STRATEGIC PLATFORM TO PROMOTE SUSTAINABLE ENERGY TECHNOLOGY INNOVATION, INDUSTRIAL DEVELOPMENT AND ENTREPRENEURSHIP IN BARBADOS

CLEANTECH QUALITY INFRASTRUCTURE FRAMEWORK

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GLOSSARY

Acronym	Definition
AFP	Accreditation Focal Point
ANCE	Association for Standardization and Certification
BCCI	Barbados Chamber of Commerce and Industry
BIDC	Barbados Investment and Development Corporation
BIPM	International Bureau of Weights and Measurements
BLOOM	Barbados CleanTech Cluster
BNEP	Barbados National Energy Policy
BNSI	Barbados National Standards Institution
BREA	Barbados Renewable Energy Association
BSJ	Bureau of Standards Jamaica
BSO	Business Support Organisation
CARIMET	Caribbean Metrology Cooperation
CCA	Caribbean Cooperation for Accreditation
CARICOM	Caribbean Community
CMC	Calibration and Measurement Capability
COVID-19	Novel Coronavirus
CROSQ	CARICOM Regional Organisation for Standards and Quality
DANAK	Danish Accreditation Fund
DCCA	Department of Commerce and Consumer Affairs
DIN	German Institute for Standardization
EP	Enquiry Point
EPD	Environmental Protection Department
EU	European Union
GDP	Gross Domestic Product
GEF	Global Environment Facility
GQII	Global Quality Infrastructure Index
GRP	Good Regulatory Practice
HR	Human Resource
IAF	International Accreditation Forum
ICT	Information and Communications Technology
IEC	International Electrotechnical Commission
IECRE	International Electrotechnical Commission Renewable Energy
ILAC	International Laboratory Accreditation Cooperation
INN	National Institute for Standardization
ISO	International Organization for Standardization
ISRAC	Israel Laboratory Accreditation Authority
JANAAC	Jamaica National Agency for Accreditation
JBS	Jamaica Bureau of Standards
KSC	Key Supplementary Comparison
LPG	Liquified Petroleum Gas
MSME	Micro, Small and Medium Enterprise
MVE	Monitoring, Verification and Enforcement
NCB	National Certification Body
NCBJ	National Certification Body of Jamaica
NQI	National Quality Infrastructure
NMI	National Metrology Institute
NSB	National Standards Body
NWIP	New Work Item Proposal
OIML	Organization of Legal Metrology

PPP	Public-private partnership
PTB	Physikalisch-Technische Bundesantalt
PV	Photovoltaic
QI	Quality Infrastructure
QMS	Quality Management System
RQI	Regional Quality Infrastructure
SBDU	Small Business Development Unit
SDO	Standards Development Organization
SDOC	Supplier Decelration of Conformity
SFS	Finnish Standards Association
SIDS	Small Island Developing State
SII	Standards Institute of Israel
SIM	Inter-American Metrology System
SRC	Scientific Research Council
SSA	Sanitation Services Authority
SWOT	Strengths Weakeness Opportunities and Threats
TBT	Technical Barriers to Trade
TR	Technical Regulation
TTBS	Trinidad and Tobago Bureau of Standards
TVET	Technical Vocational and Education Training Council
UL	Underwriters Laboratory
UNIDO	United Nations Industrial Development Organization
UNDP	United Nations Development Programme
UN SDGs	United Nations Sustainable Development Goals
VTT	Technical Research Centre
VTT MIKES	Finnish National Metrology Institute
WBG	World Bank Group
WTO	World Trade Organization
YES	Youth Entrepreneurship Scheme

Executive Summary

Barbados is seeking to develop a CleanTech sector through the promotion of sustainable energy technology, innovation, industrial development, and entrepreneurship. The National Quality Infrastructure (NQI) has been identified as a catalyst for improving industrial development and economic activity in Barbados. The main purpose of this CleanTech Quality Infrastructure Assessment is to derive practical recommendations on how to improve the current framework, eliminate barriers and access quality infrastructure services as well as explore the potential role of BLOOM regarding standards development, quality infrastructure assurance and enforcement.

Broad consultation was conducted directly with some BLOOM CleanTech Cluster members and other key stakeholders across the sector. Quality Infrastructure (QI) experts, policy makers and National Standards Body (NSB) professionals were also interviewed. The assessment identified the Global Quality Infrastructure Index (GQII) as an applicable QI measure since it is an internationally accepted measurand that allows country comparisons. A comparative review of external CleanTech QI structures was conducted to receive a better understanding of how Barbados' CleanTech sector correlates. The local CleanTech QI structure was also reviewed and observed to capture its applicability and relevance.

Local QI actors were identified along with their general service offerings, their role in the NQI and the service they can offer to the CleanTech sector. Regional and international actors who can offer QI services to the CleanTech sector were also identified. A Barbados QI ecosystem map further summarized the local context of the QI system.

The assessment further examined the processes of the QI components and how the CleanTech sector can assess QI services. The survey instrument contributed to the establishment of the current status of each QI component by identifying the QI needs of the CleanTech sector, QI service deficiencies and expected support of the sector. Each QI component was individually assessed in comparison to benchmarks garnered from the GQII. Maturity service levels of the QI components were presented in comparison to

current service levels. A summary of the status of the Barbados QI system was illustrated to highlight where strengths and deficits lie.

Driven by the survey results and the need to eliminate barriers to access QI services, principle solutions were developed. A gap analysis of the Barbados QI system illustrated what needs to be addressed to make the QI relevant in support of CleanTech businesses and new and emerging sectors.

Additionally, a Strength Weakness Opportunity and Threat (SWOT) analyses of the QI system and the Barbados NSB were conducted which illustrates their characteristics and provides a basis for strategic considerations required to enhance the NQI and reform of the NSB.

The GQII was then presented in further detail with the country ranking and sub-ranking of the QI components. Having identified the QI deficiencies a switch to a forward looking preview of the QI and NSB was conducted. The National Quality Policy was put forward to envision where the NQI of Barbados would be within the next five (5) years.

Having addressed the QI components, the fundamental supporting elements of the CleanTech QI were explored with respect to their contribution to the NQI.

Supporting legislative and policy amendments were proposed that would create the enabling legislative and regulatory framework to advance the QI system.

The Critical Factors for Success were established under the three (3) given objectives of this QI assessment. A suite of 24 recommendations to enhance the QI components and 9 recommendations to improve the Fundamental Supporting Elements were advanced.

The potential role of the Barbados Bloom CleanTech Cluster was examined in the areas of Standards Development, QI Assurance and Enforcement and recommendations advanced.

Finally, ten (10) priority standards were identified to assist in improving the quality of CleanTech products and services to a world class level. An abstract of the ten priority standards was given in Annex A.

1. Introduction

1.1. Background

The United Nations Industrial Development Organization (UNIDO), Export Barbados (BIDC) and the Barbados CleanTech Cluster (BLOOM) are jointly implementing the Global Environment Facility (GEF) funded project “Strategic platform to promote sustainable energy technology innovation, industrial development and entrepreneurship in Barbados”. The project contributes to the implementation of the National Strategic Plan 2005-2025, which aims at making Barbados a “green circular economy” and the “most environmentally advanced green country in Latin America and the Caribbean”.

There exist barriers and limitations of the CleanTech sector to access services of the National Quality Infrastructure (NQI), which has been identified as the catalyst for improving the industrial development and economic activity of Barbados. It is this quality infrastructure that supports industrial development from ideation to commercial enterprise. None more so than micro, small and medium-sized enterprises (MSMEs), start-ups and new and emerging sectors require support from the components of the NQI, such as standardization, metrology and accreditation, and conformity assessment services of testing, inspection, and certification, to thrive in the business environment. With the establishment of the body responsible for standards and quality in Barbados in 1973, the formal process of quality infrastructure development got underway. Today, that quality infrastructure exists, and its fitness for purpose in assisting CleanTech MSMEs and start-ups to thrive in a dynamic business environment, requires some examination.

1.2. Summary of Components

Quality Infrastructure (QI) refers to a complex arrangement of private and public institutions that deliver services in support of the quality production of goods and services. These services also perform fundamental roles in the seamless functioning of a modern economy with respect to many sectors and sub-sectors such as health and safety, agricultural production, food and non-food processing, industrial development, domestic trade, export, and the realization of the United Nations Sustainable Development Goals (UN SDGs), to name a few.

The quality infrastructure of a country, termed NQI, has several components, namely Standardization, Metrology and Accreditation. However, for purposes of simplicity of this report, conformity assessment services of Testing, Inspection, Certification, and Quality Management have been grouped with the QI components. Fundamental supporting elements, Education, Human Resource Training & Development, Market Surveillance, Verification, and Enforcement, Technical Regulations and Trade Facilitation and Market Access, enable the QI components to function as expected. These components will be explored in greater detail in subsequent sections.

1.3. Purpose

The main purpose of this CleanTech Quality Infrastructure Assessment is to provide practical recommendations on improving the current framework to reduce/eliminate the barriers and access quality infrastructure support services for the CleanTech sector. Additionally, it seeks to explore the potential role of BLOOM regarding standard development, quality infrastructure assurance and enforcement.

1.4. Objectives

The main objectives are to develop the Barbados CleanTech Quality Infrastructure Assessment to enhance the quality infrastructure for CleanTech products and services. The assessment identifies how to access local supplier-side QI services and create an enabling environment for CleanTech entrepreneurship and innovation, including the delivery of certification. The assessment will: -

- Provide an overview of the existing NQI
- Provide practical recommendations on how to improve the current QI framework
- Explore the potential role of BLOOM regarding standards development, QI assurance and enforcement
- Identify at least ten (10) standards for products and services, which are of high priority for the local CleanTech sector

2. Methodology

The approach given to the quality infrastructure assessment was guided by the following: -

- Broad consultation with stakeholders
- Identification of an applicable quality infrastructure measure
- Establishment of components and indicators relevant to the implementation of quality infrastructure supporting CleanTech
- Desktop research on the Global Quality Infrastructure Index (GQII)
- Data collection and gap analysis
- Recommendations.

With respect to the quality infrastructure assessment, the methodology combines both qualitative and quantitative aspects. In this regard, the core individual components of a national quality infrastructure are presented along with fundamental supporting elements. Some of the QI components and supporting elements lend to the construction of the GQII. The national quality infrastructure is primarily a complex array of institutions and actors who operate in support of industrial development, economic and societal activities. QI development has been accepted as one mechanism to address major societal challenges such as climate change, sustainable resource use, innovation, ageing population, integration of people with disabilities, consumer protection and health and safety.

The interrelationships and interdependencies of these institutions and actors dictate that for the quality infrastructure to develop and function appropriately, there needs to be constant consultation between all the stakeholders in the private and public sectors. These include policymakers, government ministries, departments and agencies, the productive sectors, and consumers of QI services. Therefore, this project, similarly, needed to consult broadly with these stakeholders to capture their expectations, secure existing QI data and assess the QI gaps. These activities were primarily done using survey instruments, interviews, and site visits.

To establish the relevance and maturity of the QI supporting CleanTech, the determination of a unit of measure was required. This QI measure would best serve the purpose of this assessment, where it was an internationally accepted measurand that would allow country comparisons.

With the identification of the internationally accepted QI measure, the assessment sought to establish indicators to bring the local CleanTech context into relevance and applicability. These components and indicators measured the suitability of the NQI to meet the needs of the CleanTech sector.

Survey instruments and interviews were utilized to capture QI data from the stakeholders, assess its status and observe the maturity of the NQI. The QI service deficiencies identified by the CleanTech sector were used as inputs for the gap analysis. The gap analysis provides the foundation for recommendations to improve the quality infrastructure and the potential role of BLOOM going forward.

QI Component	Description	Identification of Institution
Standards	Publication of an official document (Standard) developed by consensus, containing the requirements that a product, process or service should comply with. Standards are inherently voluntary. However, once they are cited in a contract, or referenced in a technical regulation, compliance with these requirements becomes a legally binding obligation.	• National Standards Body • Standards Development Organisation (usually sector specific)
Testing	The examination and determination of whether stated requirements of a standard are observed.	• Testing laboratories • Medical laboratories NOTE: Can be public or private
Certification	The formal substantiation through the issuance of a certificate by a certification	• National Certification Body

QI Component	Description	Identification of Institution
	entity after evaluation, inspection, testing and assessment, stating that a product, service, organization or individual meets the requirement of a standard.	• Testing and certification laboratories
Metrology	The science of measurement involving scientific, industrial and legal fields. It involves defining in reality units of measure, how they are applicable in practice and commerce, and traceable to the international measurement system.	• National Metrology Institute • Legal Metrology Agency • Calibration laboratories
Inspection	The process of determination of whether a product meets a specified benchmark through competent expert review of product design, documentation and operation.	• Inspection body
Accreditation	The activity which provides an independent attribution as to the competency of an individual, or an organization to offer specified QI services (e.g. testing, inspection, certification).	• National Accreditation Body • National Accreditation Focal Point

Table 1 – Quality Infrastructure Components and Institutions

2.1. Review of External CleanTech QI Structures

A comparative review of external CleanTech QI structures was conducted to better understand how Barbados' CleanTech sector correlates. The countries chosen for this exercise, Germany, Finland, Denmark, Israel, Chile and Jamaica, satisfy those in the CleanTech QI continuum from developing to mature. The review of these external CleanTech QI structures can, therefore, provide a suitable snapshot of where Barbados lies.

2.2. Desktop Research

Desktop research of the economies of the chosen countries to benchmark their QI system and CleanTech sectors, were conducted to capture a global view of how a QI system develops in response to economic drivers. Additionally, pioneering work in the field of a comparative global index for QI was referenced as it suitably identifies and captures the state of QI systems from a country perspective. This index was used to establish an understanding of the status of Barbados' QI.

2.3. Review of Local CleanTech QI Structures

The local CleanTech QI structure was reviewed and observed to capture its applicability and relevance. This was accomplished using CleanTech stakeholder interviews, quality infrastructure expert interviews, and one-on-one interviews with BLOOM cluster participants and on-site inspection visits of CleanTech sector businesses.

