilience, societies can better withstand and recover from the inevitable impacts of a changing climate, ensuring a sustainable and secure future for all.

The UNFCCC (United Nations Framework Convention on Climate Change) is an international environmental treaty adopted on 9 May 9 1992, that entered into force on 21 March 1994. The primary aim of the UNFCCC is to stabilize GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic (human-induced) interference with the climate system, becoming the first major milestone in addressing climate change.

The UNFCCC provides a framework for negotiating specific international treaties (called "protocols" or "agreements") that may set binding limits on GHGs. The most notable of these is the Kyoto Protocol (1997) and the Paris Agreement (2015).

The Kyoto Protocol established targets for a reduction in overall emissions of the six main GHGs, namely:

» Carbon dioxide (CO_2)

» Methane (CH_4)

» Nitrous oxide (N_2O)

» Hydrofluorocarbons (HFCs)

» Perfluorocarbons (PFCs)

» Sulphur hexafluoride (SF_6)

In 2012 another GHG began to be tracked—Nitrogen trifluoride (NF_3)—because of its high global warming potential and the increase of its presence in the atmosphere. NF_3 is used in the electronics industry for processes such as the production of semiconductors and flat-panel displays, including the production of thin-film solar cells. As the demand for electronic devices continues to grow, the use of NF_3 in manufacturing processes may increase, leading to higher emissions.

A decade after the Kyoto Protocol entered into force, the 2015 Paris Agreement outlined several key goals to address climate change and its impacts. The three main goals of the Paris Agreement are:

» Limit global temperature increase

» Enhance adaptive capacity

» Finance flows consistent with a low-GHG future

Countries have committed to pursuing efforts to limit global temperature rises to 1.5°C. The figure serves as an indicator of how much the Earth has warmed (or how little it has cooled) compared to the long-term global average. In 2018 scientists revised a decades' old estimated temperature threshold of dangerous impact, stressing that exceeding 1.5°C would be calamitous for the world, resulting in more frequent and severe droughts, floods and heatwaves, and widespread species loss.

The Paris Agreement is a legally binding international treaty on climate change that was adopted by 196 Parties at the United Nations Climate Change Conference (COP21) in Paris, France, on 12 December 2015. It entered into force on 4 November 2016.

Its overarching goal is to hold "the increase in the global average temperature to well below 2°C above pre-industrial levels" and pursue efforts "to limit the temperature increase to 1.5°C above pre-industrial levels". Scientists use average temperature data from the years 1850–1900 as an approximation of pre-industrial temperatures, i.e. how hot the world was before the shift to fossil fuel—coal, oil and natural gas—reliance.

However, in recent years, world leaders have stressed the need to limit global warming to 1.5°C by the end of this century. This is as a result of the UN's Intergovernmental Panel on Climate Change indicating that crossing the 1.5°C threshold risks unleashing far more severe climate change impacts.

The Paris Agreement was a landmark in the multilateral climate change process because, for the first time, all nations made commitments to combat climate change and adapt to its effects.

Climate change is accelerating and the world will cross the 1.5°C (2.7°F) warming threshold this decade. As a result, global strategies are being devised to limit global warming to within 1.5°C above pre-industrial temperatures and to adjust to the imminent temperature rise and their consequences.

Although climate change adaptation is guaranteed to be costly and disruptive, trade and trade policies can contribute to climate change adaptation strategies. International trade can help prepare

for climate-related shocks more effectively by supporting the development and access to climate-resilient technologies, such as new drought-resistant crops. Trade in services, such as weather forecasting, insurance, telecommunications and logistics, can also be essential to identify, prevent and reduce climate risks and vulnerabilities and to minimize unavoidable losses and damages caused by climate change. As we shall see later, a sound QI comprising metrology, standards, technical regulations, accreditation, conformity assessment and market surveillance can be vital to support not only international trade, but also to define, monitor and report global climate change initiatives.

As QI provides confidence to markets, citizens and consumers that their needs and expectations are understood, clearly defined and will be (or are being) met, establishing a QI system is vital for implementing the Paris Agreement and the 2030 Agenda for Sustainable Development and for tracking progress. It helps nations meet trade and economic goals and seize the many opportunities provided by the SDGs.

By adhering to quality and standards, we can tackle climate change and achieve sustainable development. Examples of QI tools to address climate change include:

» **ACCURATE & RELIABLE MEASUREMENT:** Precise and globally comparable measurement results to detect, monitor and improve climate effects globally.

» **TECHNICAL REGULATIONS & STANDARDS:** Mandatory and voluntary requirements that products and processes must meet in support of positive climate action.

» **SUSTAINABLE BUSINESS PRACTICES:** New business practices, circular approaches and sustainable production in line with international best practices (codified in standards).

» **ACCREDITED CONFORMITY ASSESSMENT:** Competent and internationally recognized bodies that can verify and prove compliance.

Addressing climate change also enhances product quality and supports sustainable development, examples of which follow in the next section.

In addition to progress at the global level, advancements towards reducing GHG emissions can be performed by sector.

In 2021, for example, the Group of Twenty (G20) countries pledged to cease financing new coal-fired power plants abroad.

In 2022, countries in the International Civil Aviation Organization also set a goal of achieving net zero emissions for commercial aviation by 2050. Companies, acknowledging their role as a large contributor to GHG emissions, are also stepping up to reduce their emissions.

FIGURE 2: INTERLINKAGES BETWEEN TACKLING CLIMATE CHANGE, SUSTAINABLE DEVELOPMENT, AND QUALITY & STANDARDS

WHY CLIMATE ACTION HAS BECOME A STRATEGIC IMPERATIVE

Climate action is no longer viewed as solely an environmental concern but as a critical strategic imperative that intersects with economic, social, regulatory, and technological factors. Organizations that proactively address climate change are better positioned to navigate risks, capitalize on opportunities, and contribute to a more sustainable and resilient global future.

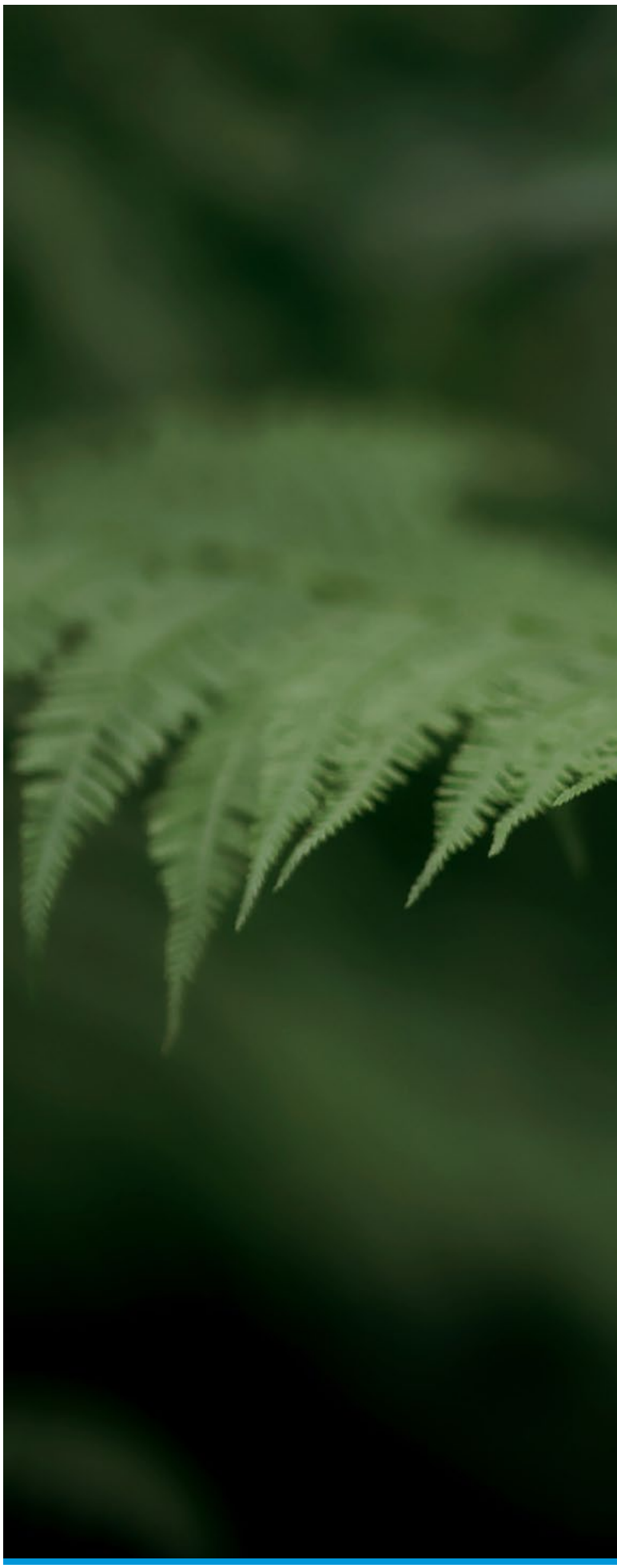
Some of the key reasons why addressing climate change has become a strategic priority include:

Economic Risks and Opportunities: Climate change poses significant economic risks, including damage to infrastructure, disruptions to supply chains, and increased costs associated with extreme weather events. On the flip side, there are opportunities for economic growth through the development and deployment of clean technologies, renewable energy, and sustainable practices.

Global Security Concerns: Climate change can exacerbate existing social, political, and economic tensions, leading to conflicts over resources such as water and land. It can also contribute to the displacement of communities due to sea-level rise and extreme weather events, creating potential sources of conflict. Addressing climate change is seen as crucial for global stability and security.

Regulatory and Legal Pressures: Governments worldwide are implementing and tightening regulations to reduce GHG emissions and promote sustainable practices. Companies that fail to adapt to these regulations may face legal challenges, reputational damage, and increased operating costs. Proactive climate action can help organizations stay ahead of regulatory requirements.

Investor Expectations: Investors are increasingly considering environmental, social, and governance (ESG) factors when making investment decisions. Companies that demonstrate a commitment to sustainability and climate action are more likely to attract investment, while those perceived as high carbon emitters may face financial risks.



CASE STORY: SMEs & Farmers' Cooperatives in Sierra Leone

CONTEXT & CHALLENGES

In Sierra Leone, a combination of factors has led to an increase in crop failures, more intense rainfalls, decreased water quality, greater burden of infectious disease, coastal infrastructure damage, and various other climate-related losses. These, however, are not just risks but very strong reasons to invest in climate adaptation strategies now. As ESG (environmental, social and governance) standards continue to develop in a climate adaptation context, it is important that Sierra Leone does not get left behind. As an ESG investment destination, the country has a significant opportunity to take the lead.

On the onset of UNIDO's intervention in Sierra Leone, it was observed that Sierra Leonean MSMEs, farmers and farmers' cooperatives had not yet implemented standards such as ISO 9001:2015 (the core quality management standard), ISO 22000 (food safety management) and GLOBALG.A.P. (a standard for good agricultural practices that also considers welfare and hygiene of farmers and quality and safety improvement of crops). In Sierra Leone, no company was certified on ISO 9001:2015, ISO 22000 or GLOBALG.A.P. This was mainly due to the following:

- Low awareness about ISO standards and certifications related to ESG.
- Non-availability of consultants/ implementers, trainers and auditors in the country.

INTERVENTION

UNIDO assisted in creating awareness among SMEs and farmers' cooperatives regarding the importance and benefits of implementing these standards. Awareness and capacity building trainings with the engagement of the public and private sectors were conducted through a call for interested SMEs to participate in Technical Assistance Programmes (TAPs). From the 62 applications received from different SMEs, seven SMEs were selected for technical support to implement ISO 9001 and ISO 22000 standards. Local trainers were supported and engaged to implement these standards along with international experts. Similarly, engagement of farmers' cooperatives started and after a thorough evaluation of the applications received in the call for proposals, four cooperatives in different districts of Sierra Leone for cocoa and cassava value chains were selected for the implementation of GLOBALG.A.P.

IMPACT & RESULTS

The adoption of ISO 9001, ISO 22000, and GLOBALG.A.P. is a strategic step towards sustainability, aligning with ESG goals and addressing climate change challenges. In addition to enhancing operational efficiency and product quality, these standards also contribute to the development of a more resilient, responsible, and sustainable business ecosystem. SMEs and agricultural value chains are increasingly recognizing the importance of ESG factors, and these standards play a crucial role in ensuring a sustainable future and aiding in the effort to mitigate climate change impacts.

This project is part of the West Africa Competitiveness Programme (WACOMP), implemented by UNIDO and funded by the European Union (EU).

Brand Reputation and Consumer Preferences: Consumers are becoming more environmentally conscious, and they are more likely to support companies that demonstrate a commitment to sustainability. Conversely, businesses that are perceived as environmentally irresponsible may face reputational damage and a decline in consumer trust.

Physical Risks to Assets: Rising sea levels, extreme weather events, and changing climate patterns pose physical risks to assets such as buildings, infrastructure, and agricultural land. Companies and governments must adapt to these changes to protect their investments and ensure long-term resilience.

Innovation and Technological Advancements: The transition to a low-carbon economy requires innovation and the development of new technologies. Businesses that invest in research and development of sustainable technologies are likely to gain a competitive edge and position themselves as leaders in their industries.

Insurance Industry Impact: Climate-related risks are increasingly affecting the insurance industry. As the frequency and severity of extreme weather events rise, insurance companies may face greater liabilities. This can lead to increased insurance premiums, reduced coverage, or challenges in securing insurance for high-risk assets.

CONCEPTS OF CLIMATE CHANGE ADAPTATION AND MITIGATION

Adaptation and mitigation are two interconnected approaches to addressing climate change on both natural and human systems. Adaptation deals with the impacts and vulnerabilities that result from climate change, while mitigation focuses on reducing the emissions of GHGs to limit the extent of future climate change. An effective response to climate change often involves a combination of both strategies tailored to specific contexts and challenges.

ADAPTATION

Refers to the adjustment or changes made in response to the actual or expected effects of climate change. It involves actions taken to reduce vulnerability, enhance resilience, and cope with the adverse impacts of changing climate conditions.

Examples of adaptation activities include: Construction of sea walls in coastal regions to protect against rising sea levels, farmers changing crop varieties or planting schedules to adapt to altered growing seasons, and urban planners designing physical infrastructure to withstand extreme weather events.

Key Aspects of Climate Change Adaptation

These include:

- **Flexibility:** Adaptation strategies are often flexible and context-specific, recognizing that the impacts of climate change can vary widely across regions and sectors.
- **Local and Community Focus:** Adaptation efforts are often tailored to local needs and involve collaboration with communities to understand their vulnerabilities and strengths.
- **Long-term Planning:** Adaptation involves long-term planning to address the gradual changes and uncertainties associated with climate change.

"It is not the most intellectual of the species that survives; it is not the strongest that survives; but the species that survives is the one that is able best to adapt and adjust to the changing environment in which it finds itself." – (attributed to) Charles Darwin

MITIGATION

Refers to actions and strategies aimed at reducing or preventing the emission of GHGs and thereby limiting the extent of future climate change. It involves addressing the root causes of climate change by making changes to those activities

that contribute to the build-up of GHGs in the atmosphere. Examples of mitigation activities include: Using different technologies, different business models and different processes and practices. This includes, for example, transitioning to renewable energy sources, improving energy efficiency in buildings and transportation, afforestation (planting trees to absorb CO_2), and implementing sustainable agricultural practices.

Key Aspects of Climate Change Mitigation

These include:

- **Global Focus:** Mitigation efforts often have a global perspective, as reducing GHG emissions requires coordinated action on an international scale.
- **Technological Innovation:** Mitigation strategies involve the development and deployment of new technologies that promote cleaner and more sustainable ways of producing energy and conducting various human activities.
- **Policy and Regulation:** Government policies, regulations, and international agreements play a crucial role in shaping mitigation efforts, encouraging industries and individuals to adopt cleaner practices.
- **Complementary Nature:** While adaptation focuses on dealing with the impacts of climate change that are already occurring or expected, mitigation aims to prevent further climate change by addressing its root causes. Both adaptation and mitigation are seen as complementary strategies in a comprehensive approach to climate action.

CASE STORY:
Addressing Climate Change and Biodiversity in South Africa

CONTEXT & CHALLENGES

Climate change is likely to become one of the most significant drivers of biodiversity loss by the end of the century. Current global warming is already affecting species and ecosystems around the world, particularly the most vulnerable ecosystems such as coral reefs, mountains and polar ecosystems.

Recognizing the importance of genetic resources for climate action, the *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity*, ratified by 141 parties and entering into force in 2014, aims at sharing the benefits arising from the utilization of genetic resources in a fair and equitable way.

In South Africa, UNIDO promotes indigenous, essential and vegetable oils value chain development as well as various environmental, social and economic sustainability dimensions of the Nagoya Protocol to conserve South Africa's rich biodiversity and support indigenous communities with livelihood development. With a focus on biotrade, UNIDO supports the training of farmers to select the relevant genetics of the species so as to prevent economic and environmental losses, especially for indigenous peoples, and to conserve natural resources. Moreover, UNIDO considers the Department of Environmental Affairs (DFFE) list of indigenous species for economic development and the South African list of endangered species. The 2nd South African essential and vegetable oils (hybrid) conference held in July 2022 with the theme of "New horizons and innovations for the essential and vegetable seed oil industry" attracted numerous in-person and remote delegates. The interactive sessions focused on climate change and environmental policies, diversity and ecological state of aromatic plants, resource-effective practices such as regenerative agriculture/organic farming and community involvement. Moreover, in the course of the project, some of the farmers have successfully transitioned to renewable energy by running farms that are fully solar-powered, thereby contributing to an overall reduction in carbon footprint.

INTERVENTION

UNIDO continues to promote the role of QI and other support organizations for sustainable industrial development, while also taking into account environmental concerns, particularly climate change and energy supply. In addition to continuing to strengthen SMEs' awareness of market requirements, UNIDO's support in South Africa focuses on SMEs' responsiveness to the effects of rising natural disasters (such as flooding) and increasing energy shortages. The impact of climate change on the industry is to be assessed, and the awareness of climate change-responsive smart-farming technologies could further enhance the sustainability and competitiveness of the SMEs. The intervention in South Africa continues to build innovative partnerships through the BioTrade Stakeholder Forum and hopes to address various climate dimensions affecting the industry.

IMPACT & RESULTS

Through its actions, UNIDO supports the conservation of South Africa's biodiversity, livelihood development for indigenous communities, and the prevention of further endangerment of species. The transition of some farmers to renewable energy contributes to a reduction in carbon footprint, aligning with broader environmental sustainability goals. Additionally, by promoting awareness of market requirements and climate-responsive technologies among SMEs, UNIDO's intervention in South Africa aims to enhance the sustainability and competitiveness of the industry as a whole. Through partnerships and forums, it seeks to create a lasting impact on the industry, considering the challenges posed by climate change and energy supply issues.