2.3.1. Conduct Broad Consultation with Stakeholders

There were several engagements with stakeholders that contributed to the build out of the quality infrastructure assessment framework. They include:

- interviews with BLOOM cluster CleanTech members
- interviews with a wide range of CleanTech stakeholders
- surveys of national quality infrastructure systems from various countries.

A full list of the stakeholder consultations can be found in Annex C.

2.3.2. Perform Data Collection

Data was captured from the BLOOM CleanTech cluster members, CleanTech stakeholders and National Standards Bodies of the QI services currently being offered, those being utilized and those that are needed. The data is presented throughout the assessment report.

2.3.3. Perform Analysis

An analysis of the data captured was illustrated and a comparison made to other benchmarks to determine the status of Barbados' QI structure in support of the CleanTech sector. An analysis was also done on the availability and delivery of QI services to determine their status.

2.4. Propose CleanTech QI Structure

The proposed CleanTech QI structure must be one that meets, at minimum, the following criteria:

- Be responsive to the demand for quality services
- Brings knowledge and highlights awareness of the relevant international standards for cleantech products and services that are required by customers
- Satisfies the demand for skills, QI laboratory support and resource availability for companies that need help to comply with standard requirements
- Provides timely trade information with respect to opportunities for export market access for the sectors' products and services
- Have a plan for sustainability of the QI system.

2.4.1. Establishment of Relevant Indicators to Illustrate Progress of CleanTech QI

The following indicators would be useful to identify progress being made in the QI supporting CleanTech:

- provision/facilitation of QI service within 3 business days
- programmed consultation with the CleanTech sector
- reference to the Barbados National Quality Policy Implementation Plan indicators
- provision of trade information within 24 to 48 hours
- strategic business or sustainability plan for QI in the CleanTech sector.

2.4.2. Develop Recommendations for Improvement of CleanTech QI Structure

Ultimately, the goal is to strive toward a QI structure that meet the demands of the CleanTech sector having meet the requirements of section 2.4. To achieve this, recommendations will be developed in a subsequent section.

3. Review of External QI Structures

3.1. Review of International QI Structures

The success of any quality infrastructure model is defined by its ability to meet the demands of business (mainly industry), government and society with the provision of quality services. The structure of the QI model is highly influenced by the types and scope of industrial activity, as these are the major economic drivers of an economy. Unsurprisingly, the NQI model tends to advance and mature in a manner that is reflective of the country's industrial landscape while also meeting societal goals such as the UN SDGs.

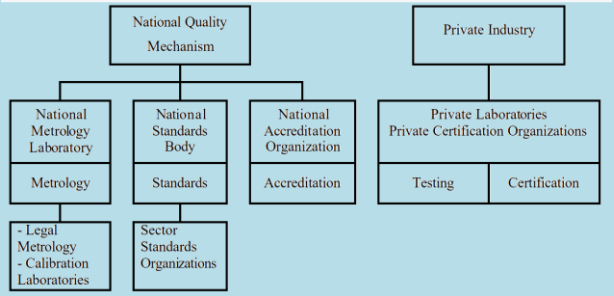
A review of international CleanTech QI structures revealed different models that could be placed in identifiable categories. The countries reviewed were Germany, Denmark, Finland, Israel, Chile, and Jamaica. Our review highlighted the fact that more diverse and advanced economies have a QI structure that is reminiscent, or close to a national quality mechanism.

Box 1 The National Quality Mechanism

A national quality mechanism is a QI structure where most of the quality services are provided by the private sector in a competitive business environment. There is some, but limited government involvement only in component areas where it is fundamental for society's health, safety and ethical oversight. This may be observed in the form of an oversight Council of the body responsible for coordination of standardization, metrology and accreditation, for example.

However, the private sector is usually found to dominate in areas with commercial returns such as testing, inspection and certification.

Some sub-sectors fully embrace QI and provide the full suite of services required for their productive endeavors. An example of a national quality mechanism QI structure is given below. This QI structure is found in Germany due to its diverse and mature industrial landscape.



Source: ITC Road Map for Quality, 2014

Box 1 – The National Quality Mechanism

3.1.1. Denmark

The Danish QI system is one that has seen recent evolution at the beginning of the 21st century. Most of the components of the QI system were overseen by national authorities. However, with the introduction of the European Union laws treating to QI, there has been a divestment of the QI system. The Danish QI now includes more private involvement in the form of public-private partnership (PPP), cooperation agreements and even innovative structures with shared ownership and funding arrangements.

One example is the accreditation component which was previously operated by the Danish National Testing Board, a public authority under the Ministry responsible for Industry. In 2002, a change was made where the responsibility for accreditation was transitioned to a Danish Accreditation Fund (DANAK), an independent non-profit business fund. The fund was founded by invested stakeholders that include representatives of Danish companies from a newly established Danish Confederation, clients (other QI institutions) requiring accreditation services and public authorities. DANAK has been contracted to provide accreditation services as the National Accreditation Body of Denmark by its oversight body, a public safety authority, which is an agency under a government Ministry.

The evolution of the accreditation component saw the delivery of QI services transition from a public testing board to a broader-owned cooperation fund. With this evolution, there was an expansion of the scope of QI accreditation services offered in response to the needs of the productive sectors. Additionally, the financing of accreditation also transitioned from total reliance on government funding to one where a significant portion of revenue is derived from accreditation services offered, while state funding supports the international cooperation work.

The Danish QI structure is, therefore, one that has benefited from its evolution of separating statutory and commercial QI activities into a form of a national quality mechanism. The legislative agenda, therefore, was the main driver for the advancement

of the QI system in Denmark in support of European Union (EU) Regulation No. 765/2008 on Accreditation.

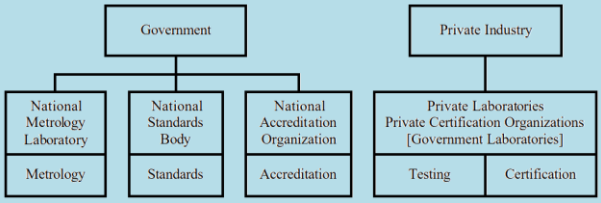
Box 2 Separation of Statutory and Commercial QI Activities

This QI structure is one where the government believes its involvement in components of the QI system is necessary because the private sector is not interested as there is no commercial value in doing so.

However, those components that are commercially viable are left fully to the private sector. These typically include conformity assessment activities of testing, inspection and certification.

This QI structure is usually found in well-developed economies such as those in Europe and the United States of America.

Standardization, accreditation and metrology are conducted by public authorities as these require the most technical resources to deliver with competence. Until recently, this QI structure was found in Denmark and is under evolution into a national quality mechanism due to its well-developed economy.



Source: ITC Road Map for Quality, 2014

Box 2 – Separation of Statutory and Commercial QI Activities

The advantages of this QI structure are that it provides for a high level of competition among the players in the market, has measures in place to ensure a level playing field with respect to technical competency and is generally acceptable to most trading partners. Furthermore, since the private sector provides most of the QI services needed in the country there tends to be a more responsive effort to put QI services in place to support new and emerging sectors.

3.1.2. Finland

At the start of the 21st century, the Finnish economy underwent significant reforms to address market liberalization and deregulation. There existed many state monopolies, a lack of competition and barriers to entry of foreign investors and parties. The same is reflected in the QI in Finland, with reformation bringing about a reconfiguration of QI actors and a more open QI system. The NSB, Finnish Standards Association (SFS) is a private sector-led central standardization organization that controls and co-ordinates national standardization work in Finland. It overseas other affiliates who perform the role of SDOs

in the country. On the other hand, the National Metrology Institute (VTT MIKES), is part of a division of the Technical Research Centre of Finland Ltd. (VTT), a limited liability company wholly owned by the Finnish State. Because the use of accurate and reliable measurement and calibration solutions are highly demanded in Finland and intrinsic to innovation and entrepreneurial development, it is no surprise that metrology occupies the role of significant QI enabler of economic activity. VTT claims the group revenue intake for 2020 was approximately 149 million Euros. All modern economies depend on reliable measurements to function and trade.

Although a state entity, VTT appears to be well managed and is committed to its mandate as a research and scientific institution addressing the needs of Finnish, and now global industrial players. It collaborates actively and broadly with stakeholders to encourage information flows and a common vision for Finnish priority areas. As a research entity, VTT appears to turn global challenges into opportunities for Finnish businesses to incorporate and utilize as part of their sustainable growth and development.
Finland appears to have a QI structure, as given in Box 2, which is adequate and satisfactory to support its economy and society.

3.1.3. Germany

A significant portion of the QI services provided to the German industrial complex is performed by private sector bodies and associations. Even though the technical work may be conducted by private institutions, they have to, by legislation, collaborate with federally designated institutions which represent the components of QI, to publish national QI measures. For example, the automotive industry in Germany develops its own standards, and then collaborates with the German Institute for Standardization (DIN) to publish them as national standards. DIN was established as a PPP between private enterprise and the German Federal Republic. It is an independent, private organization that is registered as a non-profit association. DIN has been designated as the sole NSB of Germany. It has established subsidiary and associated companies which assist in its QI mandate. One of these associated companies develops standards, whilst another conducts certification activities.

Due to the mature industrial landscape and the need for QI services to support the global export of quality goods and services, the NQI has matured into a QI structure categorized as the national quality mechanism, which can be seen in Box 1. The advantages of a national quality mechanism for the CleanTech sector are: -

- A choice of QI service providers
- Each QI institution could focus on its specific technical area of competence
- This QI structure inherently has little, or no conflicts of interest
- CleanTech entrepreneurs can invest, build capacity, and have a meaningful involvement in the delivery of QI services
- The CleanTech sector and other stakeholders can contribute to the development of national strategies and policies which are sustainable.

The main disadvantages to this type of QI structure are that it requires significant investment in human resource capacity, operation and management capabilities, technical equipment, and facilities. While it may appear unfeasible for a Small Island Developing State (SIDS), in Barbados' context, the possibility, if approached from a sectoral/collective standpoint such as a BLOOM cluster will be explored in the review of local QI structures.

3.1.4. Israel

After 1948, the nation state of Israel saw an influx of well-educated North American and Western European immigrants. Its economic policy focus was growth and integration into the world economy. The government assisted by facilitating low-interest rate loans from its development budget to industrial growth. Progress was made toward these goals despite a scarcity of natural resources, heavy capital expenditure on defense, a small domestic market limiting economies of scale, a boycott by most Arab states in purchasing its products and high rates of inflation. Notwithstanding these challenges, there was substantial growth of Israel's industrial sectors due to local demand. The country now boasts world-class sectors in advanced technologies, software, electronics, agriculture, chemicals, plastics, medical and industrial equipment, to name a few. It is said that Israel's impressive status in innovation and new technology is due to its emphasis on higher education and research and development. Export trade has supported economic

expansion as the country takes advantage of its free-trade agreements under World Trade Organiation (WTO) trade rules.

The Standards Institute of Israel (SII), a statutory body, is the leading QI actor in Israel. Its suite of QI services span from standardization, to testing, product and management system certification, environmental label verification, some trade facilitation, consultancy and advisory services. It provides an expansive suite of QI services for its stakeholder base. SII has a significant laboratory capacity and expertise. The legislation giving power to the SII appears to focus on a somewhat rigid requirement for most products entering, and exports from the Israeli market to conform to an International Standard, a recognised international benchmark, or an Israeli standard. These regulatory drivers spur demand for QI services in the country and are the basis for the concentration of QI services within SII. It appears there is little room for other QI players outside of state authorities. The QI structure that supports Israel can be categorized as a totally integrated model.

Peculiarly, this model works for Israel because of the exigency of the external environment.

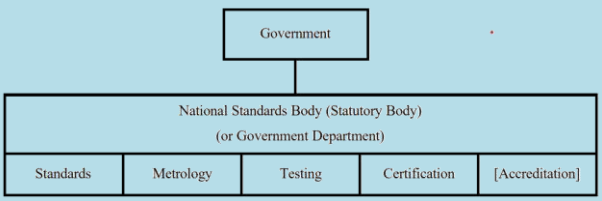
Box 3 Fully-Integrated Quality Infrastructure

This QI structure is one where all of the QI components are found under one agency, which primarily is an agency of government as this is the most viable mechanism.

Typically, in the early stage of the QI development, there is little private sector investment in the QI components, due to a lack of education and understanding.

This QI structure is usually found in developing and transition economies where there are efficient use of scare resources through the sharing of administrative skills, facilities, personnel, equipment and budget allocation.

This QI structure can be found in Israel due to the nature of external pressures on the economy and society. Accreditation, being a relatively recent structural phenomenon to QI structures may or may not be found under the authority of the NSB. In Israel's case, their accreditation authority, Israel Laboratory Accreditation Authority (ISRAC), is a separate legal entity established in law as a statutory body. Market Surveillance and Enforcement functions are typically found under the NSB authority.



Source: ITC Road Map for Quality, 2014

Box 3 – Fully-Integrated Quality Infrastructure

The integration of QI components does bring some benefits: -

- Optimum use of scarce public resources through sharing
- A common, predictable approach to the delivery of QI services
- Targeted support to key sectors.

While this QI structure does have some benefits, it has over time become inappropriate to support a modern open trade economy where the disadvantages include:

- The QI institutions become unresponsive and inefficient over time as they are usually the only body providing QI services as they enjoy legal protection having been established under law
- There is little or no option to access QI services other than from a public authority
- The QI services available do not match, and are slow to respond to new sectors of the economy
- There could be instances of conflict of interest between the QI institutions and sometimes duplication, overlap and gaps in responsibility for QI components.

3.2. Review of Regional QI Structures

3.2.1. Chile

Chile has one of the leading economies in South America. Its economic policy appears to focus on the production and export of high-value commodities and products. To achieve this goal and support the acceptance of its exports in foreign markets, there was a need to establish a quality infrastructure to support the productive sectors.

The National Institute for Standardization (INN) leads this charge where it oversees the standardization, accreditation, and metrology QI components. Conformity assessment activities are satisfied by private sector entities in the areas of inspection, testing and certification.