This project is part of the Global Quality and Standards Programme (GQSP), implemented by UNIDO and funded by Switzerland through the Swiss State Secretariat for Economic Affairs (SECO).

HOW A FOCUS ON TRADE CAN HELP

Climate change has significant implications for global trade, and businesses along the value chain are increasingly recognizing the importance of incorporating climate considerations into their operations. The impact of climate change on trade is multidimensional, influencing supply chain resilience, regulatory compliance, consumer preferences, financial pressures, and international trade dynamics. Businesses along the value chain are facing increasing pressure to integrate climate considerations into their operations, not only to manage risks but also to seize opportunities associated with a transition to a more sustainable and low-carbon economy.

There are several ways in which climate change, particularly in relation to trade, can influence and drive action within the value chain:

Supply Chain Resilience/Climate Risks: Climate change introduces new risks to supply chains, including extreme weather events, changes in temperature and precipitation patterns, and disruptions to transportation infrastructure. Companies are under increasing pressure to assess and address these risks to ensure the resilience of their supply chains.

Regulatory Compliance/Climate Regulations: Governments worldwide are implementing and strengthening regulations related to climate change and environmental sustainability. Companies engaged in international trade must comply with diverse regulations, such as emissions standards, carbon reporting requirements, and sustainable sourcing practices.

Consumer Expectations and Preferences/Eco-conscious Consumers: Consumers are becoming more environmentally conscious and are increasingly making choices based on a company's environmental practices. Businesses in the value chain, from manufacturers to retailers, are under pressure to adopt sustainable and climate-friendly practices to meet consumer expectations and enhance their brand image.

Emission Reduction Commitments/Corporate Commitments: Many companies are making voluntary commitments to reduce their GHGs. This includes setting science-based targets, investing in renewable energy, and adopting sustainable practices in their operations. Such commitments can extend throughout the value chain, influencing suppliers and partners to also adopt climate-friendly practices.

Carbon Pricing and Trade Policies/Carbon Tariffs: Some countries are considering or implementing carbon tariffs, which impose charges on goods based on their carbon footprint. This approach aims to level the playing field for businesses in countries with stringent climate policies and encourages global adoption of cleaner production methods.

Financial Pressures/Investor and Financial Institution Expectations: Investors and financial institutions are increasingly integrating ESG factors into their decision-making processes. Businesses that are proactive in addressing climate risks and adopting sustainable practices may find it easier to access capital and attract investment.

Supply Chain Transparency/Emission Reporting: Increased demand for transparency in supply chains has led companies to disclose their GHG emissions and environmental impacts. This transparency can expose areas of high emissions within the value chain, prompting companies to seek cleaner alternatives and reduce their carbon footprint.

Innovation and Green Technologies/Market Opportunities: The shift towards green technologies and sustainable practices presents new market opportunities. Companies that invest in innovation and develop climate-friendly products and services may gain a competitive advantage and enhance their position within the value chain.

International Trade Agreements/Sustainable Trade Practices: International trade agreements may increasingly incorporate sustainability and climate considerations. Businesses that align with such agreements and adopt sustainable practices may benefit from preferential trade conditions and market access.

PART 2
THE EVOLVING CONCEPT OF QUALITY

Very simply put, quality is "the ability to meet needs and expectations".[1] These needs and expectations might be for a product or a service, for a process, a system, a person or an organization, and are typically defined by customers, regulators or other interested parties.

In today's high-tech and increasingly socially and environmentally conscious world, however, the traditional "inherent quality" of products and services alone is no longer enough. Consumers and society in general are more demanding in terms of the ways in which those products and services are provided, including the processes employed and the effects they can have on sustainability. This means, for example, they have concerns that can include carbon or water footprint, contributions to climate change, use of socially unacceptable practices and overall corporate governance. If any one of these factors is found to be deficient, today's social media communications can result in almost instantaneous global condemnation of the organization concerned—including potential boycotts by consumers—even though the "inherent quality" of their product or service may be impeccable.

In a similar fashion in the B2B supply chain, many organizations are placing additional requirements on their suppliers that go beyond those for the "inherent quality" of the products or services they provide.

This has caused a shift in recent years by more progressive organizations from a traditional ("narrow") approach to quality (focused almost exclusively on the quality of the products and services they provide) to a more holistic "broad" quality philosophy that extends along the value chain and addresses the many different dimensions of quality that are important for today's consumers and society. This "broad quality" approach includes, for example, the following dimensions:

- Product or service quality
- Organizational efficiency (aiming to reduce waste, including energy, non-renewable resources, etc.)
- Environmental considerations (including energy use, GHG emissions and others)
- Social issues (such as paying a living wage, avoiding child labour or forced labour)
- Governance (fraud, bribery, corruption, etc.)

In the context of climate change as one component of "broad quality", we then ask the question "WHOSE requirements need to be met?", and the answer can be found in the so-called "Brundtland Report" of 1987 (Report of the World Commission on Environment and Development: Our Common Future [2]):

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

In other words, the ***quality of life*** for future generations. This is an important concept, and one that we will revisit in Part 4 when we discuss the changes that are being made by ISO to its series of management system standards—including ISO 9001 (quality management), ISO 14001 (environmental management) and ISO 50001 (energy management), among others—as part of the deployment of its "London Declaration on Climate Action". Future generations are a key "interested party" and need to have their needs and expectations articulated and considered.

"Little time is available for corrective action. In some cases, we may already be close to transgressing critical thresholds. While scientists continue to research and debate causes and effects, in many cases we already know enough to warrant action. This is true locally and regionally in the cases of such threats as desertification, deforestation, toxic wastes, and acidification; it is true globally for such threats as climate change, ozone depletion, and species loss. The risks increase faster than do our abilities to manage them." Brundtland Report (1987)

[1] Derived from the definitions of "quality" and "requirement" provided in ISO 9000:2015 (Quality management systems - Fundamentals and vocabulary)

[2] https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf

By looking at the question of climate change from this perspective, it is not surprising that we can therefore expand the traditional "narrow" focus of a quality infrastructure system (QIS), focused initially on trade-related "narrow quality" issues, to include a broader perspective—that can support initiatives aimed at climate adaptation and mitigation—for example, through the lens of "broad quality". A system that goes beyond the original intent of providing confidence and trust in the inherent quality of products and services that are traded nationally, regionally and internationally to one that can provide confidence and trust in the measurements, data and reporting that are used to demonstrate the achievement of climate change or net zero related initiatives. Just as a sound QI can help guard against the trade of substandard, non-compliant goods and services, it can also help to prevent so-called "greenwashing", where ill-founded (and sometimes downright false) environmental declarations are made by organizations, or where a nation's claims of meeting their climate change targets as part of their sustainable development commitments cannot be substantiated.

PART 3
WHAT IS A QUALITY INFRASTRUCTURE SYSTEM AND HOW DOES IT SUPPORT CLIMATE ACTION?

The International Network on Quality Infrastructure (INetQI)[3] has adopted the following definition of a QIS:

The system comprising the organizations (public and private) together with the policies, relevant legal and regulatory framework, and practices needed to support and enhance the quality, safety and environmental soundness of goods, services and processes.

The quality infrastructure is required for the effective operation of domestic markets, and its international recognition is important to enable access to foreign markets. It is a critical element in promoting and sustaining economic development, as well as environmental and social wellbeing.

It relies on:

- **METROLOGY**
- **STANDARDIZATION**
- **ACCREDITATION**
- **CONFORMITY ASSESSMENT**
- **MARKET SURVEILLANCE**

Setting up an effective and efficient National Quality Infrastructure (NQI) System is one of the most positive and practical steps that a developing nation can take on the path towards the establishment of a thriving economy as a basis for growth, prosperity, health and well-being. The NQI is required for the effective operation of domestic markets, and its international recognition is important to enable access to foreign markets, via the use of harmonized standards and technical regulations and mutual recognition of conformity assessment methodologies. Establishing a NQI does not necessarily involve large investments in physical structures. Adoption and implementation of international standards (including in legislation and technical regulations) together with the acceptance of certificates of conformity can go a long way towards a NQI. When complemented with inspection and quality control, for example, at ports of entry and markets, a full-fledged NQI can be achieved rapidly and lead to very efficient outcomes.

The International Network on Quality Infrastructure (INetQI) is a forum in which a variety of international organizations exchange information and, where possible, collaborate in supporting the development of technical infrastructures. INetQI has 14 members: BIPM, IAF, IEC, IIOC, ILAC, IQNet, ISO, ITC, ITU, OIML, UNECE, UNIDO, the World Bank and the WTO.

In recent years, however, it has become increasingly clear that a well-implemented NQI contributes to governmental policy objectives beyond trade of products and services to areas such as industrial development, efficient use of natural and human resources, health, the environment, climate change, and other topics included in the UN 2030 Sustainable Development Goals (SDGs), shown in Figure 1.

[3] See https://www.inetqi.net/

FIGURE 3: THE UN 2030 SUSTAINABLE DEVELOPMENT GOALS (SDGS) (Source: www.un.org)

While the SDGs are not legally binding, governments are expected to take ownership and establish national frameworks for the achievement of the 17 SDGs. At this point on the way to 2030, the integration of the SDGs into policies, regulations, budgets, monitoring systems, and other government policies and procedures still varies greatly across countries.

CASE STORY:
Improving Sustainability Practices, Livelihoods and Resilience to Climate Change of Indonesian Coastal Communities

CONTEXT & CHALLENGES

As 70% of Indonesians live in coastal areas and rely on the ocean for their livelihoods and sustenance, there is a need to support sustainable fisheries and coastal livelihoods. To ensure a healthy and equitable future, the oceans are in need of sustainable management and further research. Indonesia is the second largest contributor to plastic waste, with massive amounts of plastics seeping into the ocean every year making marine debris a critical threat to Indonesia's valuable ocean resources. As the world's largest archipelagic nation, Indonesia's people, economy and environment greatly benefit from the blue economy—employing oceanic resources sustainably for economic growth and livelihoods while maintaining healthy marine ecosystems.

INTERVENTION

UNIDO's work in Indonesia aligns with the Indonesian Government's priority to support the blue agenda and blue economy development. It focuses on improving productivity, competitiveness and market access for actors in selected aquaculture value chains (shrimp, seaweed, milkfish, catfish and pangasius) at both national and regional levels. In collaboration with other UN agencies and development partners, UNIDO actively participates in the National Blue Agenda Partnership (NBAAP) led by the Coordinating Ministry of Maritime Affairs and Investment and the Blue Economy Road development led by BAPPENAS.

The NBAAP, launched in Bali in November 2022 during the G20 Summit, aims to support the Indonesian Government to promote sustainable and inclusive fisheries and marine resource development, as regulated in national development frameworks. The National Blue Agenda has four pillars namely: Blue Health, Blue Food, Blue Innovation and Blue Finance. UNIDO is a member of the Blue Innovation Pillar and co-chairs the Blue Food Pillar, which focuses on activities related to production, consumption, aquaculture, market access, supply chain, food security system, small-scale producers, sustainability, competitiveness, certification and investment. The programme contributes written inputs and participates in public consultations for the development of Blue Economy Roadmap led by BAPPENAS, particularly regarding aquaculture and market access. The Blue Economy Roadmap was unveiled during the ASEAN Blue Economy Conference in Belitung in July 2023. On a global scale, there is active participation in the development of Seafood MAP, initiated by GSSI and supported by UNIDO, FAO and more than 90 stakeholders worldwide since its inception in 2019.

IMPACT & RESULTS

The Seafood MAP platform is a public-private partnership designed to empower seafood producers of all sizes to share their sustainability achievements, regardless of size or destination. It is a novel approach to map and accelerate fisheries and aquaculture pathways to sustainability, fostering fisheries and aquaculture sustainability through storytelling and measuring progress against the SDGs. This platform provides global producers, including those in Indonesia, with opportunities to learn, connect to markets, access technology solutions, and explore investment prospects.

This project is part of the Global Quality and Standards Programme (GQSP), implemented by UNIDO and funded by Switzerland through the Swiss State Secretariat for Economic Affairs (SECO).

Overall, the pursuit of the SDGs requires a fundamental shift in economic activities, social practices and human behaviour, and this transformation can be supported by QI systems using the concept of "broad quality" mentioned in Parts 2 and 3. This is especially the case for SDG 13 ("Take urgent action to combat climate change and its impacts") and its associated five targets, four of which are directly relevant here:

- Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries
- Integrate climate change measures into national policies, strategies and planning
- Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
- Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and Small Island Developing States, including focusing on women, youth and local and marginalized communities

Pursuing climate action and sustainable development in an integrated and coherent way offers the strongest approach to enable countries to achieve their objectives efficiently and quickly under the Paris Agreement and the 2030 Agenda for Sustainable Development.

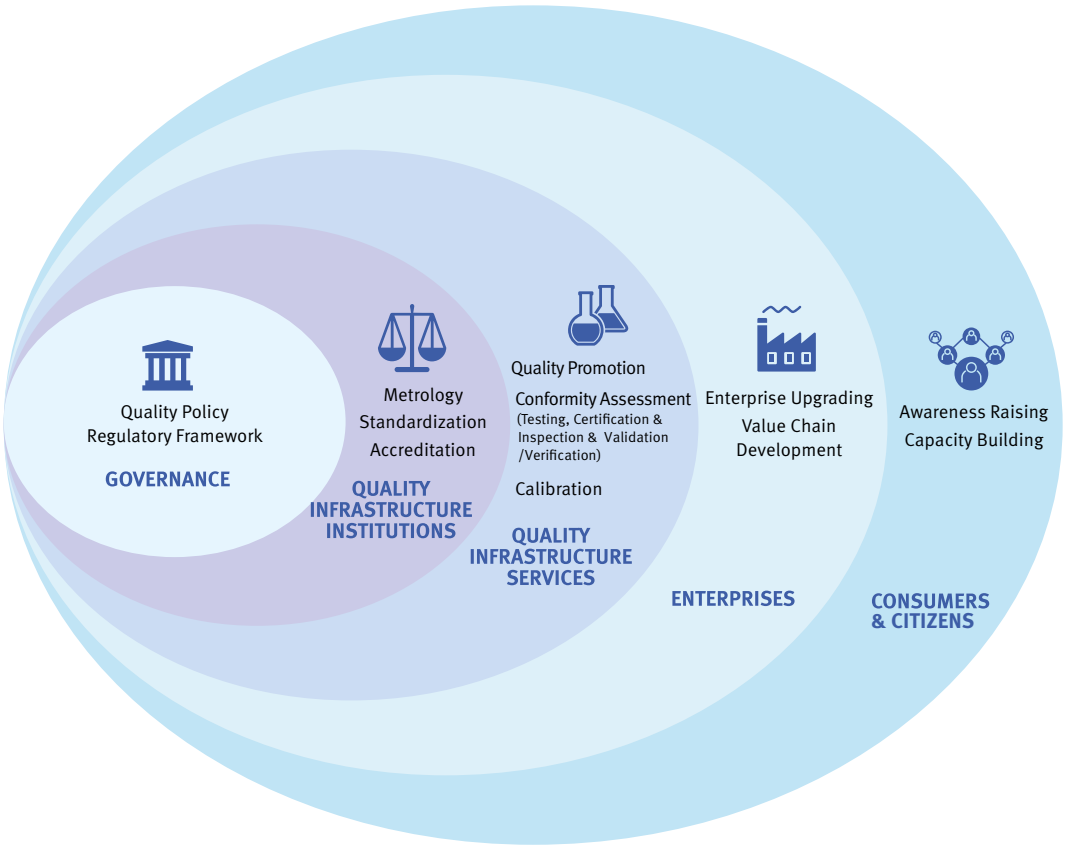
When all QI building blocks are in place—standardization, metrology, accreditation and conformity assessment (in particular, testing, certification, validation/verification and inspection services)—a QI can help consumers and citizens to make informed choices, encourage innovation, lead businesses and industries to take up appropriate new technologies and organizational methods improving current practices, and support public authorities in designing and implementing public policies aligned with the SDGs.

Recognizing the need to assess and measure the contribution of QI to climate action, the Quality Infrastructure for Sustainable Development (QI4SD) Index provides a framework of indicators that summarizes the overall state of development of a country's and/or region's QI readiness to support the SDGs. As QI is an important enabler of sustainable development, the QI4SD Index aims to bridge an information gap by being the first tool that explicitly measures how fit for purpose QI is in meeting sustainable development.

Figure 4 shows schematically UNIDO's holistic approach to quality infrastructure development, which aims to stimulate industrial development, trade competitiveness, innovation and efficient use of resources, while ensuring food safety and protecting human health and the environment. More specifically, as it relates to climate action:

- The **"governance"** element can include regulations that are relevant to climate, net zero and other sustainability-related initiatives, whilst at the same time, the "quality policy" (traditionally focusing on trade-related topics) can easily be transformed into a policy that embraces "broad quality" (including climate change considerations), as discussed in Part 2.
- The **"quality infrastructure institutions"** can readily embrace climate action initiatives into their remit and portfolios.
- The **"quality infrastructure services"** can focus on "broad quality" promotion including, issues relating to climate change. Conformity assessment bodies can support climate action initiatives and calibration and verification services adapted to provide additional confidence.
- **"Enterprises"** will need to adapt to the growing global concerns about climate change and adapt and/or mitigate as appropriate for their particular context. This includes the promotion of climate action throughout the value chain.
- **"Consumers"** (and, more broadly, "citizens") need to be made aware of their own responsibilities to make informed decisions not only about the products and services they are offered, but also on their own behaviour as a member of the global community.

FIGURE 4: FROM POLICY TO CONSUMER – UNIDO SYSTEMIC APPROACH TO QI



A QIS is a powerful tool for defining, developing and verifying quality requirements for products and services. The QIS not only helps to demonstrate that products and services actually meet the relevant requirements for their intended markets, it can also be used to support and provide confidence in sustainability-related claims made for those products and services, and help to avoid "greenwashing", among other things. It helps to promote products and services that meet the state-of-the-art "broad quality" requirements and best practices that are essential for participating in modern-day international trade.

Robust QI systems better position developing economies to achieve sustainable development, through increasing prosperity, meeting the needs of people, and protecting the planet. In turn, a well-functioning, internationally harmonized and recognized QI system is essential for climate protection as QI provides confidence not only for the assessment of the impact of services and products on our climate, but also for monitoring national and international commitments such as those of the Paris Agreement as well as for SDGs.

In a similar fashion, within the financial sector, investors who traditionally evaluated performance based on financial measures alone are now taking into consideration non-financial parameters to support their decision-making process. The concept of environmental, social and governance (ESG) was first discussed in depth at the UN Global Compact's 2005 Conference "Who Cares, Wins" which brought together institutional investors, asset managers, buy-side and sell-side research analysts, global consultants and government bodies and regulators to examine the role of ESG value drivers in asset management and financial research. So-called "green financial instruments" are now in increasing demand to support projects aimed at climate change adaptation and mitigation measures at the international, regional and local levels. To support the analysis of such proposals and to allow for monitoring of the level to which the project objectives have been achieved, it is vital to have confidence in the impartiality and accuracy of associated performance indicators, which can only be provided by conformity assessment processes that are supported by appropriate standards, metrology and accreditation—in other words by a robust QI system.

CASE STORY:
Ghana's Clusters in Climate Action

CONTEXT & CHALLENGES

Over the last decade, the relative size of the agriculture sector in Ghana has decreased. Smallholder farming remains a mainstay in Ghana's agricultural sector. As of the second quarter of 2022, agriculture accounted for 22.1% of nominal GDP, down from 31.8% in 2009. This decline may be attributed to challenges such as climate change impacts and land degradation, among others. However, there are opportunities for growth through sustainable practices, technology adoption, and value addition. Adoption of environmental, social, and governance (ESG) standards within Ghana's agricultural sector is now evolving.

UNIDO's intervention identified pressing challenges including that processors were unaware of standards, personal hygiene and food safety. There were also difficulties to comply with Good Agricultural Practices (GAPs), Good Manufacturing Practice (GMP) and food safety standards. Farm productivity was identified to be very low and did not allow for systemic efficiency of the value chain caused by inadequate farm management practices, insufficient agronomy knowledge by many famers, and inadequate pest and disease control.

INTERVENTION

Through its implementation approach, within the three commodity value chains, UNIDO's intervention integrated activities that promote climate adaptation, mitigation and ESG. These were achieved directly through capacity-building trainings and call for proposals for SMEs and their clusters to implement innovative actions. Training was provided in areas such as GAPs, plant disease control and safe handling of agro-chemicals, post-harvest handling and industry transformation, and climate smart agriculture and integrated pest management. Processors were also trained in GMP and Introduction to ISO 45000: Occupational Health and Safety Management System. Furthermore, farmers were supported with improved planting materials and seeds as an adaptation measure. Some processors have also received support to install and/or construct solar dryers and solar irrigation systems.

IMPACT & RESULTS

Environmental (E) Impact: Farmers and agribusinesses within the value chains now adopt sustainable farming practices that consider environmental impact, resource conservation, and biodiversity. Some farmers have been equipped to GlobalG.A.P certification. Their farm practices now have a reduced ecological footprint. The environment around processing centers has also been enhanced through training in GMP, operational health and safety (OHS) and equipping the processors. Training in sustainable waste management practices and conversion of waste to compost has reduced harmful impact on the environment. Effluent from processing is being managed properly and converted into additional income streams for the processors. There is reduced consumption of biomass, up to 40%, by shea semi-processors.

Social (S) Responsibility: Improved production and processing practices has increased the number of workers engaged in excess of 24,000. Income levels have also increased by connecting farmers and processors to markets locally and internationally. The various interventions have contributed to social outcomes, i.e. social inclusion among shea semi-processors who are mostly female and sustainable energy transition. Support to farmer groups to obtain organic certification has significantly impacted those opening up markets and leading the expansion of farms.

Governance (G): Clusters are better organized and strengthened. For instance, a northern cluster of shea processors has been formed. Cluster Management Organisations (CMOs) were identified and supported with capacity building as a strategy to strengthen governance of the clusters. Farmer cooperatives have also been strengthened through training in group dynamics. As a result, some farmer cooperatives

have received financing from financial institutions that formerly considered farmers risky. Through having better governance structures, other farmer cooperatives are now linked to major off-takers and processors.

UNIDO has also contributed to Ghana's nationally determined contribution (NDCs), enhancing mitigation co-benefits in the nationally determined adaptation actions in agriculture through the adoption of climate-smart agricultural practices, promoting sustainable land management practices and the use of renewable energy, among others. Within the NDC policy actions, UNIDO's intervention has contributed to managing climate-induced and gender-related health risks; building resilience and promoting livelihood opportunities for youth and women in climate-vulnerable agricultural landscapes and food systems; sustainable production in industry; low carbon electricity generation; expanding the adoption of market-based cleaner cooking solutions; and scaling up renewable energy penetration by 10% by 2030.

This project is part of the West Africa Competitiveness Programme (WACOMP), implemented by UNIDO and funded by the European Union (EU).

QUALITY POLICY

WHAT IS IT?

As the various components of QIs develop within individual countries, they can sometimes evolve independently and result in overlapping or even conflicting functions and responsibilities. A basic cornerstone for ensuring good governance of QI is therefore to develop a National Quality Policy (NQP) to facilitate a proper and coherent division of work between the various QIS actors within a particular country's context. The NQP provides details of the preferred QI structures and their relevant responsibilities, as well as the relationship of the NQI with the framework for technical regulations. Countries (and in particular developing countries) cannot afford to duplicate effort and resources to establish parallel systems of standards, testing and certification—one for the marketplace and another for regulatory purposes—so the collaboration between national standards bodies (NSBs) and regulators is of particular importance.

HOW DOES THE QUALITY POLICY SUPPORT CLIMATE ACTION?

The Quality Policy, adopted at national level, aims to define and sustain an efficient and effective QI needed to address a number of policy objectives including, but not limited to, climate change, in line with global and national objectives.

In addition to (and in support of) the global initiatives represented by the SDGs, there are a number of policy initiatives around the world that depend on a sound QI for their effective deployment. These include the following:

OVERARCHING REGIONAL POLICIES

The EU's "Green Deal" is one such example. It is a comprehensive plan that aims to make the EU's economy sustainable and climate-neutral by 2050. The key elements of the Green Deal include:

» A commitment to cut GHG emissions by at least 55% by 2030, compared to 1990 levels.

» The creation of a circular economy that minimizes waste and promotes the use of renewable resources.

» The development of sustainable infrastructure, including renewable energy, public transportation, and smart grids.

» The promotion of energy efficiency in buildings and industries.

» The protection of biodiversity and restoration of ecosystems.

South Korea announced a similar "Green New Deal" in 2020, which includes plans to invest in renewable energy projects, such as solar and wind, and achieve carbon neutrality by 2050.

"NET ZERO" POLICIES

The EU's Net Zero initiative is a commitment to achieve carbon neutrality by 2050, which means reducing GHG emissions to the point to which they are balanced by the removal of carbon from the atmosphere. The key elements of the Net Zero initiative include:

» A commitment to reduce GHG emissions to net zero by 2050.

» The promotion of renewable energy, such as wind, solar, and hydropower.

» The development of carbon capture and storage technologies to remove carbon from the atmosphere.

» The implementation of energy efficiency measures in buildings and industries.

» The promotion of sustainable transportation, including electric vehicles and public transportation.

Sweden aims to achieve net zero GHG emissions by 2045. The country's climate policy framework includes measures to reduce emissions from various sectors, such as energy, transportation, and industry, as well as investments in renewable energy and carbon capture technologies.

Canada's Net-Zero Emissions Accountability Act, introduced in 2021, sets the goal of achieving net zero GHG emissions by 2050. It requires the government to set interim emission reduction targets and develop plans to achieve them, with accountability mechanisms to track progress.

California's Executive Order N-79-20 set the goal of achieving carbon neutrality in the state by 2045. The order directs state agencies to develop and implement strategies to achieve this goal, including transitioning to renewable energy and reducing emissions from transportation and industry.

Japan's Green Growth Strategy was announced in 2020, which includes the goal of achieving net zero GHG emissions by 2050. The strategy outlines measures to promote renewable energy, accelerate the transition to electric vehicles, and improve energy efficiency in various sectors.

EMISSIONS TRADING POLICIES

The European Union Emissions Trading System (EU ETS), established in 2005, is a cornerstone of the EU's policy to combat climate change and is a key tool for reducing GHG emissions cost-effectively. It was the world's first major carbon market and remains the biggest one. Its core principle is to make polluters pay for their GHG emissions, helping to bring emissions down and generating revenues to finance the EU's green transition. The EU ETS works on the 'cap and trade' principle. A cap is a limit set on the total amount of GHGs that can be emitted by the installations and aircraft operators covered by the system. The cap is reduced annually in line with the EU's climate target, ensuring that emissions decrease over time.

In order for the ETS to operate effectively, the monitoring and reporting of GHG emissions must be robust, transparent, consistent and accurate. EU Regulation 2018/2066 lays down rules for the monitoring and reporting of GHG emissions and activity data. This includes the appropriate standards to define sampling, inspection and testing procedures, reliable (accredited) testing laboratories and competent and impartial V&V bodies to assess the reports that are submitted.

CASE STORY: Delivering confidence for EU ETS Verification Accreditation

European Accreditation (EA) has worked closely with the Directorate-General Climate Action (DG CLIMA) of the European Commission (EC) to implement accreditation according to EN ISO 14065 and Commission Regulation (EU) N° 600/2012 for the EU Emissions Trading System (EU ETS), namely GHG verification.

The main activities of the EA-EC cooperation consisted of:

- Peer-evaluating policies and procedures established by EA NABs for accreditation of verifiers against EN ISO 14065, the Regulation, the related guidelines provided by DG CLIMA and EA-6/03 M : 2013 EA Document for recognition of Verifiers under the EU ETS Directive and any additional criteria being defined (in advance of subsequent revision of EA-6/03).
- Training EA peer-evaluators for NAB accreditation of EU ETS verifiers.
- Establishing an EA-EU ETS Network of experts on EN ISO 14065 and the Regulation.

Setting up national databases for publication of accredited verifiers: EA NABs providing accreditation of EU ETS verifiers set up a national database of accredited verifiers to allow public access to information (data and scope) on verifiers accredited by each EA NAB. According to the Regulation, EA should also facilitate and harmonise access to these national databases in order to enable efficient and cost-effective communication between EA NABs, national authorities, verifiers, operators, aircraft operators and competent authorities. The databases of EA NABs for their EU ETS accredited verifiers is available on the EA website.

EA has worked with DG CLIMA to develop the most relevant delegated acts that further specify the rules for verification and accreditation in Regulation (EU) N° 757/2015 on monitoring, reporting and verification of carbon dioxide emissions from maritime transport.

Source: *https://publicsectorassurance.org/case-study/delivering-confidence-for-eu-ets-verification-accreditation/*

Similar policy initiatives are in place in other parts of the world, including:

» **California's Cap-and-Trade Program:** Implemented in 2013, this sets a state-wide limit on GHG emissions and issues permits (allowances) to pollute, which can be bought, sold, or traded.

» **China's National Carbon Market:** Established in 2017, this is the world's largest carbon market in terms of potential emissions covered, aiming to help China meet its climate goals by pricing carbon and reducing emissions.

» **Norway's Carbon Tax:** Norway introduced a carbon tax in 1991, which imposes a levy on the use of oil, gas, and coal, incentivizing industries to reduce emissions and invest in cleaner technologies.

» **New Zealand's Emissions Trading Scheme (NZ ETS):** Introduced in 2008, it is designed to reduce GHG emissions by putting a price on emissions, encouraging the transition to a low-carbon economy.

» **Mexico's Emissions Trading System:** The first in Latin America, started in January 2020. It covers direct CO_2 emissions from fixed sources in the energy and industry sectors emitting at least 100,000 tCO_2 per year, covering around 40% of national GHG emissions and 90% of emissions reported in the National Emissions Registry (RENE). Allowances are allocated through grandparenting based on historical emissions, which are verified annually.

CLEAN ENERGY POLICIES AND INITIATIVES

There are a number of policy initiatives around the world that aim to phase out fossil fuels and replace them with renewable energy sources.

» Australia's Clean Energy Regulator is a government body responsible for accelerating carbon abatement for Australia through the administration of the National Greenhouse and Energy Reporting scheme, Renewable Energy Target (RET) and the Emissions Reduction Fund. The RET is a scheme designed to reduce emissions of GHGs in the electricity sector and encourage the additional generation of electricity from sustainable and renewable sources. It works by allowing both large-scale power stations and the owners of small-scale systems to create large-scale generation certificates and small-scale technology certificates for every megawatt hour of power they generate. Certificates are then purchased by electricity retailers (who supply electricity to householders and businesses) and submitted to the Clean Energy Regulator to meet the retailers' legal obligations under the Renewable Energy Target. This creates a market that provides financial incentives to both large-scale renewable energy power stations and the owners of small-scale renewable energy systems. Once again, in order to provide confidence and transparency in such a scheme, the QI System (and in particular the metrology component) is vital.

» In the USA, several states, including California, New York, and New Mexico, have implemented or proposed Clean Energy Standards (CES) policies that mandate a certain percentage of electricity to come from renewable sources by specific target years, such as 2030 or 2045.

» Germany updated its Renewable Energy Sources Act (EEG) in 2021 to further promote the expansion of renewable energy, including increasing annual renewable energy targets and introducing new mechanisms to support renewable energy deployment.

METROLOGY

WHAT IS IT?

Metrology is the science of measurement and its application. It encompasses all theoretical and practical aspects of measurement, including the measurement uncertainty and field of application.

Metrology is typically divided into three basic overlapping activities:

» The definition of units of measurement.

» The realization of these units of measurement in practice.

» Metrological traceability—linking measurements made in practice to reference standards.

These overlapping activities are used in varying degrees by the three basic sub-fields of metrology:

» Scientific or fundamental metrology, concerned with the establishment of units of measurement.

» Applied, technical or industrial metrology—the application of measurement to manufacturing and other processes in society.

» Legal metrology, covering the regulation and statutory requirements for measuring instruments and methods of measurement.

HOW DOES METROLOGY SUPPORT CLIMATE ACTION?

Measuring climate-related variables is of fundamental importance for understanding and monitoring climate change. International agreements set clear targets such as the rate at which industrialized countries should reduce their GHG emissions. Compliance with these targets can only be verified with precise and globally comparable measurement results.

As an important pillar of QI, metrology aims to minimize measurement inaccuracies and enable globally comparable measurement results. Metrological testing and calibrations of sensors are essential prerequisites for data collection on climate change. Reliable measurements help to understand climate change better and improve trust in necessary measures to reach climate targets.

Most activities of data gathering and monitoring are performed by the World Meteorological Organization (WMO), its national members and a variety of partner organizations involved in the Global Observing System (GOS), in the Global Climate Observing System (GCOS) and the international collaborative system working on the Earth's climate. The need for scientific observations of ever-increasing complexity and accuracy is placing stringent demands for the precision and traceability of measurement results to internationally agreed units.

Important emerging issues include:

» Standards and comparisons for atmospheric composition to ensure the long-term stability and reproducibility of reference materials, and explicitly defined calibration scales and their traceability according to the International System of Units (SI).

» Ultra-sensitive, SI-traceable measurement techniques for measuring the amount-of-substance of GHGs.

» Development of suites of SI-traceable, amount-of substance, primary gas standard mixtures for key GHGs with low uncertainty.

» Consolidation of the metrology infrastructure to enable SI-traceable radiometric calibration of satellite sensors at uncertainty levels relevant for monitoring the Earth's climate.

» Leveraging and expanding the use of tools and approaches for data analysis and modelling within the metrology infrastructure, from aspects such as air quality monitoring to other aspects of climate change.

The WMO actively engages with QI institutions addressing standards and conformity assessment practices for measurement in meteorological and climate science through the Commission for Instruments and Methods of Observation (CIMO). Complementing the work of WMO's CIMO there is increasing cooperation with the international metrological community through the BIPM and national metrology institutes (NMIs). This cooperation combines the unique expertise of these two scientific communities in developing and strengthening the use of metrology for meteorology purposes and for the climate community as a whole.

CASE STORY: Global GHG emission verification through measurement

CONTEXT & CHALLENGES

Effective climate change mitigation requires the management of GHG emissions and removals. Improving the quality and number of measurements producing data and information on GHG emissions across a range of geographic areas will enable effective mitigation opportunities to be identified and the efficacy of emission reduction measures verified.

Accurate data is foundational to improving the effectiveness of mitigation activities which includes the targeting, quantifying, and tracking of emissions and removals and continued monitoring of their trends across local, regional, continental, and global scales. Identification and addressing of unmet measurement needs can improve national and subnational emission inventories and their reporting. Advances, particularly in precision, accuracy and granularity at sub-national scales will contribute to increased consistency between locally determined emission and removal amounts and national inventory reports.

INTERVENTION

The BIPM, in partnership with WMO, held the Metrology for Climate Action Workshop in September 2022, with a substantial theme focusing on metrology as an integral component of operational systems to estimate GHG emissions. The sessions of the workshop resulted in 81 key technical challenge areas for metrology and related areas and made 126 recommendations to address these challenges. A detailed report on these findings is available on the workshop's website (https://www.bipmwmo22.org/), serving as a guide for stakeholders and policymakers. In 2023, the World Meteorological Congress approved a new global GHG monitoring initiative, the WMO Global Greenhouse Gas Watch (G3W), to provide an integrated, operational framework that brings under one roof all space-based and surface-based observing systems, as well as modelling and data assimilation capabilities in relation to GHG monitoring. The BIPM has initiated programmes that will ensure that GHG measurement standards are more accessible to ensure accurate flux measurements both to and from the atmosphere as well as the oceans. Coordination follow-up metrology activities are being overseen through the Sectoral Task Group on Climate Change and Environment of the International Committee of Weights and Measures (CIPM).

IMPACT & RESULTS

These actions will address the urgent need for reliable information that helps to understand the impact of mitigation actions taken by the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement on the state of climate. Such information will be based on accurate measurement with known measurement uncertainty and will take into consideration both human and natural influences on the levels of GHGs in the atmosphere. This will enable timely international exchange of surface and space-based GHG observations and modelling products.

In 2022 the BIPM and the WMO held a workshop on Metrology for Climate Action to:

(a) present progress and identify requirements for further development of advanced measurements, standards, reference data, comparisons and calibrations supporting the physical science basis for and adaptation to climate change, and

(b) identify stakeholders' metrology needs, assess current metrological techniques, analyses, and modeling capabilities, and identify gaps in quantifying GHG emissions and uptake for effective actions on mitigating climate change and its impacts.

Specific topic discussion sessions resulted in 81 issues on key technical challenge areas for metrology and related areas being identified and 126 recommendations being made aimed at advancing metrology in support of the physical science foundation of climate change and climate observations. For more information refer to "BIPM-WMO Metrology for Climate Action Workshop Report, 26-30 September 2022".

Source: International Bureau of Weights and Measures, BIPM

Direct measurements and calculation models are increasingly being used to obtain more precise quantifications for different types of activities, for example, the calculation of the actual GHG emissions of a manufacturing plant. The evaluation of GHG emissions, including those from individual organizations, is fundamental to achieving the Paris Agreement goals and requires the widespread engagement of businesses and society. Trusted GHG emissions data from organizations are therefore required to:

- Support the implementation and enforcement of relevant public policies.
- Support organizational management in defining and implementing their climate change strategy as an integral part of a corporate sustainability strategy.
- Accurately inform customers and stakeholders about the organization's emission-related performance and associated plans.

Countries with sound policies, realistic and well-justified plans and projects for low-carbon development, based on trusted data and backed by an appropriate QI, will have a competitive advantage when requesting climate funding. The same considerations apply for carbon offsetting projects. A QI and fit-for-purpose QI services supporting climate-related action will provide a competitive advantage to those countries that prioritize capacity building in this area.