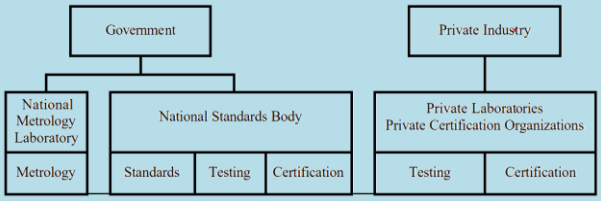
The Chilean QI system appears to fall into the traditional statutory approach, where the public authorities initially set up the QI institutions and then slowly withdraw and cede them over to the private sector when the industry develops and matures.

Box 4 The Traditional Statutory Approach

This QI structure is one where the government takes the lead initially by establishing the QI components. Over time, the government then strategically develops and invests in sectors of the economy that have viable domestic and export potential, with the ultimate aim of transitioning the responsibility for QI support to the private sector.

This QI approach is considered a good model for those in early development of their national quality infrastructure.

This QI structure is found in Chile. Currently, Chile's QI model is slowly transitioning to a separation of statutory and commercial activities.



Source: ITC Road Map for Quality, 2014

Box 4 – The Traditional Statutory Approach

New and emerging sectors are usually not prioritized for QI support until they have established themselves and signaled their intention to make a major contribution to the national economy.

3.2.2. Jamaica

The Jamaican QI structure was initially established as a fully integrated QI model with the birth of the Jamaica Standards Bureau, a statutory body, in the late 60s. As time progressed, more QI components were added to support the economy under the Bureau, as is typical of the fully integrated model. The transition from the Jamaica Bureau of Standards (JBS) to the Bureau of Standards Jamaica (BSJ) also saw some maturation of the QI structure, with the NSB beginning to spin off most of its QI components into separate legal entities. It now stands that Jamaica National Agency for Accreditation (JANAAC) is a statutory agency providing accreditation services. The National Metrology Institute has ring-fenced itself from within the NSB, and the National Certification Body of Jamaica (NCBJ), has taken the role of lead certification authority. The last area to separate itself was the market surveillance and enforcement function, now rebranded the National Compliance and Regulatory Authority of Jamaica. The Jamaica QI structure now more resembles that of the separation of a statutory and commercial activity model.

4. Review of Local QI Structures

4.1. Environment

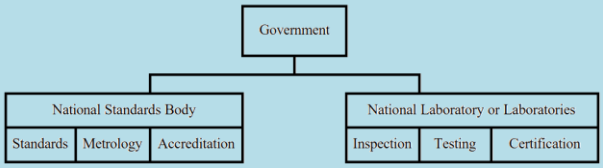
The current QI structure in Barbados appears to be based on an upgrade of the original fully integrated model, with the establishment of the Barbados National Standards Institution (BNSI), where all the components of the NQI were owned and controlled by the government. With the evolution of the Barbados economy over time from its light industrial revolution in the early 1980s, the private sector has now ventured into some commercial aspects of the QI system. Therefore, there has been some liberalization in this space, with the government also responding by advancing the QI structure from a fully integrated model to a semi-integrated one.

Box 5 — Semi-Integrated Quality Infrastructure

This QI structure is one where public authorities still governed most, if not all, of the QI components. However, administratively, the QI components are grouped under a more functional arrangement where there may be one agency responsible for each QI component or one agency governing more than one QI component.

There is some to little involvement of the private sector, but only in commercially viable areas of inspection, testing and certification.

This QI structure can be found in Barbados. In the early 90s, Barbados began to evolve its QI structure from the fully-integrated model with the separation of statutory and commercial functions. While the NSB maintains oversight over the QI system, there is encouragement of investment in the QI system by the private sector.



Source: ITC Road Map for Quality, 2014

Box 5 – Semi-Integrated Quality Infrastructure

The focus back then was on standardization with supporting inspection, testing and quality assurance that would lead to certification, and some aspects of legal metrology in support of an industrial activity, commerce and consumer protection. Other QI components appeared not to be as functionally mature as the former. The existing QI structure is illustrated as given in Box 5.

The existing NQI framework can be further described in terms of the ideas, beliefs, rules, and legislation that exists.

4.1.1. Ideas

The concept of the NQI stems from the idea that the NSB, the principal institution directing QI in Barbados, can conform to the following:

- Facilitate standards-related trade and the international competitiveness of Barbadian goods and services, the protection of consumers and the harmonious development of the sectors of the economy
- Be a responsive agency not bogged down in the bureaucratic pitfalls of a government entity. It is semi-autonomous and can seek technical assistance, partnerships and assistance from international partners outside of Barbados
- Be a non-profit benevolent organization where its priority is on its mandate/mission rather than on the bottom line, or its directorship
- Provide QI services to support new and emerging sectors, facilitate trade and realization of the UN SDGs
- has a QI structure that is, in nature, facilitating and developmental of business and where matters with legitimate objectives such as public health, the safety of persons, protection of the environment and the like are separately assigned to another regulatory agency
- the protection of consumers in the increasing global trade of goods and services
- the initiation and extension of industrialization
- is financially secure by providing paid services and not be subject wholly to the vagaries of government financing.

4.1.2. Beliefs

For the NQI being delivered to be certain, true and fit for purpose, the following beliefs must exist:

- A joint venture in the form of a PPP funding and supporting the NSB is a commitment by both sectors

- The PPP model affords the NSB to focus on the needs of its key stakeholders, which is Business, Government and Society. The private sector can unreservedly be supported as they are one of the main and dominant drivers of the engine of economy
- The establishment of the NSB as a Company avoids the pitfalls of a bureaucratic government entity. The governance of the NSB should be such that it allows the institution to easily respond to the needs of its clients
- It supports the emergence of industrialization, the protection of consumers, allows for imports while supporting exports
- The QI would facilitate the maturity of the sectors of the economy by embedding quality at the beginning of the productive process and improving export potential.

4.1.3. Rules

The rules of the QI system are such that: -

- It conforms to acceptable norms, that is, international norms and standards
- It is impartial with respect to the development support and maturity of each sector and field of business
- Preference is given to productive sectors
- Conforms to WTO Technical Barriers to Trade (TBT) principles and its trade rules.

4.1.4. Legislation

For the QI to function appropriately, it must be governed and overseen by modern and current legislation that: -

- Conforms to WTO principles
- Supports and encourages private investment in component areas of QI
- Facilitates the development of industrialization and productive enterprise
- Is clear with respect to roles, responsibilities, coordination, and oversight of the NQI.

For without enabling legislation to function as a driver of the NQI, its development is likely to languish. The private sector is not motivated to invest in the NQI unless that component

has commercial value. It is, therefore, left to the government sometimes in collaboration with the private sector to establish and develop components of the NQI.

4.2. Actors

4.2.1. Local and Regional

The current QI structure in Barbados designates a NSB, the BNSI, which is the primary institution for directing and overseeing the NQI. It provides a suite of services for the components of quality infrastructure. There are other actors operating in different components of the QI that may be able to provide QI support to the CleanTech sector, as given below in the table below.

QI Component/ Supporting element	Actor	General service	Relationship in the NQI	Service to CleanTech sector
Standardization Certification Quality management	Technical and Vocational Education and Training (TVET) Council	The TVET Council is a statutory entity which functions as a Standards Development Organization. It standardizes people processes such as training, qualification and certification to establish work-related skills	Operationally independent of the NSB, but the NSB sits on its technical governance committee	The TVET Council has the capacity and capability to similarly establish occupational standards for persons and roles in the CleanTech sector
Standardization Certification Inspection Testing Metrology Accreditation/ Training Capacity building Quality management Education Capacity building Policy and legislative support Technical regulation support Trade facilitation Market access	Barbados National Standards Institution (BNSI)	The BNSI is the National Standards Body of Barbados. It delivers services on standardization, certification, inspection, testing, metrology and accreditation. Some business support services complimentary to QI are also offered	Member-based private-public-partnership organization established under the Companies Act as a not-for-profit benevolent entity. It occupies the role of a premier scientific institution in Barbados. As the first QI designated in law, it has built capacity in many areas of quality infrastructure. Inherently, the BNSI functions as the oversight body of the NQI	The BNSI has many capabilities to deliver QI services to the CleanTech sector. Some examples include: Standards implementation Product design and development for AgriTech products to meet applicable standard requirements Certification of Blue Economy products and services to meet Codex Alimentarius Commission, CARICOM Regional Standards and other standards Metrology services to stakeholders in the Circular Economy sector to validate product constituent consistency Temperature metrology Mass metrology Accreditation services for testing laboratories
Standardization Quality management/ Awareness and promotion Training	Barbados Renewable Energy Association (BREA)	The BREA is a member-based non-governmental organization which focuses on renewable energy and energy efficiency. Its objectives are to foster "green" jobs and entrepreneurial development; the adoption of best practices in renewable	Member-based, the BREA functions as both a user and driver of renewable energy technology and energy efficiency	The BREA can be engaged to determine its capacity and capability to direct the CleanTech sector in the use of international standards, utilizing quality management, awareness and promotion, training and capacity building for renewable energy technologies

QI Component/ Supporting element	Actor	General service	Relationship in the NQI	Service to CleanTech sector
		energy technology, and energy conservation		
Testing	Private testing laboratories, E.g. LNW Environmental Inc.	Some labs in the private sector perform testing on water, the environment and for other chemicals as demanded by their clients.	These private labs refer to the NSB for verification of the credibility and competence of their results through traceability to international standards	These private labs are capable of providing testing support to the CleanTech, blue economy and biotech sectors and possible certification
Quality management	Private consultants	Provision of consultancy services, training, hand-holding and implementation support for quality management	This human resource is independent of the NSB, but defers to it with respect recognizing the competence of personnel as stated in international standards. Contact information for these professionals may be available from the NSB	There is a cadre of qualified and competent persons in Barbados who have provided quality management training and implementation support to MSMEs
Training/ Education	Megapower Inc.	Megapower Inc. is a private business and leader in electric mobility	Megapower Inc. supports Barbados' transition to a green economy. Megapower Inc. is an enabler of green technology	Megapower Inc. organizes the training of local mechanics in the service of electric vehicles, the build-out of a public charging network for electric vehicles, acts as an agent for mass transit authority with e-buses, and installs green energy technologies in keeping with its mandate of sustainability and the green economy
Policy and legislative support	Division of Energy, Ministry of Energy and Business Development	The Division of Energy is government's primary agency under the Ministry responsible for the development of energy policy and legislation	The Division of Energy is the lead agency for energy policy and legislation. It collaborates closely with the NSB to ensure policy coherence with QI support	The Division of Energy has the capacity to advise on policy support and provide regulatory compliance guidance to the CleanTech sector
Testing	Government Analytical Services (GAS) is the Ministry of	GAS was established to support both the private and public sectors with testing services for the agriculture sector	GAS occupies a key role as one of the main QI institutions providing testing support to many sectors	GAS has some capabilities to provide testing support to the biotech sector. In cases where the required tests are not available locally, either GAS or the NSB

QI Component/ Supporting element	Actor	General service	Relationship in the NQI	Service to CleanTech sector
	Agriculture's laboratory			can offer facilitation services to have the testing conducted overseas
Market surveillance Enforcement	The Department of Commerce and Consumer Affairs (DCCA)	The DCCA is a public agency under the Ministry responsible for Commerce and Trade. It regulates consumer products which are designated in Compulsory Standards and also those referenced in legislation	DCCA is a key player in the NQI. It serves to protect society by ensuring consumer products placed on the market are safe for use. It also defends domestic production from substandard products	DCCA serves not only as a regulator, but can provide other QI services such as regulatory compliance support and legal metrology support

Table 2 – Local Actors Providing QI Support to the CleanTech Sector

Similarly, there are regional actors that can support the local CleanTech with various QI services. Typically, regional support is facilitated through the NSB, which functions as a focal point. Regional QI support can be delivered by those listed below.

QI Component/ Supporting element	Actor	General service	Relationship in the NQI	Service to CleanTech sector
Facilitation of all QI components Standardization Metrology Accreditation Testing Inspection Certification Quality management/ Awareness and promotion Technical regulation support	The CARICOM Regional Organisation for Standards and Quality (CROSQ). It functions as the regional secretariat for the harmonization of all QI components within the 15 Member States of the Caribbean Community (CARICOM)	Regional standardization Testing and certification schemes CARICOM Cooperation for Accreditation Quality promotions Technical regulation	The CROSQ Secretariat is a key supporter of the NQI in-country. It provides strategic guidance and technical support on the development of the NQI	The CROSQ Secretariat has a history of facilitating the provision of QI support services to Barbados, its NSB. In countries where the local QI service is not available, the NSB and CROSQ facilitate the QI service in another country within the CROSQ network

QI Component/ Supporting element	Actor	General service	Relationship in the NQI	Service to CleanTech sector
Standardization Testing Certification Inspection/ Quality management	The Trinidad and Tobago Bureau of Standards(TTBS) is a statutory agency under the Ministry responsible for Trade which is designated as the National Standards Body	The TTBS provides a range of QI services in support of its diverse industrialized economy	As the NSB of Trinidad and Tobago, the TTBS is the lead driver in the NQI	TTBS has a mature laboratory system and has been designated as a Centre of Excellence by the CROSQ for its testing infrastructure for lighting technologies. It can support testing for energy efficient lighting technologies
Standardization Testing Certification Inspection/ Quality management	The Bureau of Standards Jamaica (BSJ) is a statutory agency under the Ministry responsible for Industry which is designated as the National Standards Body	The BSJ provides a range of QI services in support of its economy. It also plays a major role in the provision of QI services for imports	As the NSB of Jamaica, BSJ is the lead driver in the NQI	BSJ has a mature laboratory system and has been designated as a Centre of Excellence by the CROSQ for its energy efficiency testing of refrigerators and air conditioners
Standardization Testing/ Training Consultancy	Scientific Research Council (SRC), Jamaica	The SRC is a public authority in Jamaica with a scientific research mandate. This mandate manifests itself in the forms of standardization, testing, training, consultancy services and education	SRC is a key player in the Jamaican NQI. It also plays a significant role as a QI institution regionally with its in-built QI capacity	The SRC offers many services to the blue economy, bio-energy and waste-to-energy sectors as highlighted in the general service column
Standardization Inspection Testing Certification Metrology/ Training Quality management	Association for Standardization and Certification (ANCE), Mexico	ANCE is a private non-profit institution that offers a multi-functional range of QI services	ANCE serves as a QI institution providing services to private and public sectors. It has a high degree of credibility due to its international accreditation and traceability to the international QI system	ANCE offers QI services to those in the solar Photovoltaic (PV), solar thermal, energy efficiency and electricity sectors -

Table 3 – Regional Actors Providing QI Support to the CleanTech Sector

4.2.2. Barbados QI Ecosystem Map

The Figure 1 below best illustrates the Barbados QI ecosystem.