STANDARDIZATION

WHAT IS IT?

Standardization is a central pillar of any QIS, providing clarity and comparability for government, business, consumers and citizens. Standards encode knowledge regarding usability, quality, safety, performance or any other characteristics required by users into technical specifications for products or product components (e.g. dimensions, sizes, formats, tolerances, performances, and interfaces) and their testing, as well as requirements and guidance on best practices for products, services, processes and systems. ISO/IEC Guide 2 defines a standard as a "*document, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context*". It goes on to say that "*standards should be based on the consolidated results of science, technology and experience, and aimed at the promotion of optimum community benefits*".

International standards are voluntary in their application, though they can also be used as a basis for or support the application of regulatory requirements and assessments of conformity.

The three best-known global standardization entities are IEC (the International Electrotechnical Commission), ISO (the International Organization for Standardization), and ITU (the International Telecommunication Union), which under the banner of the WSC (World Standards Cooperation) work together to advance and strengthen the voluntary consensus-based international standards system.

Voluntary standards are powerful tools that policymakers can use in addition to or in conjunction with laws and regulations to implement public policy and achieve their objectives. Once international standards are widely disseminated, they can facilitate the reduction of costs and increased efficiency at company level or at national level, thereby promoting improved productivity. In international business, standards provide a common language to harmonize concepts and understanding, and avoid unnecessary differences in requirements between countries, ultimately reducing costs and facilitating trade.

ISO STANDARDS, REGULATION AND PUBLIC POLICY

The WTO TBT Agreement and good regulatory practices call for policymakers and regulators to use "international standards", where relevant and appropriate, to ensure that they align with global best practices. The international standards, as developed by ISO, IEC and ITU, jointly known as the World Standards Cooperation, are in line with the WTO Technical Barriers to Trade's six principles for the development of international standards, guides and recommendations. Therefore, there is a presumption that ISO/IEC/ITU standards do not cause any unnecessary obstacles to trade.

A need has been identified to increase awareness of the benefits of using international standards as a tool to achieve public policy objectives, as well as meeting business objectives. Therefore, ISO has developed a dedicated capacity building programme on Standards and Public Policy to enhance collaboration between policymakers, regulators and national standards bodies in using international standards (including conformity assessment standards) in the preparation, adoption and application of policy and, in particular, technical regulations.

The flagship deliverable of this programme is the Standards and public policy: A toolkit for national standards bodies, which sets the overall framework and provides a step-by-step guide for NSBs to plan and prepare for their engagement with policymakers and regulators. The ISO toolkit is supplemented by guides that help to equip policymakers, regulators and NSBs with the knowledge on how to maximize the value of international standards and the support that can be provided by NSBs, and "how to" reference standards in regulation.

Building on this foundation, a comprehensive programme of action was designed to increase collaboration between NSBs, policymakers and regulators, in priority sectors such as, but not limited to, climate change, plastic pollution, energy, hydrogen, digital transformation, green trade and food safety. The programme includes thematic priority briefs, research initiatives, workshops and peer-to-peer knowledge-sharing. The ultimate goal is to establish a global community of interest that utilizes international standards to accomplish public policy objectives, foster trade, and promote international regulatory cooperation.

HOW DOES STANDARDIZATION SUPPORT CLIMATE ACTION?

By their very nature and their stated objective of achieving *"the optimum degree of order in a given context (...) based on the consolidated results of science, technology and experience"*, standards offer great support for many sustainability-related initiatives that include environmental management, helping organizations and countries alike to measure and improve their carbon footprint, reduce GHG emissions, make more efficient use of resources such as energy, and move towards "NetZero" capabilities.

Some examples include:

IEC

IEC standards together with the four IEC Conformity Assessment (CA) Systems[4] provide the technical foundation that allows countries to put in place sustainable, resilient infrastructure to stimulate economic development, innovation and apply global best-practice to manage quality and risk. They are used by technical experts to design, build and manufacture a very broad range of devices and systems used in homes, offices, healthcare facilities, industrial manufacturing, farming and much more. IEC's work enables all forms of power generation including on-grid and off-grid use of reliable renewable solar, wind, marine and hydro energy generation.

[4] IECEE for Electrotechnical Equipment and Components; IECRE for Equipment for Use in Renewable Energy Applications; IECEx for Equipment for Use in Explosive Atmospheres and IECQ for Quality Assessment System

CASE STORY: Contributing towards global climate action in Thailand

Recognizing the impact of climate change on people's lives, the IEC Thai National Committee and the Thai Industrial Standards Institute (TISI) aim to make the intentions of standardization move from paper to reality.

To this end, a number of IEC Standards have been adopted by Thailand to contribute to global climate change efforts.

Solar energy: 25 IEC Standards related to photovoltaic solar panel and its components have been adopted as Thai Industrial Standards (TIS) to encourage the usage of renewable energy with confidence in its safety and efficiency, especially solar energy. These standards cover everything from the installation to the design qualification, type approval, and the safety of the photovoltaic solar panels. The TIS also extend to the application of solar panels in real-world situations as well.

Energy efficiency: IEC TR 62837 has been adopted as the TIS for industrial energy efficiency usage, which enables industries to integrate automation in manufacturing, process control and facility management. Use of this standard helps to reduce energy consumption by the community as a whole and contributes to the global effort of reducing carbon emission.

Conformity assessment: Climate change contributors such as GHG and carbon footprint have been incorporated into Thai Conformity Assessment Standards (TCAS). The standards ensure that the industrial sector and beyond have a clear understanding regarding climate change factors, and provide coherent frameworks and necessary regulations for all sectors to follow on the path to a greener society.

This is just a glimpse of Thailand's efforts and contributions toward climate change issues. Thailand is an active participant in standardization within IEC technical committees that contribute to SDG 13 ("Climate action").

Source: https://www.iec.ch/basecamp/case-study-thailand

Policymakers and regulators lean on IEC International Standards to establish safety, security, and reliability benchmarks for quality infrastructure in diverse fields such as energy generation, water management, sanitation, healthcare and transportation. Leveraging IEC work strengthens governance, enabling legislation to safeguard populations from unsafe products and environmental hazards.

IEC International Standards not only enhance national innovation and economic productivity, but also support the adoption of or upgrading/ retrofitting cleaner and environmentally sound technologies and industrial processes. IEC CA Systems allow governments to verify that systems are properly installed, manufacturer promises are kept, and consumers are protected from dangerous and counterfeit products.

IEC's work provides the framework for built-in energy efficiency and integrating renewable energy sources into power generation, including solar, wind, marine, and hydro energy. Of particular relevance is the associated IECRE Certification Scheme for Equipment for Use in Renewable Energy Applications.

Beyond measuring and assessing energy performance and efficiency, IEC Standards actively help reduce energy consumption and increase the energy efficiency of devices and systems. They allow for building energy efficiency measures directly into devices and support a wide range of energy efficient technologies such as electric motors, LED, plasma welding, electric heating, and heat pumps.

CASE STORY: Planning regulatory instruments for energy efficiency based on IEC Standards in Ecuador

Energy efficiency (EE) means obtaining the same service or product by using less energy. Implementing EE contributes to reducing the import of petroleum fuels, mitigating the effects of climate change and creating a sustainable growth culture. It is a key factor in complying with global commitments on energy and climate, as outlined in the Paris Agreement on Climate Change and the UN 2030 Agenda for Sustainable Development.

Energy efficiency (as a result of promoting EE through plans, programmes, projects and the dissemination of best practices) impacts three areas: sustainable growth, human development and environmental sustainability. It contributes to the reduction of public spending, increased employment, improved industrial productivity, energy savings, reduction of air polluting emissions, energy security, energy sufficiency, to name but a few.

The Ecuadorian Government is promoting EE through the Organic Law on Energy Efficiency (LOEE), which provides for the articulation of initiatives for all sectors of energy supply and demand. Currently, strategic planning is defined in the 2021–2025 National Development Plan, based on the following instruments:

- 2016–2040 National Energy Agenda (ANE)
- 2016–2035 National Energy Efficiency Plan (PLANEE)
- 2018–2027 Electricity Master Plan (PME)
- 2021 National Energy Balance (BEN)
- 2022 Public Policies to promote energy efficiency in Ecuador

Ecuador's EE policy pillars are based on strengthening the legal, institutional and regulatory frameworks; energy performance standards, energy management, technological innovation, training and research; promoting the use of energy-efficient technologies; promoting best practices; encouraging investment; and sustainable urban planning.

Therefore, the 2016-2035 PLANEE has incorporated actions and measures to help the market in Ecuador transform by using energy efficient, safe, quality and environmentally friendly equipment; equipment replacement programmes in different sectors; energy management; and the development of a market for energy service companies.

IEC Standards and COPANT Standards have contributed considerably to the technical regulations on energy efficiency in the 2016–2035 PLANEE. These standards establish the minimum levels of energy performance. In addition, IEC Conformity Assessment Systems enable consumers to feel confident they have acquired and are using quality, safe and efficient products.

Examples of key standards for the PLANEE include the IEC 60335 series of safety standards for household appliances, the IEC 60034 series of energy efficiency standards for motors, IEC 60901, and IEC 60968 standards for lamps, and many more.

Transportation is another axis of the 2016–2035 PLANEE and IEC Standards for electric vehicles, specifically for charging services, such as charging stations (IEC 61851 series), charging connectors (IEC 62196), and charging cables (IEC 62893), are included in the national regulation.

Source: https://www.iec.ch/basecamp/case-study-ecuador

To cut global GHG emissions, cleaner transport systems are crucial. Nations worldwide, both developed and developing, are adopting sustainable mobility strategies that extend beyond electric cars. Trains, light rail, underground systems, and electric vehicles (EVs) all contribute to reducing CO_2 levels and congestion. The IEC provides technical standards for these systems, including electricity and hydrogen-powered options, as well as for infrastructure, self-driving tech, and in-vehicle multimedia.

Furthermore, the IEC's efforts extend to fostering smart cities through collaboration across technical committees, resulting in the development of thousands of standards that underpin smart energy, water management, mobility, security, healthcare and other essential services. These standards not

only serve as a basis for testing and certification, but also enable interoperability and data protection, critical for realizing the potential of technologies like IoT, AI, and VR in urban environments.

However, the proliferation of interconnected systems also introduces cybersecurity risks. Electrical installations and power plants form part of the critical infrastructure of countries, and renewable energy systems are increasingly viewed as the weak link in the grid by cyber criminals. Supervisory control and data acquisition (SCADA) technology and human-machine interfaces (HMIs) are now widespread in electric power plants as the latter automatize an increasing number of tasks. SCADA systems are based on large communication networks that reach directly or indirectly into thousands of facilities.

To mitigate these threats, the IEC develops standards and frameworks such as ISO/IEC 27001 and IEC 62443, supporting comprehensive cybersecurity strategies that address both IT (Information Technology) and OT (Operational Technology) that are common to critical infrastructure environments. The IEC 62443 series of cybersecurity standards for automation and control systems can be applied to any critical infrastructure facility, such as power utilities, public transport or healthcare units. These horizontal standards establish efficient security processes and procedures that cover the whole value chain, from the manufacturers of automation technology to installers as well as operators. They address and mitigate current security vulnerabilities as well as pre-empt future ones. A cyber-attack on critical infrastructure such as a power plant or a hospital can bring down the whole system and affect people's physical well-being, and their ability to run a business or obtain basic services such as water, food, or healthcare.

Additionally, IEC Standards along with the IEC CA Systems promote the circular economy by guiding environmentally conscious design and controlling hazardous substance usage. A new IEC CA service verifies product carbon footprint declarations to allow companies to avoid accusations of greenwashing.

In the realm of manufacturing, IEC standards facilitate smart manufacturing practices that optimize the entire product lifecycle, from design to recycling, while integrating real-time feedback for continuous improvement.

In essence, the comprehensive efforts of the IEC, encompassing standards development, conformity assessment, and support for emerging technologies, contribute to building a safer, more sustainable, and more resilient interconnected world.

ISO

ISO has long been involved in the development of standards aimed at environmental issues, including climate change adaptation and mitigation (typically those standards in the ISO 14000 series developed by its Technical Committee TC207 for Environmental Management to address environmental and climate impacts, including related social and economic aspects, in support of sustainable development).

MANAGEMENT SYSTEM STANDARDS

One of the earliest and most important standards for environmental management is ISO 14001, which defines requirements for an environmental management system. Such a system can help an organization to define and achieve concrete environmental goals and (if needed) to be able to provide confidence to relevant interested parties via accredited certification. ISO has also issued standards on GHG accounting, thus allowing companies to verify their corporate carbon footprint according to the ISO 14064-1 standard. It is also possible to establish the carbon footprint of products or services according to ISO 14067, determining all GHG emissions caused by a product throughout its entire life cycle.

Energy management systems (EnMS) can also significantly contribute to the reduction of GHG emissions, as specified in the internationally established ISO 50001 standard. Many organizations introduce EnMS to reduce their energy consumption and increase energy efficiency. In addition to ISO 50001, ISO has published many energy-related standards on topics—including measuring energy performance using energy baselines and energy performance indicators; energy efficiency assessment and energy data management for buildings; and design of energy saving family homes—and on emerging technologies such as solar power and biofuels.

ISO'S CAPACITY BUILDING WORK

ISO recognizes that many of its developing country members need capacity building support to strengthen their national quality infrastructure, thus contributing to their countries' development objectives and the advancement of the UN SDGs. Representing ISO at the national level, NSBs support the national quality infrastructure's standardization pillar. Many also shoulder specific responsibilities in matters regarding conformity assessment. ISO's capacity building projects seek to empower developing countries so that they actively contribute to the ISO system and benefit fully from the use of ISO standards addressing social, economic and environmental challenges. Specific projects focus on the implementation of selected ISO standards linked to climate action—such as energy management, environmental management, life-cycle assessment and water footprint—by SMEs. A short video highlights the concrete results and benefits to the SMEs in implementing these ISO standards. More details on ISO's capacity building work can be found here.

OTHER ISO STANDARDS RELATED TO CLIMATE CHANGE

» Ecolabelling and Environmental Declarations (ISO 14020 series)

The ISO 14020 family of standards provide principles and requirements for communicating environmental aspects and environmental impacts of products through environmental statements, e.g. self-declared environmental claims (ISO 14021), ecolabels (ISO 14024), environmental product declarations (EPDs) (ISO 14025) and footprint communications (ISO 14026).

» Green Debt Instruments (ISO 14030 series)

Another of ISO's major initiatives to support climate action has been the development of the ISO 14030 series of standards on green debt instruments, as follows:

» **ISO 14030-1** Green debt instruments - Process for green bonds providing the key principles, requirements and guidance for designating bonds as "green", for selecting projects, assets or activities, for managing proceeds, and for defining, measuring and reporting on their environmental impacts. It specifies the process steps for designating a bond as green, including the identification of appropriate performance indicators.

» **ISO 14030-2** Green debt instruments - Process for green loans following the same principles as ISO 14030-1, but its structure is slightly different, with distinctions being made for the various responsibilities of wholesale and retail borrowers and lenders. The administration of such retail loans can be complex, sometimes involving hundreds of SMEs or thousands of individuals borrowers.

» **ISO 14030-3** Green debt instruments – Taxonomy will deal with the classification ("taxonomy") of eligible investment projects, including categories that:

- are green "by default" (e.g. wind, marine, tidal and solar energy power plants)
- are green by meeting category qualification (e.g. renewable energy power plants)
- pass a process test with screening criteria such as:
  - Climate change mitigation
  - Climate adaptation
  - Biodiversity
  - Water resource management
  - Waste minimization
  - Pollution prevention and control

» **ISO 14030-4** (Verification) provides requirements for verification scheme owners and conformity assessment bodies. The standard requires verification to be carried out prior to the issue of the green debt instrument and at least one post-issuance verification engagement.

» Life Cycle Assessment (ISO 14040 series)

These standards address quantitative methods for the assessment of the environmental aspects of a product or service over its entire life cycle.

» ISO 14040 is an overarching standard that describes the principles and framework for life cycle assessment (LCA) including:

- definition of the goal and scope of the LCA

- the life cycle inventory (LCI) analysis phase
- the life cycle impact assessment (LCIA) phase
- the life cycle interpretation phase

» ISO 14041 deals with goal and scope definition and life cycle inventory methods

» ISO 14042 deals with life cycle impact assessment methods

» ISO 14043 describes life cycle interpretation methods

CASE STORY: Product Environmental Footprint of Coffee in Costa Rica

When the European Commission announced the Environmental Footprint (EF) pilot phase and one of the pilot products was coffee, Costa Rica started working on its coffee's life cycle assessment (LCA) and training coffee producers on LCA in order to calculate their environmental footprint. It was the first coffee LCA in the region.

The assessment analysed the coffee's cultivation, processing, distribution, roasting, consumption and end of life. The first three stages had access to better quality of data than the other stages, given its alignment to European consumption patterns.

The Latin American and Caribbean Coffee Environmental Footprint Network was created and now 14 countries are members. At the moment, Brazil, Colombia, Honduras, and Peru have a coffee's LCA and the network is in the process of developing a common proposal for a Product Environmental Footprint (PEF).

As a result, a Costa Rican coffee producer obtained a 49% premium in an international bid after certifying the carbon footprint of its product.

Understanding that the environment is now a relevant topic around the world, the Climate Change Direction (DCC) of the Ministry of Environment and Energy (MINAE) of Costa Rica established the Carbon Neutrality Country Program (PPCN) as a voluntary mechanism for the report and reduction of GHG inventories. The PPCN constitutes part of the efforts made by the country to fulfill its international commitments established in the Nationally Determined Contribution (NDC) and the Paris Agreement (MINAE 2018).

The PPCN consists of three categories of participation: organizational, communities and products. The PPCN for products follows the guidelines established in the ISO 14025 and 14026 standards and requires the industry to prepare a study of the carbon footprint of a product (CFP) that must ensure compliance of section 7 of the ISO 14067 standard. As well, the verification processes of the CFP must be carried out by validation and verification bodies using the ISO 14064-3 standard and they shall be accredited demonstrating compliance with ISO/IEC 17029 and ISO 14065.

» GHG Assessment and Verification (ISO 14060 series)

The ISO 14060 series has been in existence for many years and today comprises a number of standards that provide requirements for the quantification and reporting of GHG emissions:

» **ISO 14064** is published in three parts which together form a set of GHG accounting and verification criteria. This approach aims to ensure that emissions statements are comparable wherever in the world they are made so that end user groups such as governments, market traders and other stakeholders can rely on the data presented and the claims made.

- **ISO 14064-1** ("GHG - Specification with guidance at the organization level for quantification and reporting of GHG emissions and removals") addresses topics including the design, development, management, reporting and verification of an organization's GHG inventory.
- **ISO 14064-2** ("GHG - Specification with guidance at the project level for quantification, monitoring and reporting of GHG emission reductions or removal enhancements") includes requirements for planning a GHG project, identifying and selecting GHG sources, sinks and reservoirs relevant to the project and baseline scenario, as well as monitoring, quantifying, documenting and reporting GHG project performance and managing data quality.
- **ISO 14064-3** ("GHG - Specification with guidance for the verification and validation of GHG statements") can be applied to the quantification of organizational or GHG projects, including monitoring and reporting carried out in accordance with ISO 14064-1 or ISO 14064-2. ISO 14064-3 also specifies requirements for selecting GHG validators/verifiers, establishing the level of assurance, objectives, criteria and scope, determining the validation/verification approach, assessing GHG data, information, information systems and controls, evaluating GHG assertions and preparing validation/verification statements.

» **ISO 14065** ("Requirements for Greenhouse Gas Validation and Verification Bodies for use in Accreditation or other Forms of Recognition") provides criteria for the verification and validation process and defines requirements for those who perform GHG validation and verification. This standard gives additional confidence to GHG programme administrators, regulators and accreditation bodies, and is used as a basis for IAF (International Accreditation Forum) mutual recognitions of accreditation that can be used globally.

» **ISO 14066** defines the competence criteria for validation and verification teams.

» **ISO 14067** provides globally agreed principles, requirements and guidelines for the quantification and reporting of the carbon footprint of an organization's products. This in turn helps organizations to better understand the ways in which they can reduce their footprint.

» **ISO 14068** provides principles, requirements, and guidance for achieving and demonstrating carbon neutrality. It focuses on quantifying, reducing, and offsetting carbon footprints, utilizing a hierarchical approach prioritizing direct and indirect GHG emission reductions and removal enhancements within the value chain over offsetting. By providing a structured approach to carbon neutrality, it aligns with global efforts to achieve net zero GHG emissions and supports countries in fulfilling their nationally determined contributions (NDCs) and meeting the goals of the Paris Agreement.

» **ISO 14080** gives guidelines by means of a framework and principles for establishing approaches and processes to:

- identify, assess and revise methodologies
- develop methodologies
- manage methodologies

This standard is applicable to climate actions to address climate change, including adaptation to its impacts and GHG mitigation in support of sustainability. Such actions can be used by or for projects, organizations, jurisdictions, economic sectors, technologies and products, policies, programmes and non-government activities.

» **ISO 14083** establishes a common methodology for the quantification and reporting of GHG emissions arising from the operation of transport chains of passengers and freight.

CASE STORY: Standards development for hydrogen technologies

Contributions to the development of ISO TS 19870:2023, Methodology for Determining the GHG emissions in the Hydrogen Production, Conversion, Conditioning and Transport up to Consumption Gate

CONTEXT & CHALLENGES

The emerging hydrogen market currently lacks a universally accepted framework for the assessment of GHG emissions throughout its value chain. The absence of such a framework gives rise to divergent approaches among producers and consumers in quantifying emissions, thereby creating uncertainties, and struggles towards unified certification schemes. Ultimately, it hinders the hydrogen technology and market developments.

INTERVENTION

UNIDO addresses activities to accelerate the uptake of low emission hydrogen for industrial application in developing countries. It aims to serve as a global platform for awareness-raising of stakeholders participating in the low emission hydrogen ecosystem, exchange of experiences, capacity building, development of knowledge materials, policy dialogue and joint development of country specific projects on low emission hydrogen in industry. UNIDO has a liaison with ISO's TC 197/SC1 - Hydrogen at scale and horizontal energy systems and, in this context, UNIDO has actively participated in the discussions of this subcommittee, and thus, in the development of the Methodology.

IMPACT & RESULTS

An internationally agreed methodology for determining the GHG emissions in the hydrogen value chain simplifies the certification process by providing a transparent tool to quantitatively compare different hydrogen batches, based on their emissions. This not only provides regulatory assurance to the sector but also facilitates the formulation of effective public policies. It also fosters the development of all technology pathways based on their emissions intensity.

UNIDO Global Partnership for Hydrogen in Industry (phase II) acknowledges that IPHE is the original author of the methodology, which has been handed over to ISO to be developed into international standards.

» Sustainability in building construction specific standards

Designers, manufacturers, users, owners and other stakeholders in the building and construction sector are increasingly demanding information that enables them to make decisions to address environmental impacts of construction works.

Therefore, there are international standards dealing with sustainability in construction works that includes the following:

- **ISO 15392** - Sustainability in building construction — General principles
- **ISO 16745-1** - Sustainability in buildings and civil engineering works — Carbon metric of an existing building during use stage — Part 1: Calculation, reporting and communication
- **ISO 16745-2** - Sustainability in buildings and civil engineering works — Carbon metric of an existing building during use stage — Part 2: Verification
- **ISO 21929-1** - Sustainability in building construction — Sustainability indicators — Part 1: Framework for the development of indicators and a core set of indicators for buildings
- **ISO 21930** - Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services
- **ISO 21931-1** - Sustainability in building construction — Framework for methods of assessment of the environmental performance of construction works — Part 1: Buildings

» Adaptation to Climate Change (ISO 14090 series)

- **ISO 14090** provides principles, requirements and guidelines for adaptation to climate change. This includes the integration of adaptation within or across organizations, understanding impacts and uncertainties and how these can be used to inform decisions.
- **ISO 14091** provides guidelines on vulnerability, impacts and risk assessment associated with climate change.
- **ISO/TS 14092** specifies requirements and guidance on adaptation planning for local governments and communities.
- **ISO 14093** discusses mechanisms for financing local adaptation to climate change (Requirements and guidelines for performance-based climate resilience grants).
- **ISO 14097** addresses GHG management and provides a framework including principles and requirements for assessing and reporting investments and financing activities related to climate change.

» Circular Economy (ISO 59000 series)

The new policy adopted by many countries requires standardization in the field of circular economy to develop frameworks, guidance, supporting tools and requirements for the implementation of activities of all involved organizations to maximize their contribution to sustainable development, so many standards are under development:

- Circular economy standards for biomethane coming from waste, manure, landfills, etc.
- ISO/FDIS 59004 Circular economy – Vocabulary, principles and guidance for implementation
- ISO/FDIS 59010 Circular economy – Guidance on the transitions of business models and value networks
- ISO/FDIS 59020 Circular economy – Measuring and assessing circularity performance
- ISO/CD TR 59031 - Circular economy – Performance-based approach – Analysis of cases studies
- ISO/DTR 59032 - Circular economy – Review of existing value networks
- ISO/DIS 59040 - Circular economy – Product circularity data sheet

In parallel, the ISO TC 323 works in cooperation with existing committees on subjects that may support circular economy including standards for biomethane coming from waste, manure, and landfills. The responsible committee for that standard is ISO/TC 193 which is now working on the development of three standards related to analysis that can confirm the quality of the biomethane to substitute natural gas.

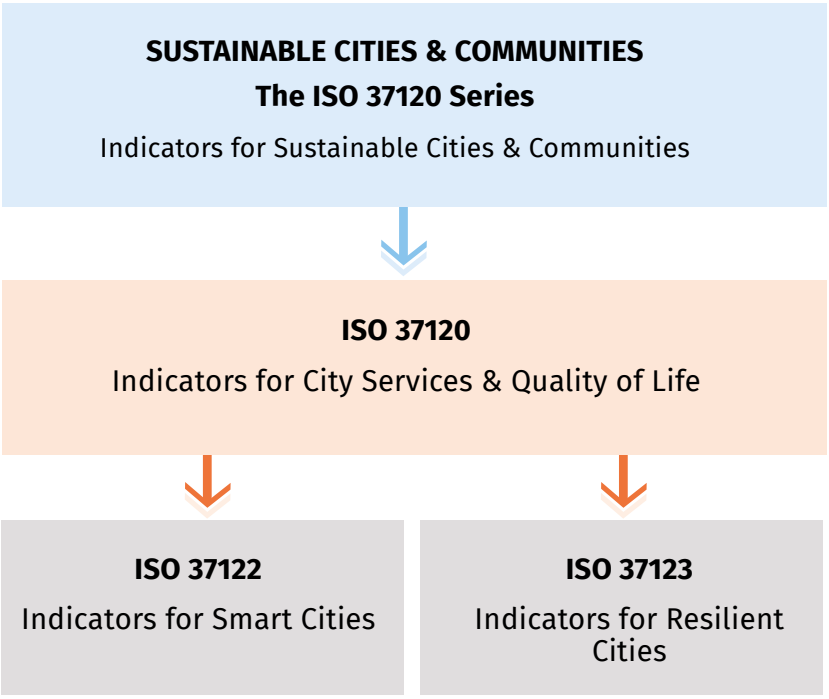
» Sustainable cities and communities (ISO 37120 series)

There are other types of standards that have been and are being developed to support climate change mitigation or adaptation such as the ISO 37120 series.

Responsible use of resources, preserving the environment and improving the well-being of citizens are the end goals for experts of ISO technical committee ISO/TC 268, Sustainable cities and communities, whose flagship standard ISO 37101 helps communities define their sustainable development objectives and implement strategies to achieve them.

Worldwide, cities are already utilizing **ISO 37120**, **ISO 37122** and **ISO 37123**—the **ISO 37120** Series of Standards — to build standardized data sets that support their work in delivering services to their residents, in advancing quality of life, and in building more smart and resilient futures for their cities. These municipal leaders recognize the importance of ISO standardized data to support and validate their commitments to ESG. Figure 5, taken from **ISO 37125** "Sustainable cities and communities – Environmental, social, and governance (ESG) indicators for cities" explains the scope and relationships of this series of standards.

FIGURE 5: SUSTAINABLE CITIES AND COMMUNITIES – RELATIONSHIP WITHIN THE FAMILY OF CITY INDICATORS STANDARDS (SOURCE: ISO/DIS 37125)



» **Environmental Labels and Declarations (ISO 14020 series)**

These standards make an important contribution to promoting consumer awareness and fighting the tendency for "greenwashing". The ISO 14020 series of standards, specifically ISO 14021, ISO 14024, and ISO 14025, includes principles and procedures for environmental communication and provides organizations with flexibility to incorporate variations in environmental policies and business practices.

ISO'S CLIMATE COMMITMENT

It is important to recognize that climate change adaptation and mitigation is not limited to organizations that have implemented environmental or energy management system standards. ISO's wider and far-reaching commitment to furthering the climate agenda came during its 2021 General Assembly, when all ISO Member Bodies approved what has become known as the "London Declaration."[5] This declaration was also endorsed by the IEC. It reads as follows:

"International Standards play a crucial role in underpinning the global economy, creating trust on all aspects of international trade. ISO has a number of standards that are essential in supporting the climate agenda; they help adapt to climate change, quantify greenhouse gas emissions and promote the dissemination of good practices in environmental management. The science is clear: the need for urgent measures to reduce emissions and help adapt to climate change is overwhelming.

Without up-to-date International Standards, industry and other stakeholders will be unable to achieve what is necessary. ISO hereby commits to work with its members, stakeholders and partners to ensure that International Standards and publications accelerate the successful achievement of the Paris Agreement, the United Nations Sustainable Development Goals and the United Nations Call for Action on Adaptation and Resilience."

In the London Declaration, ISO and its global members unanimously made the commitment to:

» Foster the active consideration of climate science and associated transitions in the development of all new and revised international standards and publications.

» Facilitate the involvement of civil society and those most vulnerable to climate change in the development of international standards and publications.

» Develop and publish an Action Plan and Measurement Framework detailing concrete

[5] https://www.iso.org/ClimateAction/LondonDeclaration.html

actions and initiatives and a reporting mechanism to track progress.

These initiatives are being overseen by a specific Climate Change Coordinating Committee (CCCC) that reports directly to ISO's Technical Management Board. For more information refer to ISO's climate commitment (https://www.iso.org/ClimateAction/LondonDeclaration.html).

One very significant component of the action plan has been the deployment of climate change considerations into just about all of ISO's Management System Standards, which are among the most widely used standards around the world. One core requirement of the "Annex SL" harmonized structure for these standards is that organizations must take into consideration the context in which they operate (including internal and external issues, as well as the needs and expectations of relevant interested parties) and how this can affect their ability to achieve the objectives of their management system. This will of course vary from one organization to another, but it is now agreed that climate change and the transition to "net zero" are certain to have an impact in most scenarios. All new management system standards issued since December 2023, and revisions to existing standards, are now required to incorporate new standardized text on climate adaptation and mitigation. Amendments to standards that are not undergoing revision were issued (for immediate implementation) in early 2024.

CONFORMITY ASSESSMENT STANDARDS

Standards that define requirements for the conformity assessment of products, processes and systems have long made a significant contribution to the economic component of sustainable development, but there is increasing awareness that these standards have an important role to play within the climate change arena to help determine the extent to which all relevant actors are achieving their stated goals and targets. With this in mind, ISO has developed a number of standards that play an essential role in climate action, helping to monitor climate change, quantify GHG emissions and promote good practice in environmental management.

ISO's Conformity Assessment Committee (ISO/CASCO) publishes a series of standards (in collaboration with the IEC) for conformity assessment known as the "CASCO Toolbox" (https://casco.iso.org/toolbox.html). These are for the operations of CABs and accreditation bodies and for peer assessment and other conformity assessment activities. Among those, there are the standards for the impartiality, competence and consistent operation of Testing Laboratories (ISO/IEC 17025), Inspection Bodies (ISO/IEC 17020), Inspection Agencies (ISO/IEC 17020), Management System, Product and Personnel Certification Bodies (ISO/IEC 17021, 17065, and 17024 respectively), Validation and Verification Bodies (ISO/IEC 17029) as well as for Accreditation Bodies (ISO/IEC 17011) and others.

The objective is to harmonize and streamline conformity assessment processes to provide confidence in results wherever the assessments are carried out.

WIDER DEPLOYMENT OF CLIMATE CONSIDERATIONS INTO GENERAL STANDARDS

Both IEC and ISO have many standards that help drive the climate action agenda forward. ISO has published guidance for its standards writers and other interested parties. This includes:

» **ISO Guide 82** - Guidelines for addressing sustainability in standards that aim to:

- raise awareness of sustainability issues arising from the application of ISO standards.
- provide standards developers with a systematic approach to addressing sustainability issues in a coherent and consistent manner, with regard to both new and revised standards, and in a manner related to the objective and scope of the standard being developed.
- promote consistency and compatibility, as far as is practical, among standards that directly or indirectly address sustainability.

» **ISO Guide 84** - Guidelines for addressing climate change in standards that are intended for developers of ISO standards and other deliverables to encourage the inclusion of provisions in standards to address climate change impacts, risks and opportunities. They aim to:

- enable standards committees to determine if the standard under consideration should take into account aspects, issues, impacts, risks and/or opportunities associated with climate change.
- provide standards developers with a systematic approach to address climate change impacts, risks and opportunities in a coherent and consistent manner,

with regard to both new and revised standards, and in a manner related to the objective and scope of the standard being developed.

- promote consistency and compatibility to the extent practical among standards that directly or indirectly address climate change and their wider uptake in support of sustainability.

» **IWA 42** - International Workshop Agreement on Net Zero Guiding Principles provides guiding principles and recommendations to enable a common, global approach to achieving net zero GHG emissions through alignment of voluntary initiatives and adoption of standards, policies and national and international regulation. It provides common terms and definitions, guidance and specific recommendations on topics including:

- net zero guiding principles for all organizations.
- incorporating net zero into strategies and policies.
- what net zero means at different levels and for different types of organizations.
- setting and aligning interim and long-term targets based on equity, latest scientific knowledge, evidence, research and agreed good practice.
- GHG emission reductions within the value chain.
- monitoring, measuring and use of appropriate and consistent indicators.
- equity, empowerment, fair share and wider impact.
- transparent reporting and effective communication.

SUSTAINABLE PROCUREMENT (ISO 20400)

ISO 20400 provides guidance to organizations, independent of their activity or size, on integrating sustainability within their procurement activities. It is intended for stakeholders involved in, or impacted by, procurement decisions and processes, and an increased awareness of the recommendations of ISO 20400 can help drive the climate agenda throughout global and local value chains.

Table A1 of the standard addresses some of the possible procurement actions that can be taken to address climate change mitigation and adaptation:

» Mitigate, in collaboration with suppliers, the adverse climate change impacts of direct and indirect GHG emissions and consider aiming for carbon neutrality through participating in appropriate programmes with other organizations. Consider the embedded carbon footprint (not just carbon emissions) associated with goods or services.

» Identify, together with suppliers and other stakeholders, opportunities to prevent or minimize damage associated with climate change such as floods, drought and water scarcity, intense cold or heat, and to ensure the security of drinking water, sanitation, food and other resources critical to human health.

EVENT SUSTAINABILITY (ISO 20121)

ISO 20121 “Event sustainability management systems — Requirements with guidance for use”, specifies requirements for an event sustainability management system for any type of event or event-related activity, and provides guidance on conforming to those requirements.

ISO 20121 emerges as a pivotal resource, guiding organizations toward practices that are more ethical, eco-friendly, and socially conscious. Highlighting new focuses on human and children’s rights, along with event legacies, the standard showcases sustainability’s transformative role in the industry. It offers various conformity demonstration methods, including self-declaration, supplier validation, and third-party certification, making sustainable practices attainable for all organizations, especially SMEs facing certification costs.

SUSTAINABLE FINANCE (ISO 32210:2022)

ISO 32210:2022 “Sustainable finance — Guidance on the application of sustainability principles for organizations in the financial sector”, gives guidance to organizations on the application of overarching sustainability principles, practices and terminology for financing activities.

It addresses what is material from the perspective of the organization and of its stakeholders.

It is applicable to all organizations active in the financial sector, including, but not limited to, direct lenders and investors, asset managers and service providers.

Beyond financial institutions and intermediaries, this document can be used by other parties in the financial sector such as providers or recipients of

sustainable finance, governmental organizations, public and private sector institutions, business entities, industry associations, financial market regulators, and supervisory and control bodies.

ITU

ITU has developed a set of standards in the ITU-T L.1500 series that underpin how information and communications technology (ICT) can help cities and countries respond and adapt to the effects of climate change, to provide a framework and guidelines for countries to integrate ICT into their national strategies for climate change adaptation and to upgrade existing ICT infrastructures.

In addition, ITU-T L.1420 assists organizations to assess the energy consumption and GHG emissions related to their operations. ITU has also developed a number of standards on monitoring and assessing energy efficiency, including metrics, measurement and informative values for telecommunication networks and equipment; infrastructure in data and telecommunication centers; minimum data set and communication interface requirements for data center energy management; as well as architecture and methodologies for evaluating the performance of power feeding systems and their environmental impact.

VOLUNTARY SUSTAINABILITY STANDARDS (VSS)

Voluntary Sustainability Standards (VSS) refer to a set of guidelines, criteria, and certification processes that organizations, businesses, and producers can voluntarily adopt to demonstrate their commitment to sustainable and socially responsible practices.