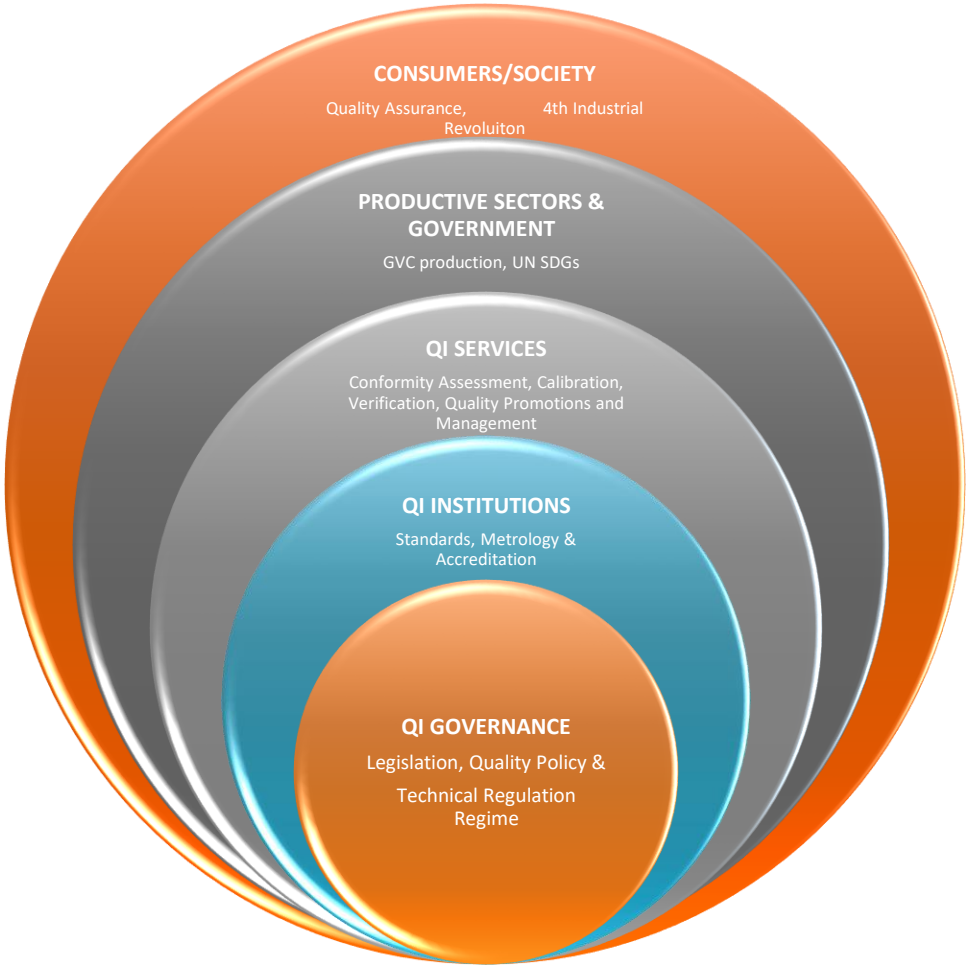


Figure 1 – Barbados QI Ecosystem Map

4.2.3. International

At the international level there are several institutions that support CleanTech with QI services as given below.

QI Component/ Supporting element	Actor	General service	Relationship in the NQI	Service to CleanTech sector
Standardization Quality management/ Training Awareness and promotion	International Organization for Standardization (ISO)	The ISO is a member-based organization recognised by the World Trade Organization as an international standardizing body. It develops global standards for the CleanTech sector	The ISO is a fundamental body that is a repository for international norms and best practice. It also provides strategic guidance and capacity building opportunities to local stakeholders	ISO provides some standardization solutions for the CleanTech sector. ISO has specific standards to address some CleanTech sectors such as Solar Thermal e-Transportation Bio Energy. Other CleanTech sectors are addressed under IEC programming. A repository of standards of relevance to the CleanTech sector is given in Annex B
Standardization Certification/ Training Awareness and promotion	International Electrotechnical Commission (IEC)	The IEC is a member-based organization recognised by the World Trade Organization as an international standardizing body focusing on electrical, electronic and related technologies. It develops global standards for the CleanTech sector	The IEC is a fundamental body that supports the NQI and international trade in electrical and electronic goods. It is a repository for international norms and best practice. It also provides strategic guidance and capacity building opportunities to local stakeholders. It has specific programs that focus on	IEC offers specific and targeted standards solutions for the CleanTech sector in the fields of Solar PV; Solar Thermal; e-Transportation; Energy Storage; Marine Power; Energy Efficiency and Wind Power. It also operates several schemes of certification giving confidence that CleanTech products meet international standards. A repository of standards of relevance to the CleanTech sector is given in Annex B

QI Component/ Supporting element	Actor	General service	Relationship in the NQI	Service to CleanTech sector
			developing countries and their ability to adopt and utilize its services. The IEC offers QI services in the Standardization and Certification components. It operates the IEC Renewable Energy certification scheme to support the CleanTech sector: (IECRE) IEC Renewable Energy. This is the IEC system for certification to standards relating to equipment for use in renewable energy applications. It covers certification for Solar PV, Marine Energy and Wind Energy sectors.	
Awareness and promotion	International Renewable Energy Agency (IRENA)	IRENA is an intergovernmental organization that gives support to countries in their transition to a sustainable energy future. It serves as a repository for renewable energy technology, policy, international cooperation resource and financial knowledge	IRENA provides sound analysis on the implementation of CleanTech to national applications. Its policy guidance serves as a confirmatory tool in the implementation of the NQI	IRENA serves as a repository for international standards and patents in renewable energy and connects CleanTech to patents and standardizers

QI Component/ Supporting element	Actor	General service	Relationship in the NQI	Service to CleanTech sector
Testing Inspection Certification/ Training	TÜV Rheinland (Germany)	TÜV is a world-leading testing service provider supporting innovations in business and technology	TÜV has a long history of the provision of QI services to businesses around the world	TÜV can offer the CleanTech sector QI services for electric vehicles, e-mobility infrastructure and renewables
Testing Inspection Certification/ Training	Intertek	Intertek is an industry leader in the provision of QI services globally. As an industry leader having global recognition of its brand, Intertek also provides its own certification mark	As an independent testing lab, Intertek's global recognition allows it to support quality infrastructure worldwide	Intertek has the capability to provide QI services to the following fields: solar PV; wind power; biotech; energy efficiency; e-Transportation: battery storage; renewable energy; Internet-of-Things
Standards Testing Inspection Certification/ Training	Underwriters Laboratory (UL)	UL initially started as a testing laboratory to confirm products placed in the market place were safe. As a global entity, UL has added many QI services to its portfolio, including technical business support	UL provides QI services globally and was once very active in the Caribbean partnering, with NSBs to offer testing services to the industry under a technical cooperation agreement	UL provides QI support to the CleanTech sector in the areas of battery and energy storage; e-mobility; renewables; energy efficiency

Table 4 – International Actors Providing QI Support to the CleanTech Sector

4.3. Processes for Products and Services

The products and services of the NQI can be a complex and sometimes confusing array of deliverables. Without a basic understanding and knowledge of the national quality infrastructure, CleanTech start-ups and entrepreneurs are likely to be unaware of the range of QI services available to support their businesses. The following details are given on each component of QI to allow for a better understanding and access to its services.

4.3.1. Standardization

Standardization activities reflect the process of codifying minimum requirements for products, processes, and services by a committee of users and experts. These minimum requirements can be characterized as the optimal measures to achieve the intended outcome and should not be regarded as the best, or latest technology.

To have a product standardized in Barbados, there are two routes available:

- Request the NSB to develop the standard
- Request the NSB to adopt an identified standard.

The publication of a standard by the NSB can take six (6) months in exceptional circumstances and between 2 and 3 years normally. The BNSI standards development process, which is publicly available, indicates the average time to publish a standard is 19.5 months.

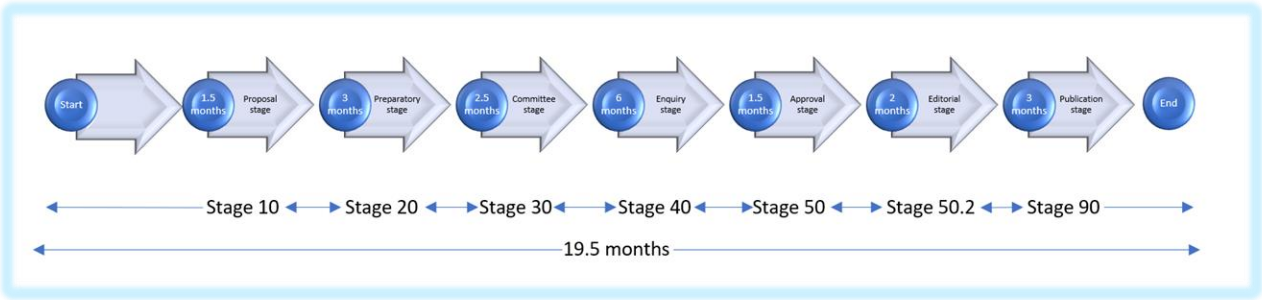


Figure 2 – BNSI Standards Development Process Map

To make the request for the development or adoption of a standard, a New Work Item Proposal (NWIP) form is required to be filled out and submitted (the proposer is expected to fill out this form). Assistance can be provided by the BNSI upon request, but it is likely

the proposer would be more successful if armed with an abundance of information, data and a justification for the standard.

Upon successful acceptance of the NWIP, the BNSI commences establishing a technical committee of users and experts who would be responsible for establishing the technical content of the standard. Alternatively, where an existing standard solution exists in the form of an International Standard, or one published by a credible Standards Development Organization which conforms to the WTO TBT Agreement and *Annex 3 The Code of Good Practice,* would be identified and brought to the attention of the technical committee for their deliberation. The process continues as illustrated above until publication.

The CleanTech sector can request the NSB to develop standards supporting its products and services. In the standards development process, the NSB has expectations of the standards proposer. They include:

- Active participation in the process by providing technical support and drafting of text
- Contributing financially, in part, to the process where it is financially capable of doing so
- Utilizing the standards by implementing their requirements and referencing them in procurement processes.

A staggering 83% of CleanTech businesses surveyed have not engaged the NSB to develop standards supporting their products and services.

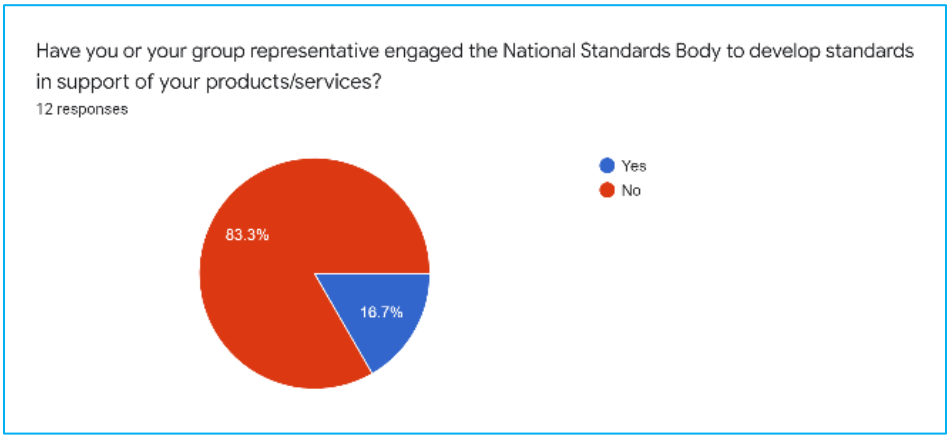


Figure 3 – Standards Support Request

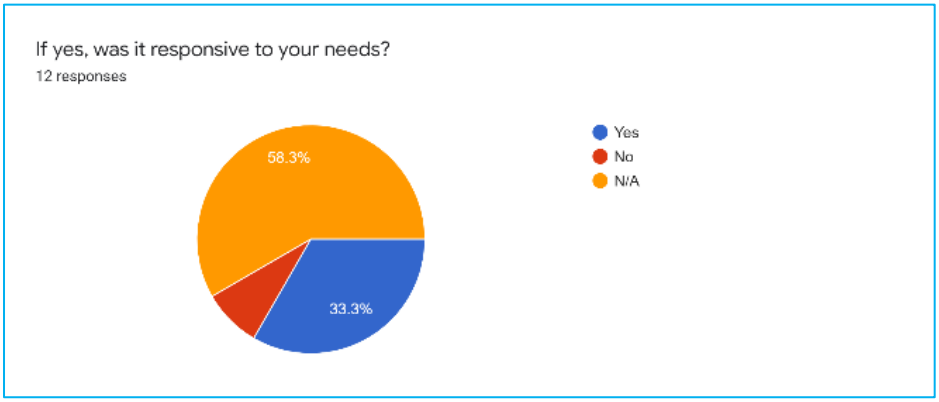


Figure 4 – Standardization Responsiveness

This is a worrying cause for concern and illustrates that the NSB has significant work to educate its stakeholders about the NQI. It also presents an opportunity for BLOOM to contribute by educating its members and stakeholders. It should be noted that just over 33% of survey respondents indicated the NSB was responsive to their needs. Responsiveness of the NSB will be addressed in the gap analysis. Just over 58% of CleanTech businesses indicated they were aware of standards for their business operation.