These standards are typically developed by non-governmental organizations (NGOs), industry associations, or other stakeholders to address environmental, social, and economic aspects of production and consumption.

Adopting VSS can enhance a company's credibility, promote sustainable practices, and respond to consumer demand for ethically produced goods and services.

Voluntary Sustainability Standards often cover a range of dimensions, including environmental impact, social responsibility, and economic sustainability. They address issues such as resource conservation, fair labor practices, human rights, and community engagement.

Many VSS offer certification programmes, where organizations or products that meet the specified criteria receive a certification or label. This certification can serve as a visible indicator to consumers that the product or service adheres to certain sustainability standards. To enhance credibility, some of them require third-party verification or auditing as well.

Examples of VSS include the Fairtrade Standards, Organic certification, carbon, water and environmental footprint of products, as well as social responsibility standards aimed at supply chains. Of particular relevance to the climate action context are the FSC (Forestry Stewardship Council) and PEFC (Programme for the Endorsement of Forest Certification) initiatives, both aimed at promoting sustainable forests. These also rely heavily on specific components of the QI, including accreditation and conformity assessment (in particular, certification).

TECHNICAL REGULATION (TR)

WHAT IS IT?

The WTO defines a TR as a "document which lays down product characteristics or their related processes and production methods, including the applicable administrative provisions, with which compliance is mandatory". TR are typically used to address the so-called "legitimate objectives" of government which include protecting the health and safety of citizens and the environment, among others. So, while conformity with standards is voluntary, technical regulations are by nature compulsory.

Like other regulations, TRs are prepared through a legislative process that is normally defined in a country's constitution or laws. A TR normally includes administrative provisions such as the accountability for the regulation and definition of the competent authority, guidance for the competent authority for interpretation of the regulation, conformity assessment procedures to be used (inspection, testing, certification and validation) to demonstrate compliance with the regulation, enforcement mechanisms to be used, and sanctions to be applied in the case of non-compliance.

HOW DOES TECHNICAL REGULATION SUPPORT CLIMATE ACTION?

Increased environmental concerns among consumers, due to rising levels of air, water and soil pollution, have led many governments to adopt regulations aimed at protecting the environment. Regulations of this type cover, for example, the recycling of paper and plastic products, and levels of motor vehicle emissions.

Technical regulations in the context of climate change are usually "horizontal" (they do not target a specific sector) in nature and can refer to specific standards, specifications, and requirements established by governments or international bodies to address and mitigate the impact of human activities on the climate. These regulations are designed to set forth guidelines and criteria for various industries, technologies, and processes, with the aim of promoting environmentally sustainable practices and reducing GHG emissions.

Technical regulations support the transition to a low-carbon economy by providing clear guidelines and harmonized practices fostering the global effort to address climate change.

Some common areas where technical regulations can be implemented in the context of climate change are:

- **Emission standards** for industries, vehicles, and power plants to limit the amount of GHGs and other pollutants released into the atmosphere. These standards often specify permissible emission levels and require the use of cleaner technologies.
- **Energy efficiency standards** for appliances, vehicles, and buildings to promote the use of technologies that consume less energy. This helps reduce overall energy consumption and, consequently, GHG emissions.
- **Renewable energy standards** to encourage and facilitate the adoption of solar, wind, hydro, and other renewable technologies to replace fossil fuels.
- **Fuel quality standards** promoting cleaner and less carbon-intensive options. This may include specifications for biofuels and other alternative fuels that have lower carbon footprints compared to traditional fossil fuels.
- **Carbon offsetting and trading standards** to promote carbon offset projects and emissions trading markets, ensuring transparency, accuracy, and integrity in the accounting and verification of emission reductions or removals.

CASE STORY: Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) in Kenya

As of 1 January 2019, under the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), all airline operators with annual emissions greater than 10,000 tonnes of CO_2 are required to report their emissions from international flights on an annual basis. Operators must keep track of their fuel use for each individual flight in order to calculate their CO_2 emissions.

To be eligible to verify emissions reports under CORSIA, verification bodies must be accredited to ISO/IEC 17029 and ISO 14065 by a national accreditation body working in accordance with ISO/IEC 17011.

In 2023, Kenya issued their accreditation scheme for GHG Verification Bodies for the CORSIA subscope and in November 2023 accredited their first verification body to verify emissions reports under CORSIA.

So far, the verification bodies have conducted the verification according to ISO 14064-3:2006 and relevant requirements included in Appendix 6 Section 3 of SARPs.

- **Green building codes** to enhance energy efficiency and reduce the environmental impact of structures.
- **Waste management standards** to stimulate the refurbishment and reuse of devices or systems, minimize methane emissions from landfills and promote recycling and composting as alternatives to traditional waste disposal methods.
- **Forestry and land use standards** to prevent deforestation, promote reafforestation, and protect biodiversity.
- **Monitoring, reporting, and verification (MRV) standards** to ensure consistency and accuracy in the measurement and reporting of GHG emissions by industries and organizations in general.

ACCREDITATION

WHAT IS IT?

Accreditation is a particular form of conformity assessment (see later) that provides confidence in the competence, impartiality and consistent operation of conformity assessment bodies (CABs) to perform their activities. The requirements for accreditation bodies are contained in ISO/IEC 17011.

International trade and commitments to social and environmental goals and targets are enhanced by multilateral recognition arrangements at the regional and international levels. Accreditation bodies that have been evaluated by their peers as being competent sign arrangements (the IAF Multilateral Recognition Arrangement (MLA) and the ILAC Arrangement (MRA)) that enhance the acceptance of products and services across national borders, thereby creating a framework to support international trade through the removal of technical barriers. ISO/IEC 17011 provides the requirements an accreditation body must meet if it is to be admitted into such an MLA.

HOW DOES ACCREDITATION SUPPORT CLIMATE ACTION?

Accreditation has always been an important component of any QIS, but it is only in recent years that its contribution within the context of climate action has been recognized. As mentioned previously, the main role of accreditation is to provide confidence in the competence, impartiality and consistent operation of conformity assessment providers. This includes many different aspects including the measurement of carbon emissions, the inspection of vehicles, certification of environmental or energy management systems, and the verification and validation of reports on climate change data. Mutual recognitions allow for meaningful comparisons in climate-related conformity assessment activities and in monitoring/reporting progress.

CASE STORY:
Accreditation supports a clean and safe environment in Poland

The level of air pollution is an important factor affecting the health and quality of life of Polish citizens. For many years, Poles have been breathing air whose pollution levels exceed the acceptable limits set in the EU. In 2015, Poland adopted the National Air Protection Programme (KPOP), aimed at improving air quality throughout the country. The KPOP identifies the causes of air pollution and points out that despite significant reductions in industrial emissions, air quality standards are still not being met. The results of annual assessments have shown that the main source of air pollution in Poland is the municipal and domestic sector, i.e. households. It is estimated that approximately 5 million domestic household boiler rooms are used in Poland, the vast majority of which are equipped with boilers having very unfavourable emission parameters.

Taking into account the KPOP, the Ordinance of the Minister of Development and Finance of 1 August 2017 on requirements for solid fuel boilers was prepared and published (Journal of Laws 2017, item 1690). The ordinance lays down specific requirements for solid fuel boilers with a rated heat output of not more than 500 kW, placed on the market after 1 July 2018, including limit values for pollutant emissions, which must be confirmed by a conformity assessment body accredited by the Polish Centre for Accreditation, in accordance with the Act of Parliament of 13 April 2016 on conformity assessment and market surveillance systems. In this area of conformity assessment, the Polish Centre for Accreditation has accredited testing laboratories and product certification bodies. Today, boiler manufacturers have the possibility to have their boilers tested in an accredited laboratory and certified to the standard PN-EN 303-5:2012. The above conformity assessment activities always include performance of pollutant emissions testing, as required by law.

The support that accreditation provides to the fight against air pollution is already being felt in the practice of economic life in Poland. The subsidy schemes for the modernisation of heating systems in Poland, including replacement of furnaces, require their beneficiaries to submit a certificate for furnaces, issued by an accredited body, to confirm both the compliance with the limit values for pollutant emissions and the efficiency parameters of the equipment. Thus, only products that have been tested and certified by an accredited body enable obtaining a subsidy. The extensive activities including accreditation are aimed at gradual elimination of the least environmentally friendly boilers.

Source: https://publicsectorassurance.org/case-study/accreditation-supports-a-clean-and-safe-environment-in-poland/

CONFORMITY ASSESSMENT

WHAT IS IT?

Conformity assessment involves a demonstration that specified requirements for products, services, processes, people or systems have been fulfilled. Such requirements may typically be specified by international, regional or national standards and technical regulations. Conformity assessment bodies (CABs) may be public or private entities that provide services such as testing, inspection, validation, verification, and certification of products, processes, people or management systems. The requirements for accreditation of a CAB are typically based on international standards developed by ISO's Conformity Assessment Committee (ISO/CASCO) and include (among others) standards such as ISO/IEC 17025 (for laboratories), ISO/IEC 17020 (for inspection bodies), ISO/IEC 17021-1 (for management system certification bodies), ISO/IEC 17065 (for product certification bodies) and ISO/IEC 17029 (for validation/verification bodies). Accreditation is usually provided by a national accreditation body (NAB) (typically, but not always, one per country) or by a multi-economy accreditation body (in some smaller economies where the establishment of a NAB might not be justified). Some CABs are global in their reach, with operations in many countries, whilst others operate on a local basis, sometimes in collaboration with international partners. International, regional and national standards provide the basis for the work of CABs, by defining (among other things), test methods, acceptance criteria, sampling methodologies, and personnel competence criteria. This in turn supports the WTO TBT Agreement, which invites members to give preference to international standards to support technical regulations that involve conformity assessment, to avoid generating technical barriers for trade.

The conformity assessment component of a QIS has traditionally focused on bodies that provide services such as inspection, testing and certification (of products, services, processes, persons and systems). The overall aim has been to service enterprises and consumers so as to ensure that products and services meet and can be shown to meet defined requirements—with the appropriate international recognitions—thereby facilitating international trade.

In recent years, however, increased attention has been given to the so-called verification and validation (V&V) bodies that are used (among other things) to provide confidence in claims made regarding a range of issues, including environmental or energy efficiency attestations, carbon footprint measurements and environmental, social and governance (ESG) reports.

CASE STORY: Boosting the Energy Efficiency of Ukrainian Wooden Windows for a Sustainable Future

CONTEXT & CHALLENGES

Even prior to the outbreak of the armed conflict in 2022, Ukraine was facing challenges related to outdated infrastructure, energy inefficiency and environmental degradation. The country has now put forward a Recovery Vision that aims to capitalize on the reconstruction efforts and ensure that these are guided by and serve as a springboard for sustainability. The so-called "green reconstruction" presents an opportunity to transition towards sustainable and inclusive growth in the post-conflict era. To achieve this, the adoption and effective implementation of appropriate standards is crucial.

Within the context of Ukraine's green reconstruction, the country has already begun boosting its energy efficiency for a sustainable future through its production of wooden windows.

Wood is a natural insulator and wooden windows can be one of the most energy-efficient window types when manufactured to the appropriate standards. About 100 producers of windows and structures operate in the Ukrainian market, which is further served by up to 10,000 small companies. However, the lack of capacities among local window manufacturers to meet quality and sustainability requirements could hamper their opportunities to participate in reconstruction activities and to generate much needed income that would allow them to stay in business.

INTERVENTION

In support of this sector, UNIDO in close cooperation with the Swiss University of Applied Sciences of Bern has put at the disposal of wooden window producers a new testing scope that will equip them to measure the thermal performance of their products, optimize their design and make them more energy efficient. The new testing capabilities will become an integral part of Ukrainian laboratories' offer of services and is the first step of a wider strategy aimed at building digital capacities among laboratories to improve their future resilience.

In line with this, UNIDO joined forces with the Ministry of Economy of Ukraine, the National Standards Body (UAS) and international partners, including CEN and CENELEC, to conceptualize and develop a National Guiding Framework to lay the foundation for green reconstruction. As part of these efforts, a series of workshops was organized for experts from relevant international, European and national partner organizations and for stakeholders from the public and private sectors to explore how standards and conformity assessment can support the reconstruction of essential infrastructure, facilities, services and their management, through green lenses, particularly applying the principles of circular economy, climate neutrality and decarbonization. The workshops furthermore addressed the importance of integrating sustainability issues into Ukrainian public policies (including technical regulations) prior to the post-conflict reconstruction process.

One of the UNIDO's main activities in Ukraine benefitting private sector producers is its work with partners to enhance the institutions that provide QI, including those responsible for the testing of products. Key QI institutions, particularly relevant to wood and processed wood industries, were strengthened through capacity building, the use of best practices, skills development and implementation of management systems to ensure quality and international recognition of their services. In Ukraine, UNIDO also assisted two laboratories for testing windows to improve their capacities and service offer. This included the provision of equipment for the laboratories' most pressing equipment needs.

IMPACT & RESULTS

As a result of UNIDO's intervention, a first draft of the national standardization strategy was drafted in cooperation with ISO. A total of 18 EU standards for windows were adopted and one national online platform for selling standards was launched.

UNIDO promotes relevant quality and standards related resources, including best practices, beneficial to producers, via social media channels, workshops and trainings. To this end, 161 experts were trained in quality management systems and business and marketing planning. Thirteen technical publications were also developed and disseminated to further support creating a sustainable quality culture among key stakeholders, particularly producers.

Additionally, in the process of strengthening the capacity of the business support entities to offer quality related services, it became evident the need to explain to SMEs, particularly in the furniture sector (which is not regulated in Ukraine), all the benefits of using the standards. This is reflected in the publication Creating value with standards: Special focus on the wood manufacturing industry in Ukraine, which includes case studies of how the use of standards has led to increased economic benefits especially in Eastern Europe.

This project is part of the Global Quality and Standards Programme (GQSP), implemented by UNIDO and funded by Switzerland through the Swiss State Secretariat for Economic Affairs (SECO).

HOW DOES CONFORMITY ASSESSMENT SUPPORT CLIMATE ACTION?

Conformity assessment bodies test, inspect, certify, verify and validate in fields including energy efficiency, reduction of GHG emissions and renewable energies. Improving energy efficiency requires, for example, measuring the energy consumption of a device, system or process. This is achieved through data collection and analysis as well as by testing and verification. A well-defined set of criteria and metrics is indispensable for achieving meaningful and comparable results, and the ability to identify whether climate targets are being met relies on the authenticity of the data collected. For example, verified reports serve as the basis for the European Union Emissions Trading System (EU ETS)—an important instrument for the efficient reduction of GHG emissions.

Companies in certain industries must record their GHG emissions, submit an annual emissions report and purchase CO_2 emissions certificates. Validation and verification bodies verify and assess the conformity of these emission reports. The competence of these bodies is ensured by meeting the requirements of ISO/IEC 17029, and accreditation is the formal recognition of that competence by a third-party assessment conducted by accreditation bodies. This system of accreditation and conformity assessment operationalizes European emissions trading.

CASE STORY: GHG Monitoring, Reporting and Verifying in Ukraine

Ukraine has a national programme for verification of GHG statements. This programme is defined by the national legislative framework, in particular:

- Law of Ukraine "On principles of monitoring, reporting and verification of greenhouse gas emissions".
- Resolution of the Cabinet of Ministers of Ukraine "On Approval of the Procedure for Verification of the Operator's Report on Greenhouse Gas Emissions" No. 959 dated 23 September 2020.
- Resolution of the Cabinet of Ministers of Ukraine "On Approval of the Procedure for Monitoring and Reporting on Greenhouse Gas Emissions" No. 960 dated 23 September 2020.
- Resolution of the Cabinet of Ministers of Ukraine "List of activities, greenhouse gas emissions of which are subject to monitoring, reporting and verification" No. 880 dated 23 September 2020.

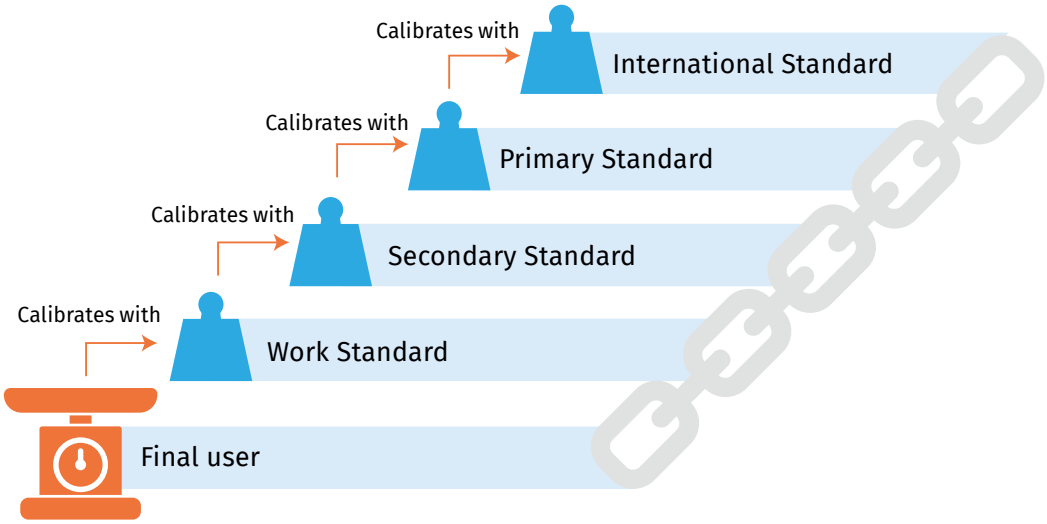
Reporting of GHG emissions is required annually for CO_2 emissions from the following activities:

- fuel combustion in installations over 20 MW.
- oil refining.
- the production of coke, metal ores, pig iron, steel, ferrous alloys including ferroalloys (if the total nominal thermal capacity of combustion units exceeds 20 MW), cement clinker, lime or the calcination of dolomite or magnesite (with a production capacity exceeding 50 tonnes per day), nitric acid, and ammonia.

Additionally, for nitric acid production, N_2O emissions must also be reported.

Emissions data reports and their underlying data require third-party verification by an accredited verifier therefore the National Accreditation Agency of Ukraine has accredited six verification bodies in compliance with ISO 14065.

FIGURE 6: TRACEABILITY CHAIN



As far as climate change considerations are concerned, the following key CABs play an important role in ensuring that results that are being reported are reliable, consistent and—when they are appropriately accredited—internationally recognized:

» Calibration Laboratories

Every measurement has a degree of uncertainty associated with it. An understanding of the overall level of uncertainty requires a metrological traceability chain and is ensured through the calibration technique. For climate change, measurement instruments are used, for instance, to measure activity data used to quantify GHG emissions. For example, the amount of kilowatts (kW) used by a company, the amount of litres of fuel that a car or a furnace utilizes, or the height or width of trees.

Certainty in measurement is relevant, therefore every GHG programme requires the use of calibrated instruments. ISO/IEC 17025 sets the requirements for impartiality, competence and consistent operation of calibration laboratories.

» Testing Laboratories

Even though testing is one of the most used conformity assessment activities in industrial sectors, in climate change the use of testing has not been a constant. Testing is used, for instance, in the agricultural sector when there is a need to measure the carbon fixed in the soil by trees and crops, to quantify the amount of nitrogen in a fertilizer and for some direct measurement of emissions, mainly of short life pollutants in fixed sources where instruments measure the amount of CO_2, SO_2 and NO_x released by companies to the atmosphere.

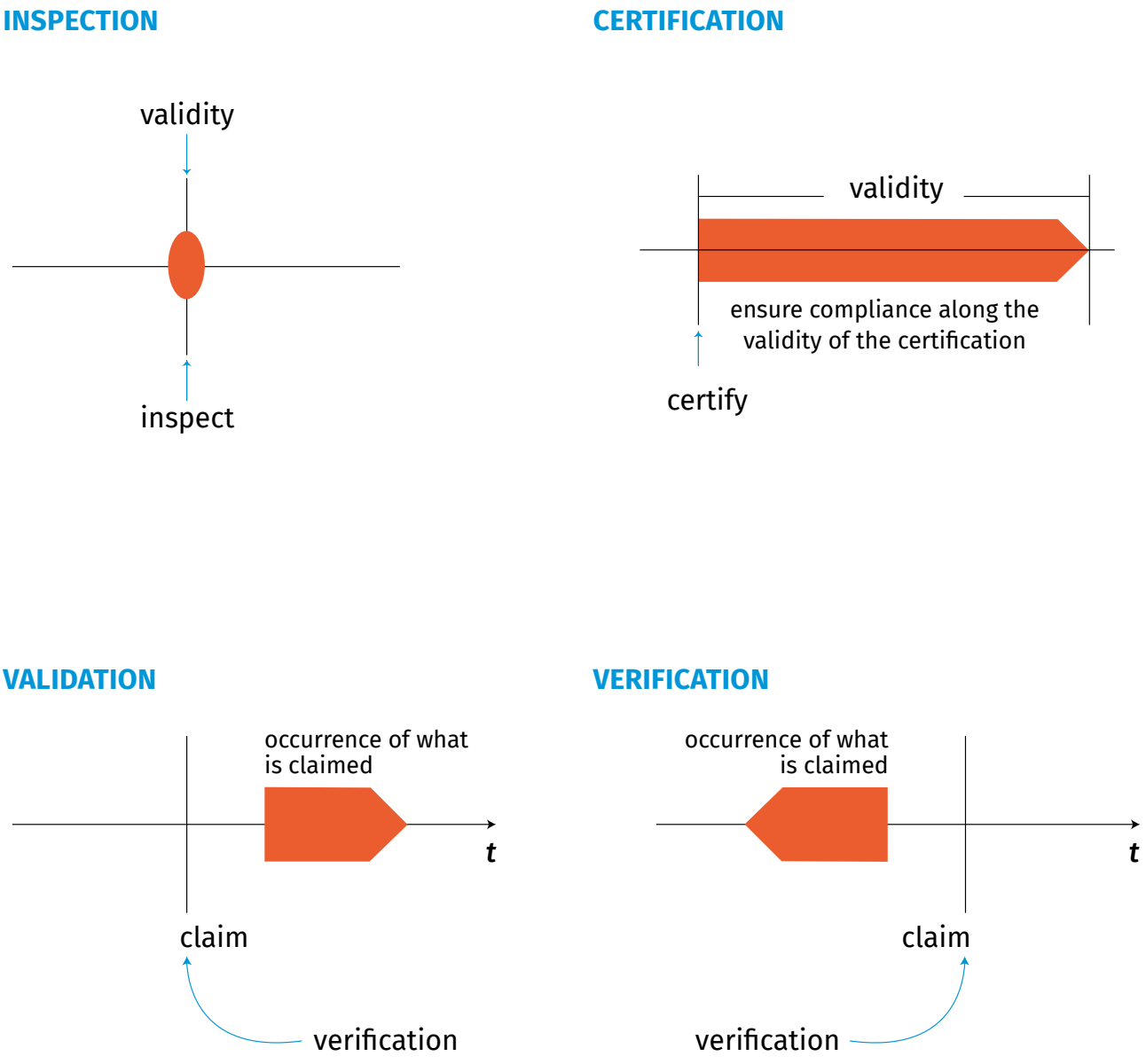
There are some methodologies to monitor mitigation emissions projects that require testing such as efficiency of cook stoves through water boiling testing when a project substitutes fuel for biomass.

Because testing supports the determination of compliance of a product or service with a given specification, requirement, or characteristic, it is often required in regulations to demonstrate that a company is not affecting the environment.

ISO/IEC 17025 sets the requirements for impartiality, competence and consistent operation of testing laboratories.

Before entering in the description of the following CABs, let us see the difference between inspection, certification and validation/verification activities. We will follow a diagram illustrated in the ISO/IEC 17029 standard.

FIGURE 7: DIFFERENCE BETWEEN INSPECTION, CERTIFICATION & VALIDATION/VERIFICATION ACTIVITIES



» Inspection

Inspection is essential to ensure the safety and operation of things that we use daily in our lives. Its impact on climate change, however, is primarily related to the inspection of tangible assets (such as vehicles and industrial equipment) to verify the extent to which they are contributing to carbon emissions, or their ongoing energy efficiency. Inspection can play an important role in asset management, for which organizations can seek certification in accordance with the ISO 55001 asset management system standard to ensure that assets are being maintained in good order. Inspection can also become part of validation or verification activities when, for example, new and more environmentally-friendly equipment is included in sustainability-related projects.

CASE STORY: Accreditation of the renewable energy industry is helping the UK reach net zero targets

CONTEXT & CHALLENGES

Making better use of renewable energy resources is going to be crucial in reducing overall emissions and reaching net zero targets. UKAS accredits the national microgeneration certification scheme, and testing and inspection bodies that examine solar, wind and wave energy installations.

Before the introduction of the Microgeneration Certification Scheme (MCS) in 2006, government and industry initiatives in this fast-growing area were based entirely on self-certification. This lack of independent appraisal meant it was difficult for government, industry and end users to have confidence in either the quality of microgeneration products or the competence of their installers.

The situation is similar for larger-scale renewable energy production, which contributes around 30% of the UK's electricity. {Source: Energy UK, the trade association for energy industry in the UK.} Here innovation has ramped up as the sector aims to deliver practical solutions that are affordable for mass use and meet required service levels.

INTERVENTION

The MCS is an independent UKAS accredited quality assurance scheme that provides market confidence in microgeneration products and installations without the need for direct government intervention. Under the MCS, products and installers must be MCS certified by a UKAS accredited certification body in order to be eligible for UK government financial incentives, such as feed-in tariffs and the renewable heat incentive. In turn, certification bodies must demonstrate their own competence, impartiality and integrity to UKAS in order to be accredited under ISO/IEC 17065: 2012.

The European Marine Energy Centre (EMEC) has been accredited by UKAS since 2005. It is the world's first and only center of its kind to offer open-sea testing of wave and tidal energy conversion systems at its purpose-built facilities. In addition to providing independently verified performance assessments through its accredited laboratory (ISO 17025), EMEC also offers independent accredited inspection and verification of environmental products and systems (ISO 17020).

Similarly, in October 2021 Global Wind Service became the UK's first Type C inspection body to receive accreditation (against ISO/IEC 17020) for the statutory inspection of all types of wind farms and wind farm projects. Here accreditation acts as an important indicator of a reliable and high-quality service in a burgeoning industry.

IMPACT & RESULTS

Accreditation of the MCS provides assurance to end users that renewable energy products are fit for purpose and that installers are competent to install them. Similarly, the independent verification and testing of renewable energy systems helps them to fulfil their potential, whilst simultaneously enabling innovative and potentially more effective technologies to reach the market.

Renewable energy production is a fast moving and innovative industry. By underpinning testing, inspection and certification services, accreditation gives assurance to potential users and increases market, consumer and regulatory confidence in renewable energy schemes, systems and policies. In turn, this will lead to increased adoption of renewable energy products and systems, helping government to reach net zero targets.

Source: https://publicsectorassurance.org/case-study/accreditation-of-the-renewable-energy-industry-is-helping-the-uk-reach-net-zero-targets/

» Certification

Certification is a form of conformity assessment that is used to ensure that a person, a process, a service, a device or a system complies with requirements established in regulations, voluntary standards or any specification through a combination of rules and procedures defined in a certification scheme. In addition to standards that directly impact individual technologies and processes, such as those published by the IEC, the management standards that are most relevant in terms of climate change are those related to environmental management (ISO 14001), energy management (ISO 50001) and carbon footprint measurements.

There are also certification schemes for persons, such as environmental auditors and for products in ecolabelling.

» Verification and Validation

Verification and validation bodies are the CABs that are most directly linked to climate change due to the fact that they confirm the quantification of GHG emitted by a company in their operations, confirm the emission reductions in a GHG mitigation project, confirm the carbon footprint of a product or verify the environmental declaration of a product or company.

Validation and verification bodies are used for both regulatory and voluntary objectives with the aim to contribute to the mitigation of climate change or the adaptation to the vulnerability to the impacts of climate change.

It is relevant to highlight that even though the validation and verification bodies, named Designated Operational Entities (DOEs) working for the Clean Development Mechanism (CDM), are not accredited with the CASCO Toolbox, they are also accredited CABs.

CASE STORY: Strengthening environmental validation & verification schemes through accreditation in Sri Lanka

CONTEXT & CHALLENGES

Accreditation provides assurance that conformity assessment services are provided competently, including validation and verification services such as GHG validation/verification and verification of the carbon footprint of products.

Sri Lanka Accreditation Board (SLAB) is a IAF Multilateral Recognition Arrangement (MLA) signatory for Greenhouse Gas Validation and Verification (ISO 14065). SLAB has expanded its scheme requirements to cover emerging validation/verification schemes such as verification of the carbon footprint of products, the Verra Verified Carbon Standard (VERRA VCS) and the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) under the organisation/project level of greenhouse gas emissions and removals.

Currently SLAB has accredited three validation/verification bodies (VVBs) for ISO 14065 and two VVBs for ISO 14067 (organizational level verification ISO 14064-1).

Sri Lanka Accreditation Board has established an accreditation scheme for Greenhouse Gas Validation/Verification (ISO 14065) considering the global and national requirement to strengthen the VVBs involved in environmental assessments. SLAB became an IAF MLA signatory for Greenhouse Gas Validation and Verification (ISO 14065) in 2018. SLAB is the first accreditation body in the South Asian region to obtain international recognition under the IAF MLA for ISO 14065.

Sustainable Future Group Pvt Ltd, Sri Lanka Climate Fund and National Cleaner Production Centre of Sri Lanka (Sri Lanka NCPC) are among the leading VVBs in the environmental sector operating in Sri Lanka and have been accredited by SLAB for the above. Accreditation has strengthened the validation and verification process operated by them, building trust among the customers.

With the current demand, SLAB has expanded its scheme requirements to cover emerging validation/verification schemes such as verification of the carbon footprint of products, VERRA VCS and CORSIA under the organization/project level of GHG emissions and removals.

The scheme for the carbon footprint of products (ISO 14067) has expanded with the accreditation of Sustainable Future Group Pvt Ltd and Sri Lanka NCPC.

INTERVENTION

The strategy of SLAB for strengthening applicable VVBs is as follows:

- Development of the accreditation scheme and capacity building activities for staff
- Stakeholder engagement activities and building awareness
- Engagement with clients and assessing competency
- Providing accreditation for competent conformity assessment bodies
- Obtaining international recognition through the IAF MLA
- Identification of expansion requirements, customer engagement and continual improvement of the validation/verification scheme

IMPACT & RESULTS

The value of accreditation in validation and verification services such as carbon crediting and the carbon footprint of a product is difficult to quantify directly. However, the assurance and confidence provided by accreditation to the aforementioned is immeasurable.

The impact and benefits from the accreditation of VVBs include:

- The end user: The end user of the validation/verification process benefits by the accurate verification/quantification results from the validator or verifier.
- The validator or verifier: The validator/verifier benefits through the recognition for the verification process and competitive advantage gained.
- The environment: The ultimate benefit of the process is the reduction of emissions, supporting environmental sustainability.

Source: https://publicsectorassurance.org/case-study/strengthening-environmental-validation-verification-schemes-through-accreditation/

MARKET SURVEILLANCE

WHAT IS IT?

In the context of QI, market surveillance traditionally relates to activities that are conducted to ensure that products placed on the market conform to applicable laws and technical regulations. This helps foster trust from consumers and protects them from harm from unsafe or environmentally non-compliant products. Market surveillance is typically provided by regulatory bodies (or by entities appointed by them) on a national, regional, or even local basis with, for example, powers to enter premises or conduct searches at borders, take samples, demand product safety files or other information, recall or confiscate and, where necessary, dispose of nonconforming goods, order a halt to production, delay or prevent market entry or, in extreme cases, even close down premises. Once again, international, regional and national standards can be used to support market surveillance activities by providing a basis for sampling, acceptance criteria, and conformity assessment methodologies. This helps maintain a level playing field for those companies that comply and thus avoid losing market share to rogue traders.

HOW DOES MARKET SURVEILLANCE SUPPORT CLIMATE ACTION?

In recent years, the concept of market surveillance has been applied to management system certifications (such as those issued using ISO 9001 and ISO 14001, among others) to assess their ongoing credibility.[6] Other areas where market surveillance can help to further the climate action agenda include the ongoing verification of product labelling, and specifically those related to environmental and energy efficiency claims.

[6] https://www.unido.org/sites/default/files/2017-01/MS_Guide_v_1.19-pages__1__0.pdf

CASE STORY: Empowering MSMEs in Paraguay for Climate Action

CONTEXT & CHALLENGES

In the context of climate change, there is an urgent need for businesses, particularly micro, small and medium-sized enterprises (MSMEs), to adopt sustainable practices to reduce their environmental impact. The implementation of QI is crucial in providing the necessary framework and support for MSMEs to effectively integrate sustainable practices into their operations, thereby enabling them to contribute meaningfully to climate action efforts. However, many MSMEs lack the necessary resources and knowledge to implement effective environmental management systems, hindering their ability to leverage QI for climate action purposes.

INTERVENTION

UNIDO supported 20 industrial MSMEs and 10 rural associative enterprises in implementing the ISO 9001:2015 standard for certification. It has been consistently demonstrated that the implementation of a quality management system based on ISO standards, particularly ISO 9001, establishes a strong foundation for the implementation and certification of environmental standards such as ISO 14001. This foundational framework accounts for 60% of the requirements needed for environmental certification, facilitating a smoother and more efficient process for MSMEs to adhere to environmental standards and contribute to climate action initiatives.

IMPACT & RESULTS

The implementation of management indicators that include environmental metrics such as water consumption, energy consumption, waste prevention and recycling rates has led to a significant change in the mindset of management and employees at these companies. They have become much more aware of environmental stewardship and the importance of implementing practices that contribute to this goal. This fundamental change was instrumental in the successful implementation of the UNIDO Cleaner Production Methodology. A total of 21 industrial enterprises benefited from the development and implementation of their Cleaner Production Plans, with the notable observation that those already equipped with ISO 9001:2015 quality management systems demonstrated greater agility in their actions and sustainability in the established plans.

One significant result is that the companies that received interventions experienced a reduction of 27% in water consumption and 34% in energy consumption. This highlights the key role of QI in improving the effectiveness of environmental impact initiatives, reinforcing the importance of QI in promoting sustainable practices and supporting climate action efforts.

This project is part of the MiPYME COMPITE Programme, implemented by UNIDO and funded by the European Union (EU).

QUALITY CULTURE

WHAT IS IT?

It has long been recognized that for an effective QIS to thrive an overall quality culture needs to be nurtured. A quality culture is an "environment" that has quality embedded at its core and refers to a set of shared and accepted behaviours at all levels—individual, organizational, societal and country—that contributes to the development of effective care for quality. It is an awareness of and commitment to quality, in conjunction with a solid culture of fact-based decision making and the efficient management of quality in all its dimensions.

Developing a quality culture is the most effective, meaningful and sustainable way to ensure and improve quality, and to embed a dynamic system of change for improvement at all levels. As quality does not only refer to products, but extends to all areas of production, distribution and management, a quality culture is required to assist small and medium-sized enterprises (SMEs) to strengthen their competitiveness sustainably, in order to effectively compete in the global markets.

HOW DOES A QUALITY CULTURE SUPPORT CLIMATE ACTION?

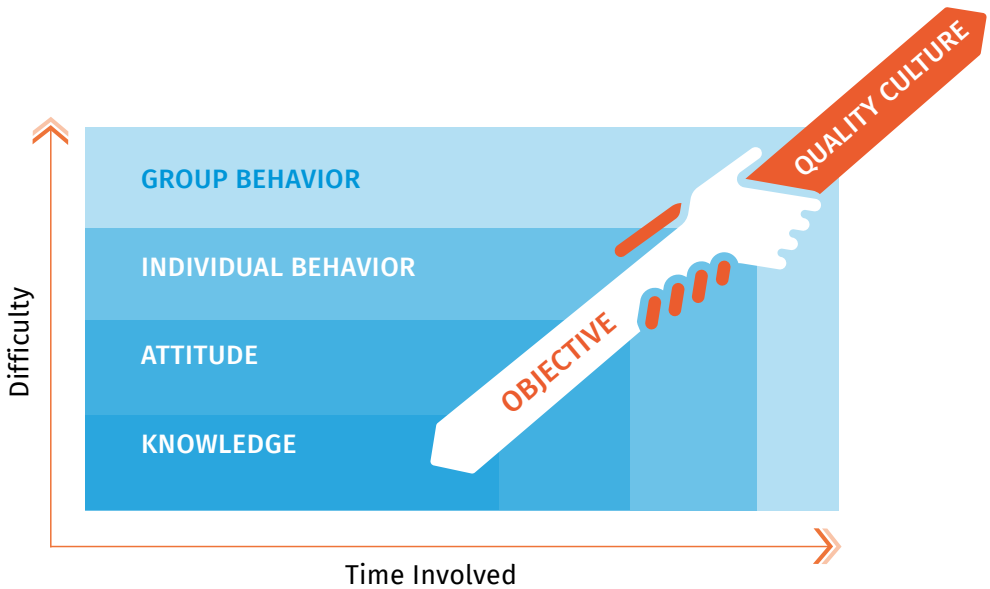
The concept of a "quality culture" has traditionally been focused on a culture of "narrow quality" (i.e. the inherent quality of products and services), see Part 2, but can readily be expanded to include wider issues such as social and environmental awareness (including climate change) as part of a more comprehensive "broad quality" culture.