There was a healthy mix of standards the CleanTech businesses believe they need to put in place. They range from specific product standards to certification schemes to international management system standards and industry standards. A common selection were ISO 9001 Quality management, ISO 14001 Environmental management and product and industry standards for solar PV and Agritech. The ten (10) priority standards are identified in section 7.

Four (4) key standardization services received a survey response of 83.3%; standards information, standards training, standards implementation services and the ability to conduct a gap analysis in reference to a standard. The gap analysis expertise will be addressed under quality management in section 4.3.7.

Having received stakeholder responses, in alignment with the GQII, local nuance, and given the need to improve the standardization component, the following are proposed standardization benchmarks: -

- Legislation on standardization in alignment with WTO principles
- Establishment of an NSB

- Participation in International Standards development
- Time to market/publication of standards
- Provision of standards information services
- Provision of standards implementations services
- Standards development capability.

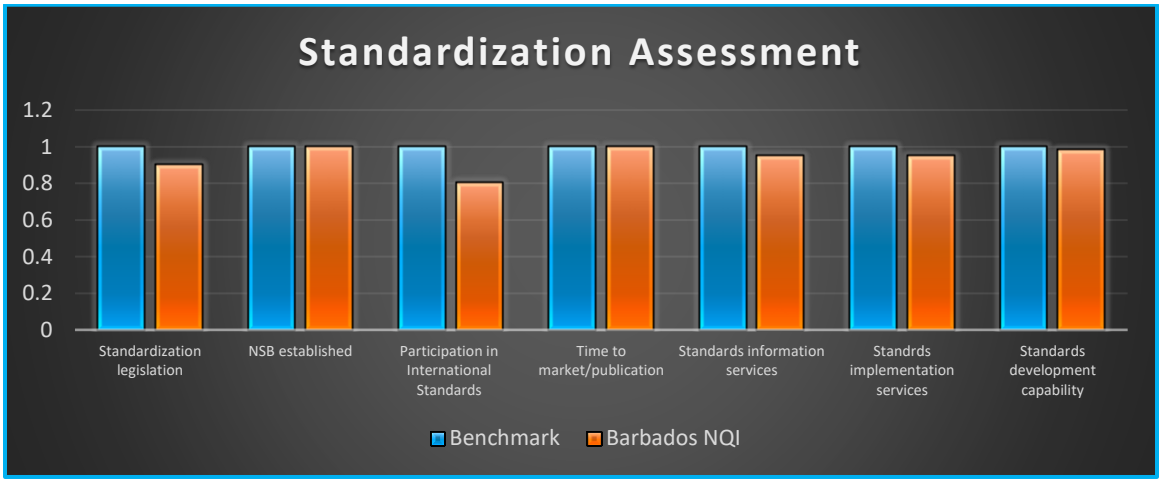


Figure 5 – Standardization Assessment

The average score for this component is 0.94 out of a maximum 1.0. Proposals to improve the standardization component are provided in a subsequent section.

4.3.2. Testing

Testing, inspection and certification activities belong to a collective QI service termed Conformity Assessment. While technically conformity assessment should not be considered a QI component, it is grouped here for simplicity of reporting. Conformity assessment can be described as a suite of evidentiary processes designed to illustrate that a product meets the requirements of a standard, or that stated requirements are met. Testing plays a vital role in all societies and economies by giving a determination of specific characteristics when tested according to a standard, method or test protocol. The emergence of the COVID−19 global pandemic forcefully illustrated to countries the need to invest in testing quality infrastructure. Without testing capabilities there would be chaos with respect to identifying who is COVID positive and who is not.

Similarly, there is a need for testing facilities which can provide support to the CleanTech sector. While establishing new facilities would be cost-prohibitive due to the immaturity of

the CleanTech sector, the other option remains improving the capabilities at already established QI institutions such as the GAS test lab. For example, Agritech entrepreneurs need to confirm the nutrient profile and other constituents in their products. Therefore, it appears more feasible to conduct the latter approach.

Box 6	National Dialogue on Quality Infrastructure Support for the Agro-processing Sector

In September 2021, the NSB, in collaboration with the CROSQ conducted a national dialogue on QI support for the agro-processing sector over a two-day period. The goal of the national dialogue was to develop an Action Plan which would enable the QI institutions to support the agro-processing sector in effectively meeting the (quality) requirements for export markets.

The objectives of the dialogue were to:

1) to increase participants' awareness of the importance of quality in enhancing the competitiveness of business

2) to increase participants' understanding of the role of QI in enhancing the development of the agro-processing sector

3) to provide guidance to the Barbados QI institutions, to structure its services to match the needs of the agro-processing sector.

The BNSI facilitated the national dialogue forum between QI institutions and agro-processors.

The national quality dialogue, therefore, represented a great opportunity to develop a QI that is relevant, current and meeting the specific needs of the agro-processing sector.

The final output was an Action Plan that identified activities required, an expected output, responsible QI institution(s), a preliminary budget and a deadline for implementation.

This targeted engagement successfully achieved the intended result of an Action Plan for enhanced QI support to the agro-processing sector. The BNSI has acknowledged that this engagement format and methodology can be repeated with different industries, sectors and fields of the economy.

Box 6 – National Dialogue on Quality Infrastructure Support for the Agro-processing Sector

Testing support for the CleanTech sector has been identified as challenging for the QI institutions to provide, due to the small number of CleanTech businesses in operation and the diverse scope of testing needs. Until there is a rationalization and country consensus on the sector's priority test needs, the challenge remains significant.

The Barbados National Energy Policy (BNEP) 2019 identifies Solar Water Heaters, Solar PV, Wind Energy, Bio-Energy, e-Transportation, Energy Efficiency and Conservation and Marine Energy as contributors to the energy mix to transition Barbados from fossil fuel power to renewable energy integration. The CleanTech sector plays a significant role in

this transition and has the potential to experience significant growth once supported by testing. The availability of local testing infrastructure that is credible and reasonably priced underpins local MSME research and development and growth. How this testing capability is established and which CleanTech sectors should be prioritised remains a bugbear for the local QI institutions. Consideration could be given to those already established cleantech sectors such as solar water heating and solar PV which has higher rates of penetration in the market. To this end, and guided by statistical evidence, the testing infrastructure could develop its capabilities to satisfy the demands of these sectors.

Having received stakeholder responses, in alignment with the GQII, local nuance, and given the need to improve the testing services, the following are proposed testing benchmarks:

- Legislation on testing in alignment with International Standard requirements
- Scope of testing in support of the economy
- Reporting of test results in 3 business days
- Facilitation of testing service
- Test results are traceable through accreditation.

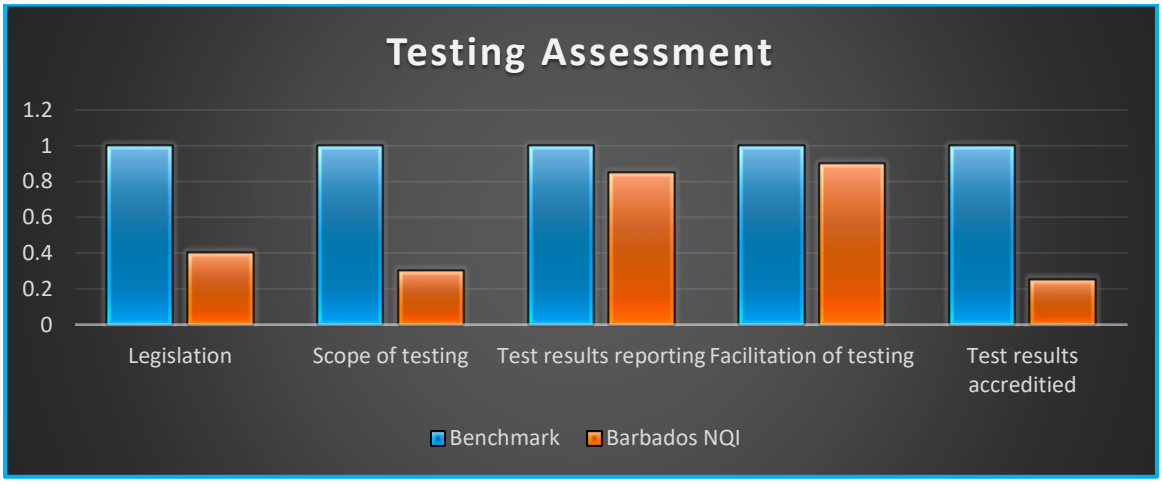


Figure 6 – Testing Assessment

The average score for this component is 0.54 out of a maximum 1.0. Proposals to improve the testing component are provided in a subsequent section.

4.3.3. Inspection

Inspection services entail the observation of a CleanTech product being able to meet the requirements of a benchmark or standard. It also includes a review and scrutiny of documentation in most cases to compare the design and reality of operations versus what is documented. The NSB can provide inspection services to the CleanTech sector, including more meaningful areas where this service is required to afford the operator market access and market entry to a foreign jurisdiction. Additionally, Export Barbados (BIDC) also provides an inspection service interestingly termed 'export certification'. This inspection service confirms the country of origin for trade agreement purposes, but as indicated in the previous section above, it is not truly a certification process from a quality perspective. Having received stakeholder responses, in alignment with the GQII, local nuance, and given the need to improve inspection services, the following are proposed inspection benchmarks:

- Legislation on inspection in alignment with International Standard requirements
- Inspection authority or body established
- Inspection capability
- Provision of inspection services
- Inspection services are accredited.

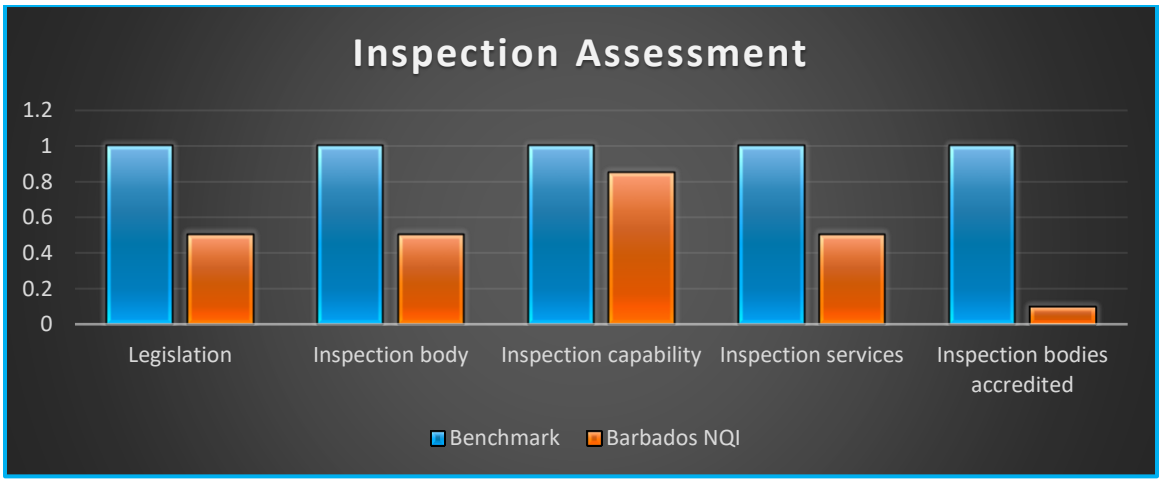


Figure 7 – Inspection Assessment

The average score for this component is 0.49 out of a maximum 1.0. Proposals to improve the inspection component are provided in a subsequent section.

4.3.4. Certification

Certification is the process of providing a guarantee that stated requirements are met. There are first, second and third-party certification schemes available.

- First-party refers to self-declaration by the manufacturer, or service provider and is commonly seen in the European Union market in the form of Supplier Declaration of Conformity (SDOC) as their certification in meeting EU legislative provisions. The CE mark on products entering the EU market is a well-known example.
- Second-party refers to consumer and customer reviews
- Third-party certification refers to an independent third-party guarantee. Locally, the BNSI and other non-official parties provide this third-party attestation.

To access certification services for the CleanTech sector, a request should be made to the NSB or National Certification Body (NCB) who can then direct where such a service is available if there is no capacity nationally to do so.

Certification is conducted by testing the requirements stated in a specific benchmark or standard to verify the CleanTech product meets those requirements. The expectation of the NSB, or NCB in this case includes: -

- That the client requesting certification services would have a consistent predictable demand for such services as these systems are costly to set-up and implement
- That the client would have been involved in standards implementation activities/work prior to requesting such services
- That the client would observe the rules of the certification scheme and not bring the certification body into disrepute.

Box 7 Certification for the Blue Economy Sector?

In 2020, the United Nations Development Programme (UNDP) Accelerator Lab for Barbados and the Eastern Caribbean conducted stakeholder outreach consultations as a means of sensing, identifying, and analyzing innovative solutions to challenges in the Blue Economy. Building on this initiative, and in collaboration with The NSB was invited to partner with the UN Accelerator lab to provide technical guidance on the certification aspects of the scheme in alignment with international best practices to ensure credibility.
The focus was placed on the Blue Seal certification program, which sought to connect business-to-business sustainable tourism industry partners

local and other stakeholders, a portfolio of mini experiments focused on the **Digitization of Micro, Small and Medium – Sized Enterprises (MSMEs) in the Blue Economy** were developed. In response to widening digital divides exposed and exacerbated by Novel Coronavirus (COVID-19), the portfolio was intended to contribute to ongoing digital disruption and innovation activities within the region focusing on digital transformation to build resilience. More specifically, by developing a mobile application that aims to improve fisherfolk's sales, enhance data collection and associated decision making, for government, connect fisherfolk directly to consumers and enhance access to sustainable fish and seafood on behalf of tourism operators. As such, the system had the potential to responsibly connect supply and demand within the Blue Economy.	(Hotels, restaurants and fish vendors); grow demand for consistent, sustainable and direct fish and seafood supply; create a resilient procurement model and increase sustainable tourism operations. The scheme included waste management, water efficiency, encouraged environmental best practices and saw the elimination of petroleum-based single-use plastics. Scheme participants were required to take a Blue Seal pledge and upon successful assessment were awarded a Blue Seal badge of Sustainability Steward, Ocean Champion and Plastic-Free. This certification program was well designed to achieve several technical and business objectives and illustrates the tremendous benefits a relevant QI solution can bring to an economy and society. Those who were in the pilot scheme indicated they were quite thrilled with the visibility to customers and the increased sales.

Box 7 – Certification for the Blue Economy Sector

CleanTech businesses did appreciate and understand the importance of having their products and services certified. Approximately 67% indicated a requirement for certification services.

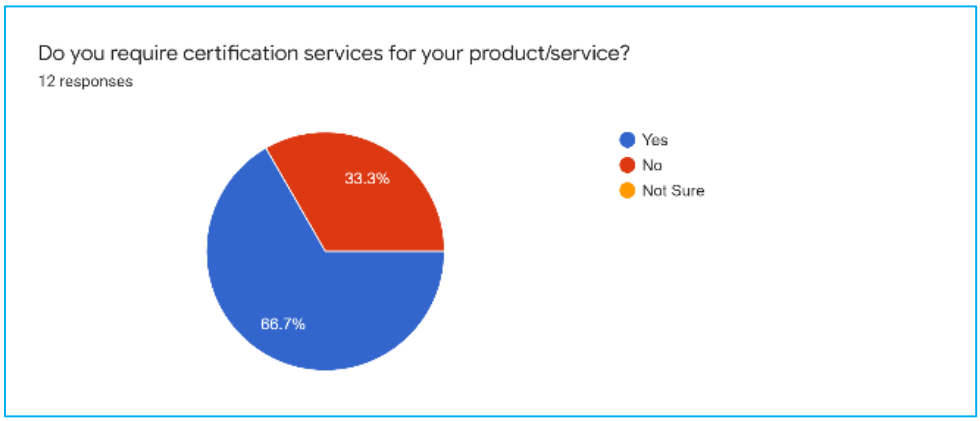


Figure 8 – Percentage Products Requiring Certification Services

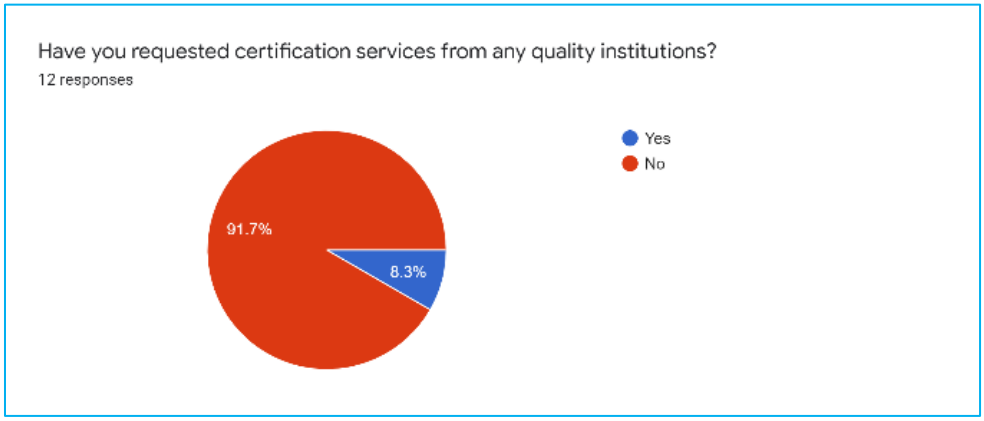


Figure 9 – Percentage Requesting Certification Services

The certification desired saw an almost even mix of the management system and product certification. Yet a whopping 92% had not yet engaged any QI institution to request assistance in providing a certification service.

Having received stakeholder responses, in alignment with the GQII, local nuance, and given the need to improve certification services, the following are proposed certification benchmarks: -

- Legislation on certification in alignment with International Standard requirements
- Conformity assessment authority, or certification body established
- Capacity to design and provide certification schemes/services
- Certification processes are accredited
- Provision of certification service within agreed timeline.

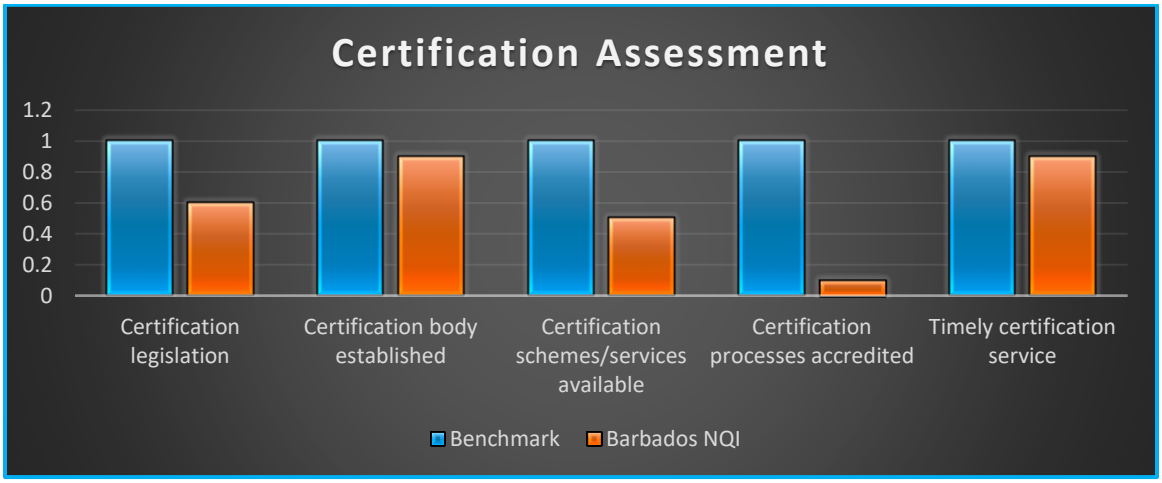


Figure 10 – Certification Assessment

The average score for this component is 0.6 out of a maximum 1.0. Proposals to improve the certification component are provided in a subsequent section.

4.3.5. Accreditation

Accreditation service provision by Barbadian and Caribbean service providers is limited to non-existent. In Barbados, as there is no accreditation capacity in design, however, the NSB offers an Accreditation Focal Point (AFP) service. The NSB functions as the AFP by acting as an agent facilitating the accreditation service with qualified vendors.

Accreditation is the process by which an authoritative entity, the accreditation body, provides formal recognition that the applicant is competent to carry out specific activities, tests, and roles. It does so by evaluating the competence of the personnel and the implemented management system of the applicant to meet relevant standards in the applied field.

While it is not expected that most of the CleanTech sector would require accreditation services to have their products globally accepted (certification better performs this role), this information is still quite useful for them to understand and identify which QI service providers are globally recognized through accreditation. Additionally, some QI service providers do need accreditation services to give credibility to their services. The CleanTech sector can engage and request the AFP to advise which vendor input/raw material is certified and internationally accredited worldwide. However, 75% were unaware of accreditation services provided to those supporting the CleanTech sector.

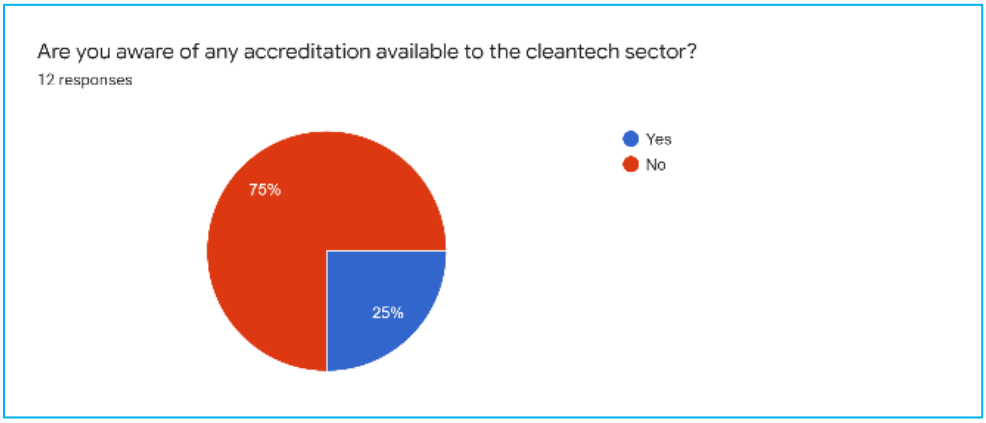


Figure 11 – Awareness of Accreditation Services

Having received stakeholder responses, in alignment with the GQII, local nuance, and given the need to improve the accreditation component, the following are proposed accreditation benchmarks: -

- Legislation on accreditation in alignment with the International Laboratory Accreditation Cooperation (ILAC) and International Accreditation Forum (IAF) principles
- Accreditation body/focal point established
- Accreditation service
- Accreditation scope coverage
- Signatory to ILAC, IAF or Regional Accreditation Cooperation.

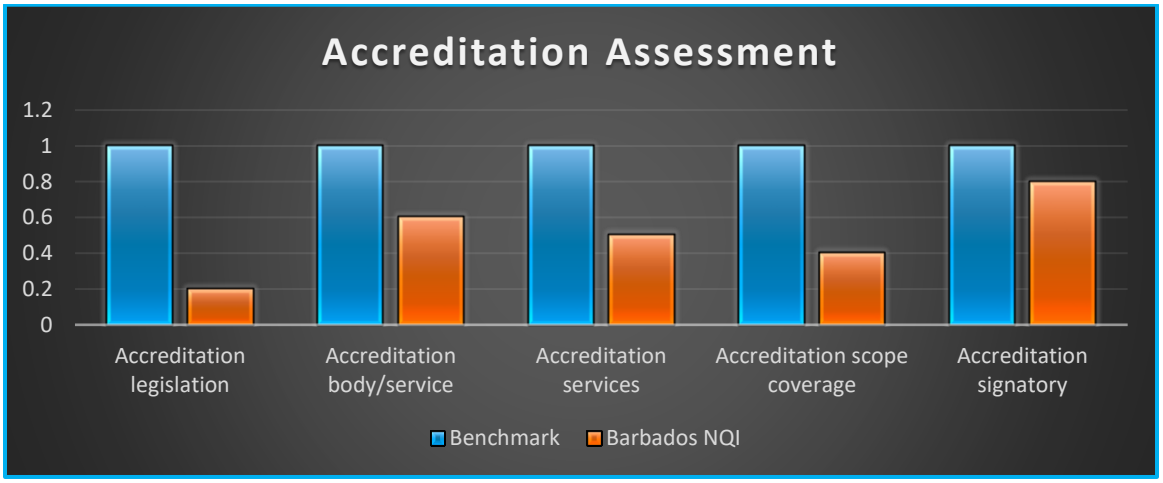


Figure 12 – Accreditation Assessment

The average score for this component is 0.5 out of a maximum 1.0. Proposals to improve the accreditation component are provided in a subsequent section.

4.3.6. Metrology

Metrology is the science of measurement. It is fundamental to commercial and economic activities in the delivery of accurate and reproducible measurements. Consumers, parties to contracts, and regulators are particularly invested in accurate and reproducible measurements to ensure fairness and equivalence. For the CleanTech sector, the fields of legal metrology and industrial metrology are of importance. Most commercial activities are governed by legal obligations which mandate that the manufacturer, or producer supply exactly the amount as stated. Renewable energy, for example, produced for the

grid is governed by laws and contracts and need accurate energy measurements for reliable operation of the electric grid. Equipment is brought into calibration by aligning its output to a reference measurand. In Barbados, metrology services for the CleanTech sector are severely limited as there has been no significant investment for new and emerging industries either in the public or private sectors.

For metrology support, the CleanTech sector can make a request to the National Metrology Institute (NMI) for the provision of services. Historically, metrology services have been established to support Barbados' light industrial manufacturing and this has not changed with the evolution of the economy over time. Nevertheless, under the Regional Quality Infrastructure (RQI) and CROSQ networks, the NMI is able to redirect and facilitate metrology services where available regionally, and further afield if necessary. Fifty-eight percent (58%) of CleanTech businesses required calibration services, yet 91% did not engage the NMI on the matter.