A quality culture typically begins with the dissemination of knowledge, encouraging appropriate attitudes, individual behaviours and, ultimately, group (or societal) behaviour to achieve a desired objective. Figure 6 shows this progression in a highly simplified form, taken from the work of Hersey and Blanchard.[7]

An example might be a parent or teacher acquiring knowledge about the importance of energy-saving for climate (or family budget) considerations, encouraging a child (or, increasingly, vice-versa) to switch off a light after leaving a room; reinforcing this attitude via their personal behaviour, and subsequently achieving group (family or societal) behaviour that can then become embedded as part of a "broad quality" culture.

[7] Hersey, P and Blanchard, K. "Management of Organizational Behavior"; 1977, p3, ISBN 0-13-548875-3

FIGURE 8: STEPS TOWARDS ACHIEVING A QUALITY CULTURE



CASE STORY:
Fruit Producers and Processors Adapting to a Changing Climate in Vietnam

CONTEXT & CHALLENGES

Vietnam, particularly its Mekong River Delta region with a mean elevation of 0 to 3 meters, faces severe climate change impacts, including rising sea levels, salinization, land subsidence, flooding, coastal erosion, erratic rainfall, and rising temperatures. These challenges will significantly affect the economy and society over the coming decades, necessitating changes in farming practices. To effectively adapt in agriculture and to enhance mitigation and adaptation strategies, it is crucial to understand farmers' perceptions of climate change, their ability to adapt, and the effectiveness of adaptation measures. The sources and quality of information necessary for farmers to effectively adapt are of particular importance. Accessible and useful local services, including irrigation, agricultural extension, credit, and healthcare, are essential for successful mitigation and adaptation in the Mekong Delta.

Climate change is also expected to significantly affect the tropical fruits industry in Vietnam, which is likely to lead to reduced productivity, shifts in logistics and transportation practices, changes in agronomic methods, and higher environmental standards needing to be met.

INTERVENTION

UNIDO's intervention in Vietnam has focused on building adaptive export systems that accommodate greater tropical fruit varieties, using more eco-friendly sea freight instead of air freight, and reducing inefficiencies in the current export process to decrease waste, including postharvest losses, while improving energy efficiency. Importantly the project is investigating climate change impacts on the export system, the conditions required for change and barriers to change. UNIDO supports existing tropical fruit producers and processors by enhancing agriculture and processing practices to boost productivity and quality, and to reduce waste and food loss along the value chain. It also aims to improve processing practices to extend product shelf life and to decrease diseases and other quality loss causes. To address this, UNIDO has supported the development of a new coating technology that extends the shelf life by up to three months without using plastic wrap. Furthermore, the programme is developing guidelines to improve practices for chemical usage, ensuring compliance with national regulations and export market requirements.

IMPACT & RESULTS

As a result of the intervention, two new technologies were introduced for long sea-freight distances, extending product shelf-life by 30–40%. Furthermore, 773 mango and pomelo value chain actors were trained in the 10 standard operating procedures developed. Four successful pilot export demonstrations to Australia, Korea, the US and the EU markets were conducted, increasing exports by 18.5%. The first mutual forum between the private sector, institutions and policymakers was launched—Vietnam Mango Association.

This project is part of the Global Quality and Standards Programme (GQSP), implemented by UNIDO and funded by Switzerland through the Swiss State Secretariat for Economic Affairs (SECO).

PART 4
ADVANCING CLIMATE ACTION AT THE ENTERPRISE LEVEL

Traditionally, the public sector has led climate change adaptation and mitigation efforts through the implementation of policies and regulations, but now businesses are playing an increasingly crucial role in advancing the climate agenda. Enterprises are increasingly aware of the climate emergency and are not only urged by many stakeholders to address their environmental impact, but also to recognize adaptation as vital for their business.

Climate action at enterprise level involves implementing strategies and practices that reduce GHG emissions, enhance sustainability, and contribute to global efforts to combat climate change.

Meaningful climate action is gaining importance in corporate strategies. International and national requirements (e.g. the Paris Agreement) and environmental reporting mandates (e.g. the European Union's Corporate Sustainability Reporting Directive) are increasing. Stakeholder expectations, including customers, investors, non-governmental organizations and consumers, are rising as well. In turn, companies must anticipate and respond to evolving regulations, stakeholder demands to needing to anticipate and respond to regulatory developments, stakeholder expectations and the evolving concept of corporate responsibility for GHG reduction.

One of the main things that enterprises are doing is eco-design, which represents a holistic approach to product development that prioritizes sustainability and environmental responsibility, aiming to create products that are not only functional and efficient but also beneficial for the planet.

Companies are including in their eco-design life cycle thinking, resource efficiency, longevity and durability and circular economy. They are investing financial resources but gaining return on investment by using sustainable materials such as recycled materials, converting their energy needs in renewable energies, implementing water-efficient processes or learning how to recycle water and use it in their processes, as well as simplifying designs.

Entrepreneurs are finding economic benefits because they save costs and have a market differentiation which allows them to increase sales because of the increased consumer awareness and demand for sustainable products.

All companies know that their efforts are relevant, considering that climate change has profound impacts on the quality of goods across various sectors, affecting their production, safety, nutritional value, and overall quality. For example, nutritional value of agricultural products can be reduced due to elevated atmospheric CO_2 levels; rising sea temperatures can alter the habitats and distribution of fish species, impacting the quality and availability of seafood; climate change can impact the availability of raw materials used in manufacturing; and certain plastics degrade faster under increased UV exposure and higher temperatures.

Businesses have multiple incentives for climate adaptation. Climate change negatively affects financial performance, but it also presents opportunities for many industries. Businesses will need to provide products and services for an effective climate response. Furthermore, the way in which governments, regions and cities adapt to climate change will impact business operating environments (World Economic Forum).

Effective and comprehensive management of climate risks and opportunities is essential for improving climate performance and addressing these challenges. This includes supporting sustainable chains, promoting sustainability and circular economy practices, and engaging employees in sustainability initiatives by raising awareness, providing training and involving them in decision-making processes related to climate action. At the enterprise level, climate action requires a long-term, strategic approach that considers emissions as well as climate-related effects on businesses.

The ability to measure carbon emissions accurately and forecast them reliably is also an essential component of well-defined and trusted project submissions for climate funding. This is a fast-growing component of the global financial market, supported by institutions such as the World Bank, development agencies and private sector ventures. This is also an important aspect of the UNFCCC mechanisms and of the Paris Agreement.

Whilst the resources available today are currently below those envisaged by the Paris Agreement, it is expected that they will grow significantly in time. Countries with sound policies, realistic and well justified plans and projects for low-carbon development, based on trusted data and backed by an appropriate QI will have a competitive advantage when requesting climate funding. The same considerations apply for carbon offsetting projects.

Carbon offsetting projects are likely to increase in number and value due to several factors: the planned new phase of the Emissions Trading System (ETS) market in the European Union (Phase 4, covering 2021–2030); the new mechanisms introduced by other countries for carbon pricing; and an increasing interest in voluntary commitments by companies all over the world.

Companies that are seriously investing to support the environment are keen to avoid greenwashing and that is why environmental labelling programmes are becoming more popular because certification of environmental criteria that confirm a better environmental performance of goods is the best way to inform the consumer or end user that their investment is contributing to reduce a negative impact for the planet.

A QI and fit-for-purpose QI services supporting climate-related action will certainly provide a competitive advantage to those countries that prioritize capacity building and conformity assessment techniques in this area.

Another important topic that enterprises are addressing is the implementation of SDG 5 ("Achieve gender equality and empower all women and girls"). Gender equality is not only a fundamental human right, but a necessary foundation for a peaceful, prosperous and sustainable world.

UN Women has concluded that gender inequality coupled with the climate crisis is one of the greatest challenges of our time. It poses threats to ways of life, livelihoods, health, safety and security for women and girls around the world.

Here some examples of how these two critical areas intersect:

» Economic disparities: Women, particularly in developing countries, often have lower incomes, fewer savings, and less access to financial resources, making it harder for them to recover from climate-related disasters.

» Health Risks: Climate change exacerbates health issues like malnutrition, heat stress, and the spread of diseases. Women, especially pregnant women, are more vulnerable to these health impacts.

» Water and Energy: In many communities, women and girls are responsible for collecting water and fuel. Climate-induced water scarcity and energy shortages can increase their workload and reduce time available for education and income-generating activities.

Promoting women's participation in climate-related decision-making processes can lead to more comprehensive and effective climate policies. Women's unique perspectives and knowledge can enhance the resilience and sustainability of climate strategies.

Women leaders and activists are often at the forefront of environmental movements and community-based adaptation efforts. Supporting female leadership in climate initiatives can amplify these efforts.

The SDGs emphasize the intersection of gender equality and climate action. Achieving SDG 5 and SDG 13 requires integrated approaches that address both gender disparities and climate challenges.

By recognizing and addressing the unique vulnerabilities and contributions of women, companies can enhance resilience, promote sustainable development, and achieve more equitable and effective climate solutions.

PART 5
TRANSITIONING TOWARDS A SMART QI SYSTEM

Protecting and nurturing the environment is vital for human well-being and survival. To achieve this, we have to adopt a new approach to economic development that prioritizes both social and environmental sustainability in general and climate action in particular within an ever-more digitalized society. QI institutions and services have a crucial role to play in this, particularly in their support for the implementation of policies and actions for sustainable resource use, ecosystem protection and moving towards a net zero economy. This includes developing standards that support public policies and regulations and facilitate the sharing of best practices, ensuring effective deployment of climate action initiatives, with the appropriate management systems, monitoring, measurement, and other assessment capabilities in place to provide credible reporting on the achievement of compliance obligations and progress towards the 2030 SDGs and beyond.

QI institutions and services are also essential for encouraging and supporting sustainable consumption and production. They provide accurate data on materials, energy, water, land usage, emissions and waste. Collaborative efforts are key in this endeavor, as exchanging these data points contribute to shaping and implementing sustainability policies and fostering eco-friendly behavior among all stakeholders.

As the march towards the digitalization of the global economy continues, most of the relevant QI institutions and service providers need to (and are) adopting new technologies to support their initiatives in the climate change arena. This can involve, for example:

- Real time monitoring, measurement, feedback and reporting on climate change data.
- Use of AI (artificial intelligence) and predictive analytics to adjust sampling criteria for monitoring climate action commitments.
- DLT (distributed ledger technology, i.e. blockchain) for traceability of results and records.
- Digital certificates to support relevant product, service, process and system certifications, as well as other climate or sustainability-related claims.
- Assessment and maximization of energy efficiency in industry and homes, using IoT (Internet of Things) and other technologies.

In terms of the key QI functions and institutions, the following are worthy of mention:

SMART STANDARDIZATION

The dominant subject regarding new types of deliverables enabled by digitalization is that of “machine readable standards”. For decades standards have been produced first as paper documents then later as electronic versions of paper documents, typically in PDF format. They have been developed to be read by human eyes. The idea behind machine readable standards concerns the possibility of transforming the standards’ content, i.e. the knowledge embedded in standards, into appropriate digital formats that can be “understood” and “acted upon” by machines. This gives us the possibility of embedding requirements and other relevant “granular” information included in standards into the software driving the operation of machines, or the analysis of data for monitoring and control functions or process optimization. ISO and IEC call this transformative programme SMART (Standards Machine Applicable, Readable and Transferable). This joint ISO and IEC programme will drive the digital evolution of international standards to address the needs of citizens, societies and economies.

A critical aspect concerns how to capture and represent the granular elements of information included in standards with their semantics. A simple example, related to IEC 60376 “Specification of technical grade sulphur hexafluoride (SF_6) and complementary gases to be used in its mixtures for use in electrical equipment”, highlights the type of issues that need to be addressed.[8] Consider the requirement on the environmental impact:

[8] Taken from Hélène De Ribaupierre, et al. (2021) Automatic extraction of requirements expressed in industrial standards: a way towards machine readable standards?

*"SF_6, CF_4 and SF_6 mixtures with N_2 and/or CF_4 have a **certain** environmental impact. Due to this impact, SF_6, CF_4 and their mixture gas shall be handled **carefully** to prevent **deliberate** release of SF_6 and CF_4 gas into the atmosphere".*

The use of bolded words presupposes that the persons reading the requirement will "understand" and "interpret" them in a consistent and repeatable manner. For example, what do the terms "carefully," "certain" and "deliberate" mean in this case and how does each user of the standard understand or interpret them? Should we anticipate the possibility of a deliberate malicious action? And if so, should it be anticipated and how should it be "dealt with"? It is evident therefore for human understanding, let alone machines, that requirements need to be expressed in a univocal, unambiguous way. For this, various techniques and tools from information science and natural language processing are needed that can be used to support the authoring of machine-readable standards.

SMART METROLOGY

Metrology is experiencing phenomenal changes because of Industry 4.0 and the digital transformation. Starting with the redefinition of the International System of Units (SI) base units, recent developments include metrology in chemistry, biology and health sciences, the emergence of quantum metrology as well as the further development of metrology at the nanoscale (nanometrology). Automation of test and measurement methodologies has made capturing and combining process data with metrological inspection and evaluation data in "real time", and processing them, thus reducing the need for separate, offline operations. An environment, characterized by a proliferation of interconnected devices, dramatic increase in data, use of advanced software and autonomous actions of equipment, is pushing metrology to innovate in order to maintain its critical functions and value.

Innovations in the measurement technology arena that are relevant to climate action initiatives also include the use of new technologies that enable satellite monitoring of relevant aspects in a wide variety of economic sectors.

One example is the satellite mapping of agricultural land, to provide inputs related to deforestation and desertification, both of which can have significant impacts on climate change. Geodata collection, especially for smallholders, however, can often be a complex, expensive, and time-consuming activity, but organizations such as 4C (The Common Code for the Coffee Community, an independent, stakeholder-driven sustainability initiative for the coffee sector), in partnership with GRAS (Global Risk Assessment Services), offer a tool to collect accurate geodata without technical knowledge in a straightforward way. With the FARAMO (Farmer Risk Assessment and Monitoring) mapping app, each smallholder's polygons are captured directly in the field using a mobile app on a smart device, without the need for geospatial skills or programming, even when offline.

Another satellite-based measurement system that applies primarily to the oil and gas industry is the US-New Zealand MethaneSAT that was launched in March 2024. This is an Earth observation satellite that will monitor and study global methane emissions in order to combat climate change. It uses Google's AI to map and quantify leaks, helping to identify where the worst spots are and who is responsible. The use of advanced software and spectrometers, which measure different wavelengths of light to detect methane, will detect concentrated locations for methane plumes as well as the broader areas where the gases diffuse and spread. It will also use Google's image detection algorithms to create a comprehensive, global map of the oil and gas industry's infrastructure, like pump jacks and storage tanks, where leaks most commonly occur.

SMART CONFORMITY ASSESSMENT AND ACCREDITATION

As with other elements of a QIS, digital transformation is also substantially impacting conformity assessment, driving innovation for all the organizations involved in traditional testing, inspection, and certification (TIC) services, as well as those that provide validation and verification services for climate action-related claims (such as GHG emissions, energy efficiency and data included in ESG reporting).

Today, remote assessments can make use of new technologies such as virtual and augmented reality headsets, smart glasses, drones, satellite mapping, real-time data analysis and many other technologies that provide a myriad of options to make conformity assessment activities more dynamic and rigorous than ever before.

Accreditation will continue to be an important component of any QIS, with the aim of providing confidence in the competence and impartiality of conformity assessment providers. This includes many different aspects including the measurement of carbon emissions, the inspection of vehicles, certification of environmental or energy management systems, and the verification and validation of reports on climate change data. Multilateral recognition between accreditation bodies can facilitate comparisons between data

that is reported by individual organizations and countries, as part of their commitments to mitigate climate change and help to minimize the risk of "greenwashing" that can result from the use of inaccurate, inconsistent, or unsubstantiated data.

Many of the areas highlighted for conformity assessment are also relevant for accreditation. Use of digital technologies by accreditation bodies is likely to continue, and is primarily related to:

» Remote assessments ("auditing" in conformity assessment).

» Use of blockchain technology for real-time verification of assessment data and for fraud prevention.

» Accredited certification of services supporting electronic transactions (such as electronic signatures, registered delivery services and certificates, website authentication), and in particular emissions trading schemes.

Further details about the use of new technologies for conformity assessment are contained in the UNIDO publication "Remote Conformity Assessment in a Digital World".[9]

Other examples of how a "Smart QI" can contribute to sustainability issues (including climate change) are provided in the UNIDO publication "Smart Quality Infrastructure: Shaping a sustainable future".[10]

[9] https://hub.unido.org/sites/default/files/publications/RCA_Publication.pdf
[10] https://hub.unido.org/sites/default/files/publications/ONLINE_EN_SMART_QI_PUBLICATION_0.pdf

CONCLUSIONS

A robust and comprehensive QIS is fundamental to support and drive climate action initiatives, and is greatly enhanced by the move towards the digitalization of QI institutions and services. Phenomenal transformations are occurring both in industry and society as a whole, and the new technologies that have been and continue to be developed can be applied to the evolving "Smart QI" initiatives that relate to climate action.

Nevertheless, we have to consider that while digital technologies provide numerous benefits, their environmental footprint is significant and multifaceted. Addressing this footprint requires coordinated efforts across technology development, policymaking, and consumer behavior to promote more sustainable practices.

Quality infrastructure, in accordance with international standards and best practices, is essential for both mitigating and adapting to the impacts of climate change, promoting sustainable development, and ensuring a more resilient and environmentally sustainable future. It is also a basic need for implementing the Paris Climate Agreement commitments as well as to track progress or gaps to fill.

For countries with mature QI systems that were developed with an initial focus on trade facilitation, the adaptation to include climate change considerations is likely to be (or has been) a simple one, requiring only a refocusing of the QI to incorporate a "broad quality" perspective. This means that the QIS has to look significantly beyond simply providing confidence in goods and services to local and global supply chains, and include sustainability considerations of how those goods and services are provided, including their positive and/or negative impacts on climate change.

For developing countries that are in the process of defining and implementing their QI systems, it should be relatively easy to incorporate climate change at the policy and QI-institution levels. There will, however, inevitably be a need for the prioritization of investments and resources to support the more operational activities among conformity assessment service providers including, laboratories for GHG emissions analyses; energy efficiency testing laboratories; and verification and validation bodies.

The private sector will discover that the transition towards environmental sustainability offers a pathway to not only reduce their ecological footprint but also to achieve operational efficiencies, foster innovation, enhance their market position, and build a more resilient and future-proof business model. Reliable QI enables businesses to make better-informed decisions.

The advent of new technologies presents both challenges and opportunities for tackling the sustainability imperative which touches on environmental and inclusiveness issues, including human rights and decent jobs. The continuous development of QI as a result of technological progress supports businesses in boosting sustainability efforts aligned to the five Ps of sustainability (people, planet, prosperity, partnerships and peace) and in realizing the SDGs, notably SDG 12 ("Responsible consumption and production") and SDG 13 ("Climate action").

Vienna International Centre
Wagramer Str. 5, P.O. Box 300,
A-1400 Vienna, Austria

+43 1 26026-0

www.unido.org

unido@unido.org

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INDUSTRIAL DEVELOPMENT ORGANIZATION