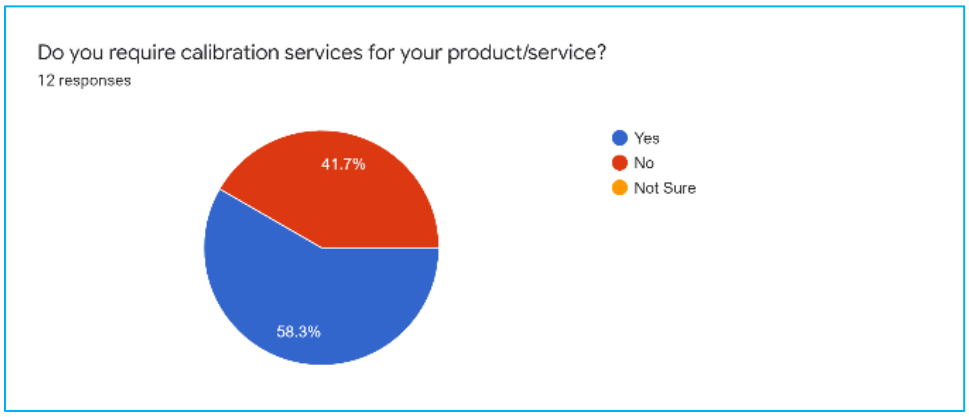


Figure 13 – Percentage Requiring Calibration Services

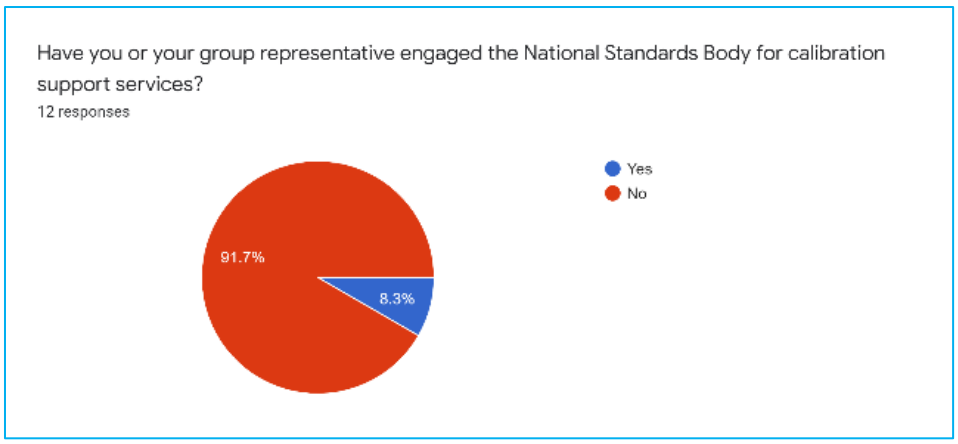


Figure 14 – Percentage Requesting Calibration Services

Most of the calibration services desired were the traditional measurands of mass, volume, temperature, force, pH and electrical conductivity. The others were more specific to the type of equipment being utilized. Almost 59% of survey respondents indicated they were aware of what calibration services they needed. Having received stakeholder responses, in alignment with the GQII, local nuance, and given the need to improve the metrology component, the following are proposed metrology benchmarks: -

- Modern metrology legislation in alignment with the International Bureau of Weights and Measurements and Organization of Legal Metrology
- National metrology authority or institute established
- Participation in international/regional metrology systems
- Metrology service capability
- Number of calibration and measurement capabilities offered
- Number of key supplementary comparisons offered

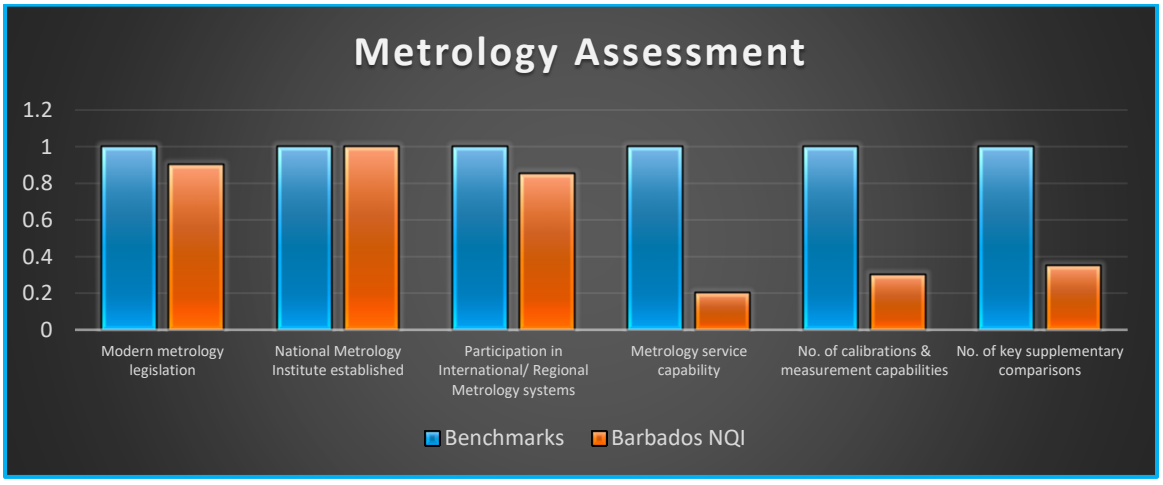


Figure 15 – Metrology Assessment

The average score of this component is 0.6 out of a maximum 1.0. Proposals to improve the metrology component are provided in a subsequent section.

4.3.7. Quality Management

Quality is a desirable characteristic expected by a mature and informed society. Best practice of quality management suggests that it is introduced at every step in the

production value chain and embedded in organizational culture. Achieving quality assurance is one step toward business viability and export potential. Quality management practices have been documented for decades and applied in every sphere of business activity with success.

The NSB offers a quality management facilitation service. Handbooks, hand-holding, other resources and technical assistance are available to support the CleanTech sector. Quality management for entrepreneurs and MSMEs has been tailored and made easy with step-by-step guidance through ISO resources which are also available from the NSB. The most populous and effective Quality Management System (QMS) globally is the ISO 9001 Quality Management Systems.

Certification of a QMS, or product certification, is one of the most effective tools for facilitating market access to foreign countries. Encouragingly, 75% of the CleanTech businesses have considered implementing a QMS, with 72% indicating the QMS is already in place or actively being implemented.

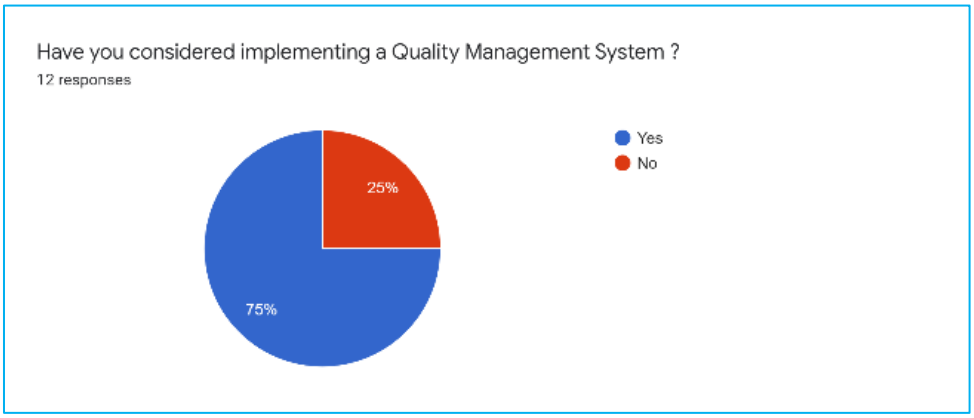


Figure 16 – Percentage Considered a QMS

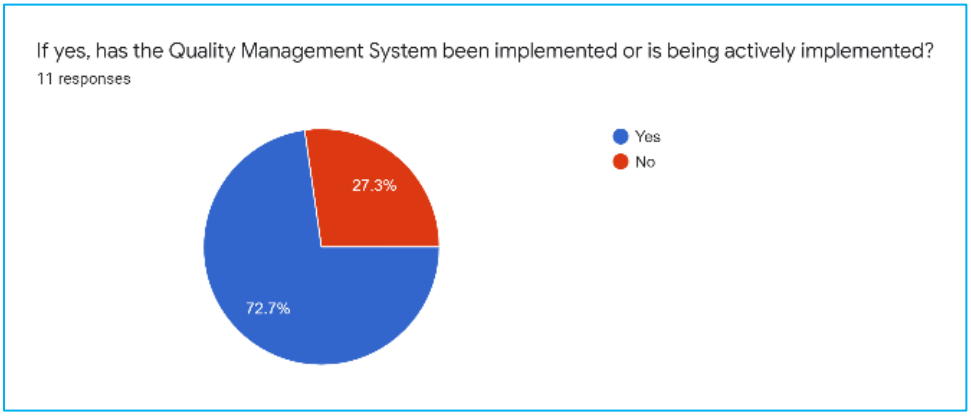


Figure 17 – Percentage Actively Implementing a QMS

The implementation of a QMS for MSMEs is supported by the NSB and individual private consultants. A list of qualified and competent private consultants should be available from the NSB.

Having received stakeholder responses, in alignment with the GQII, local nuance, and given the need to improve quality management, the following are proposed quality management benchmarks: -

- Approved national quality policy and or law on quality
- An implemented national quality policy, or one being actively implemented
- Capability to provide quality management implementation services
- Capability to provide quality management certification services.

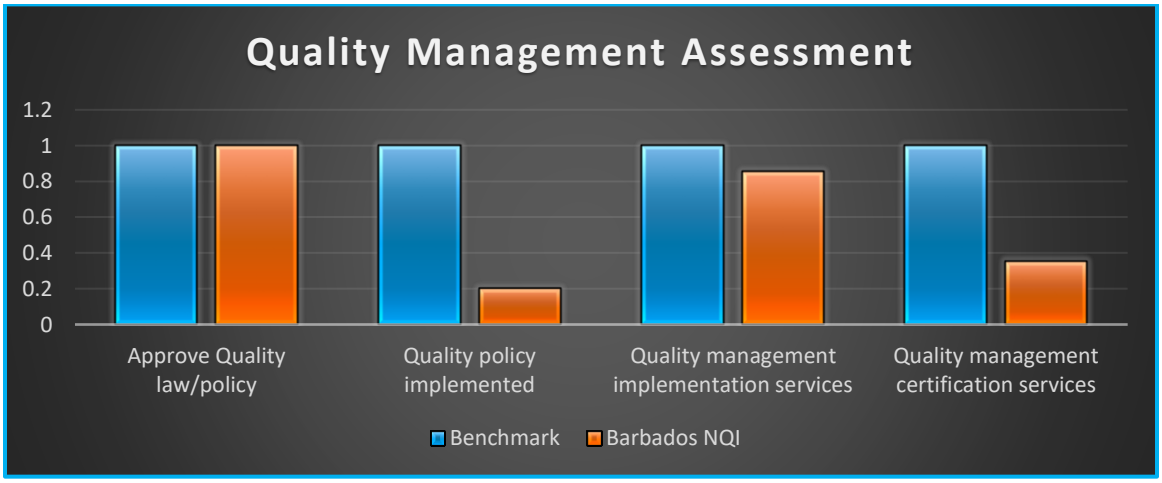


Figure 18 – Quality Management Assessment

Proposals to improve the quality management component are provided in a subsequent section.

4.3.8. Conformity Assessment

Earlier, conformity assessment was described as a suite of evidentiary processes designed to illustrate that a product meets the requirements of a standard, or that stated requirements are met. The evidence is captured in the collective activities of testing, inspection, and certification. The value that conformity assessment offers to the CleanTech sector is in its irrefutable confirmation that a product meets the requirements of an International Standard or benchmark.

CleanTech products, therefore, which are certified to International Standards in their respective fields are known to be more durable, fit for purpose, perform as intended and satisfy consumers in the market. In this globalized world, the awareness of International Standards and how local CleanTech industries can have their products tested and certified in conformance with International Standards is invaluable. Conformity assessment opens the door to foreign markets for local CleanTech products. Customers in almost every market want to purchase high quality CleanTech products that have been tested and certified. More importantly, from an industrial perspective, international investors are more secure in the knowledge that investing in an innovative quality product which has global reach and would outperform its competitors is a bankable investment. Therefore, conformity assessment affords local industries a competitive advantage at the regional and global level if their products conform to standard requirements.

At the national level, in realization of the BNEP goals and the potential for establishment of new CleanTech products and maturity of established ones such as solar thermal systems, some level of prioritization needs to be given to the local CleanTech sector by the QI institutions. Moreover, conformity assessment service providers must become aware of the key technology standards in the renewable energy and CleanTech spaces and what is the demand in Barbados for conformity assessment support. The emerging

blue economy and circular economy sectors are gargantuan sectors that need conformity assessment partnerships to overcome initial inertia.

The global interest and demand are so high for renewable clean energy, that certified CleanTech products in the renewable energy space have an inherent competitive advantage. This is seen in the continued high demand for solar PV technology, solar thermal systems such as solar water heaters, which are designed and manufactured in Barbados, wind energy as well as battery energy storage systems.

Finally, conformity assessment has been accepted by central government and public authorities as a tool in the transition to installation and utilization of clean energy in achievement of the BNEP 2019 goals by 2030. According to the Ministry of Energy, they reported that in their projects, the Energy Smart Fund and Public Sector Smart Fund Programmes for example, they procured energy and clean energy technologies conforming to applicable international standards. Only products which have been certified to ISO, IEC and other acceptable energy standards were qualified, selected and procured for government institutions. Similarly, prospective clean energy technologies such as Biogas, Ocean Energy and Hydrogen are now being given political and institutional consideration and are expected to follow the success of the other clean energy technologies using conformity assessment.

4.3.9. Status of Barbados' QI System

The composite radar diagram, Figure 19, illustrates the current status of Barbados' QI system. The values of the Barbados NQI are categorized into four (4) levels:

- 0 – 0.25: Little or nothing is in place. Development from scratch is required.
- 0.25 – 0.50: Progress/system is rudimentary needing much fundamental development.
- 0.50 – 0.75: Progress/system is acceptable but needs further development.
- 0.75 – 1.0: Progress/system is sound with little to no need for fundamental development, but maintenance is important.

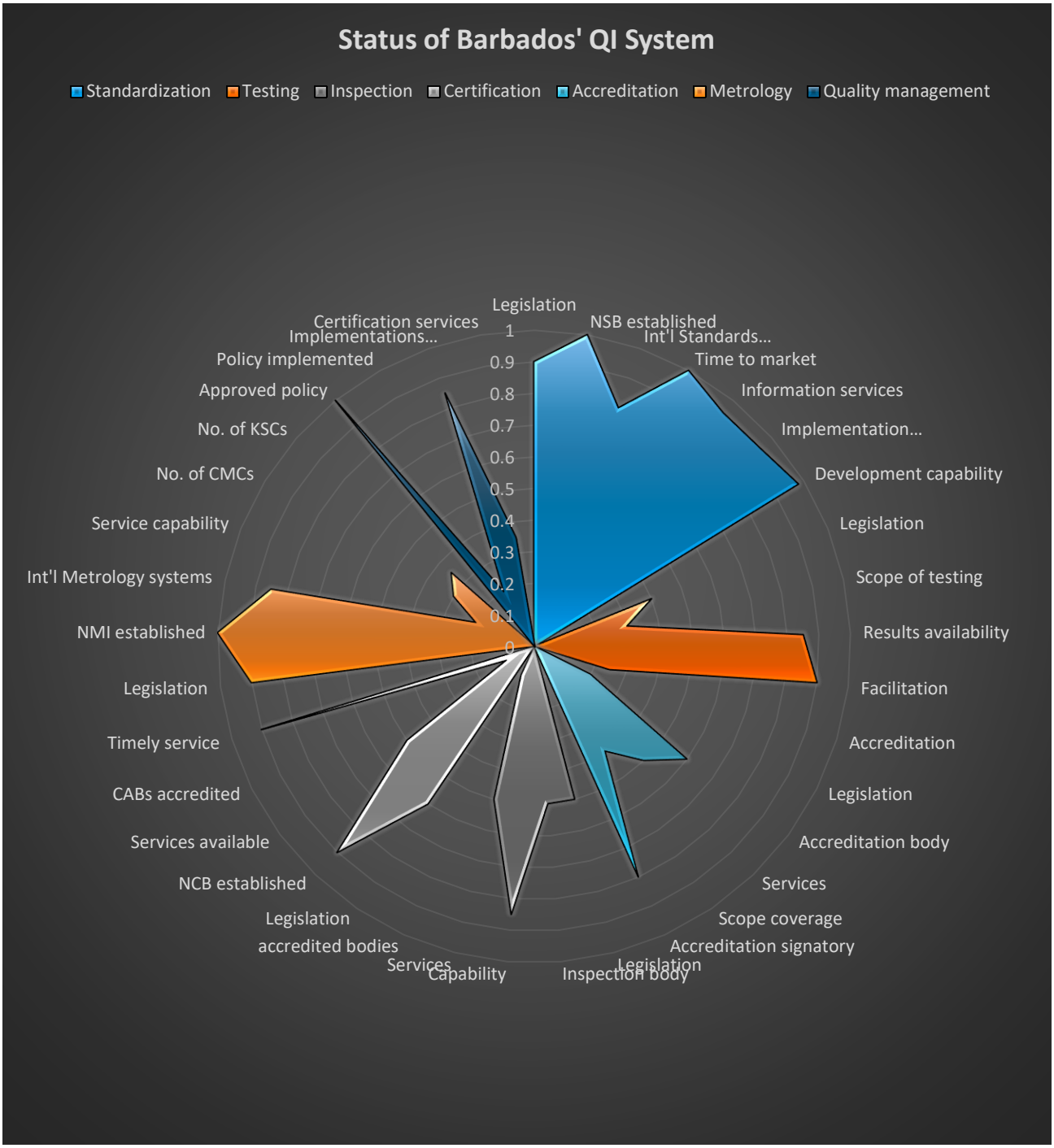


Figure 19 – Status of Barbados' QI System

4.3.10. Maturity Levels of QI Services

Work published by the World Bank Group (WBG) and Physikalisch-Technische Bundesanstalt (PTB) (Kellermann, 2019) advances for consideration the maturity level of various QI services as illustrated in Table 5 below. The information is generic and may

be applied to any country. It therefore serves as a reference point for comparison of the Barbados QI system.

With respect to maturing the QI system, Kellermann proposes that once the QI system has developed past the basic maturity level, then capacity building should focus more on demands of the country as it is counterproductive to establish higher-level QI services where there is no demonstrable demand for such services. The same applies where regional QI services are available and appropriate.

In comparison to the maturity levels of QI services advanced by the WBG and PTB the following is noted: -

- Standardization – This QI component meets all of the criteria of a Mature QI, and in some aspects has more advanced features specifically designed for the local environment. Alternatively, there are also a few weaknesses (e.g. Digitization and Information Communications Technology (ICT) infrastructure) and some maintenance (e.g. Human Resource (HR) skillset) that need to be addressed for this component to continue to perform at a high level.
- Testing − The QI component appears to fall somewhere on the lower end of the criteria of an Advanced QI. Although most are not accredited, private and public sector labs and their services are well established. There are gaps in meeting the testing needs of the productive sectors including CleanTech and new and emerging sectors.
- Inspection − The QI system component appears to meet the criteria of a Basic QI. There are public sector inspection bodies with established services, but no private sector bodies offer inspection services and conduct regulatory work.
- Certification − The QI component appears to meet the criteria of a Basic QI and a little of the Advanced QI. The NSB offers an established product certification service but no management system certification. The certification services of the NSB are not accredited. There exists a minute number of private sector entities performing certification services. These entities are not accredited either.

- Accreditation − The QI component appears to fall somewhere in the middle of the criteria of the Basic QI. There is an acceptance nationally of not having an accreditation body. However, systems have been put in place to satisfy the myriad accreditation needs of the private sector. There are gaps in accreditation services.
- Metrology − The QI component appears to fall somewhere on the higher end of the criteria of the Basic QI. New legislation has recently been passed; the NMI has formally been established. There are deficits in some metrological capabilities and services offered.

QI SERVICE TYPE	RUDIMENTARY QI (LITTLE QI IN PLACE)	BASIC QI (LOW- TO MIDDLE-INCOME COUNTRY OR LDC APPROACH)	ADVANCED QI (ECONOMYWIDE APPROACH, SECTORAL SPECIALIZATION)	MATURE QI (INNOVATIVE, CUTTING-EDGE TECHNOLOGY AND SERVICE DELIVERY)
Legal metrology	Weights and measures may be legally established, but the effect in the market is negligible.	Weights and measures for goods traded over the counter (such as mass and volume of consumer goods) with recognized services	As under basic QI but extended to prepackaged goods, water and electricity meters, selected law enforcement scopes	Measures covering the whole spectrum of trade, law enforcement, health, and safety
Scientific metrology or national measurement standards	The working standards of the legal metrology department are the de facto national measurement standards.	Small number of basic metrology laboratories (including the metrological level), with recognized services	Laboratories (including the CMCs) defined through economywide surveys and sectoral international benchmarks	High-level laboratories for innovative sectors
Standards	A government department is the de facto national standards body without any infrastructure to develop and publish national standards. It may have a rudimentary information service.	Basic infrastructure to adopt and publish international standards; rudimentary information service Correspondent member of ISO and involved in IEC Affiliate Country Programme	More-advanced infrastructure to develop and publish national standards; information service well developed Member of ISO, associate member of IEC; country a member of CAC	Mature processes to develop and publish any standard required by industry and the authorities; advanced information center Member of ISO and IEC; country a member of CAC and ITU
Accreditation	Accreditation not considered a necessity, hence no services obtained from outside the country, either	Accreditation provided by accreditation bodies from outside the country through a bilateral or regional arrangement	Accreditation body established and only recently internationally recognized; accreditation services still limited to main sectors	Accreditation body fully recognized by ILAC and IAF providing the full range of accreditation services
Inspection bodies	A few public sector inspection bodies	A few public sector inspection bodies, with recognized services	Mostly regulatory inspection but with private sector inspection services starting to take on regulatory work and work for major purchasers	Supply of inspection services fully determined by free-market principles
Testing laboratories	Maybe one or two public sector laboratories, understaffed and not accredited	A few public sector testing laboratories, with recognized services	Many public sector testing laboratories in various ministries and agencies; private sector laboratories starting to be established	Multiple private sector testing laboratories catering to the market; public sector testing laboratory importance diminished appreciably
Certification	No certification body in operation	NSB provides product and system certification, with recognized services	NSB provides product and system certification, in competition with a small number of private sector certification bodies	Supply of certification services fully determined by free-market principles, with multinational certification bodies much in evidence

Note: CAC = Codex Alimentarius Commission; CMCs = calibration and measurement capabilities; IAF = International Accreditation Forum; IEC = International Electrotechnical Commission; ILAC = International Laboratory Accreditation Cooperation; ISO = International Organization for Standardization; ITU = International Telecommunication Union; LDC = least developed country; NSB = national standards body; QI = quality infrastructure.

Table 5 – Maturity Levels of QI Services[1]

[1] Kellermann M (2019). "Ensuring Quality to Gain Access to Markets: A Reform Toolkit". WBG and PTB, p 32.

4.3.11. Summary Status of Maturity Levels of Barbados' QI Services

The composite radar diagram, Figure 20, illustrates a summary of the current status of the maturity levels of Barbados' QI services.

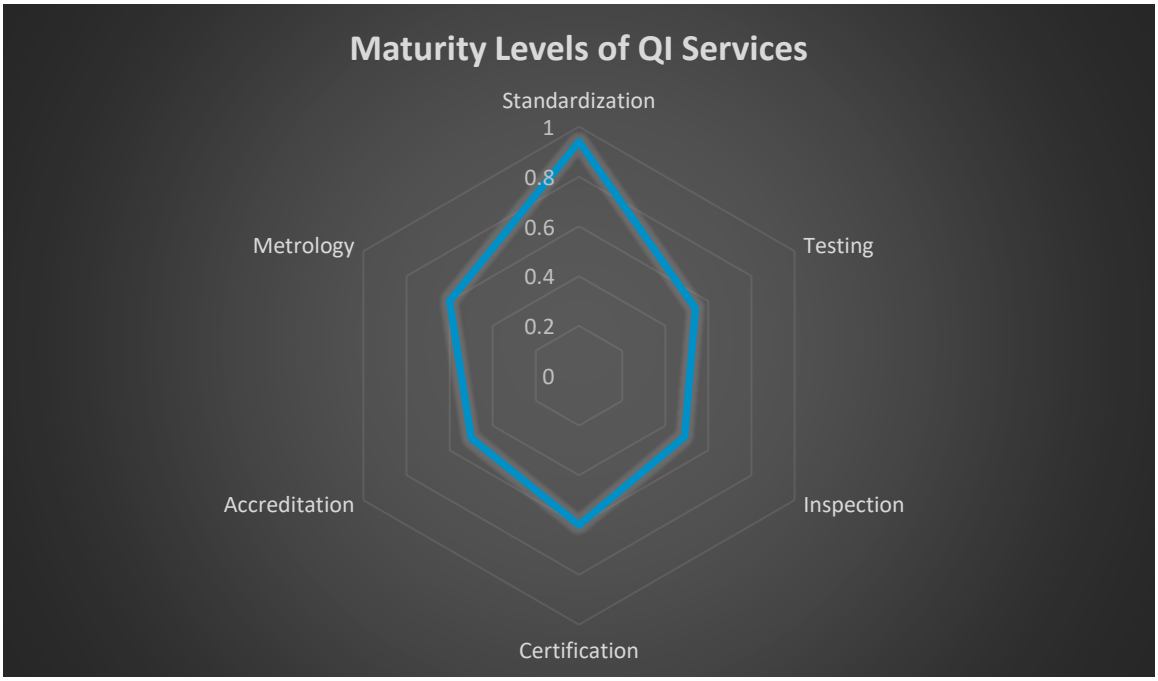


Figure 20 – Summary Status of Maturity Levels of Barbados' QI Services

4.4. Analysis

Driven by the survey results from CleanTech businesses and the need to reduce and eliminate barriers to access QI services, an analysis of the data suggests the following.

QI component	Barrier	Principle solution	CleanTech needs met	Delivered by
Standardization	Lack of education and understanding	Targeted education campaign to new and emerging sectors	Standards information services	NSB and BLOOM
	Responsiveness of the NQI	Business Process Reengineering (BPR)	Quality facilitation	NSB QI institutions
	Training and capacity building	Establishment of a calendar of training events	Standards implementation Gap analysis	NSB and BLOOM
Testing	Availability of required tests Costs	Build further capabilities	Product design, development and formulation	QI institutions

QI component	Barrier	Principle solution	CleanTech needs met	Delivered by
		Facilitation of testing services	Export facilitation	
Certification	Identification of standard to certify to Uncertainty of benefits	Develop business case, cost benefit analysis and display through digital channels	Guarantee of quality business operation/ quality product delivered Export facilitation	Certification body
Inspection	Uncertainty of service composition	Information and awareness	Cost effective QI service meeting the needs of the customer Export facilitation	Inspection bodies
Metrology – calibration services	Lack of education and understanding	Legal compliance workshops	Accuracy in measurements for commercial business/exports Legal compliance	NMI Legal Metrology Dept.
Accreditation	Identification of accreditation service and/or body	AFP service	Satisfaction of quality inputs/vendors being used	AFP Service
Quality management	Perceived complexity	Technical assistance Hand-holding	Demonstration of superior product quality	Private consultants NSB BLOOM

Table 6 – Barriers to Access QI Services

4.4.1. Gap analysis

Considering what currently exists in the NQI of Barbados, gaps have been illustrated which need to be addressed to make the QI relevant in support of CleanTech businesses and new and emerging sectors.

	Benchmark	Barbados NQI	Gap Analysis
Standardization			
Legislation	Enabling legislation, giving power to the NQI institutions	Standard Act CAP 326A	The Standards Act CAP 326A governing standardization was published in 2006. It appears to be well drafted and is in alignment with WTO principles. However, the opportunity exists to update the legislation to enable and empower the NQI concept, its actors and institutions
Time to market/publication	26 months to 36 months	Typically 19.5 months	It appears this aspect is well developed and mature and within the NSB. It could be more engaging to serve the needs of new and emerging sectors
Standards information services	A repository of standards providing information on National, Regional and International Standards	BNSI Information Services	The NSB website and social media platforms are current and provide some information. This service is available within the NSB, but needs to be more targeted toward the CleanTech sector
Standards implementation services	A cadre of well-trained resource personnel, mainly in the private sector	The Standards Act CAP 326, subsection 3. (e) requires the BNSI to facilitate the implementation of standards in Barbados. The NSB delivers this service upon request	While this service is available, it is not well known by stakeholders and hence underutilized. Consideration should be given to building capacity nationally, to avoid the NSB becoming overwhelmed due to high demand in the future. Standardization legislation should mandate (1) a minimum level of qualification for professionals delivering this service and (2) oversight by prime QI institution regarding this QI service
Standards development capability	Highly trained experts coordinating standardization	Trained experts within the NSB exists	Consideration should be given to sustainability of this skillset
Testing			
Legislation	Legislation enabling investment in testing infrastructure that conforms to QI best practices and observes WTO trade rules	No specific legislation regarding testing. The Standards Act CAP 326A requires the NSB to maintain testing labs for the purposes of testing and examining products, processes and services, research and development and to test precision instruments, gauges	There are significant gaps to support testing for CleanTech and new and emerging sectors. Updated and specific legislation is required

	Benchmark	Barbados NQI	Gap Analysis
		and scientific apparatus for accuracy and calibration	
Scope of testing	Matched to productive sectors of the economy	<u>Testing services are available for the following:</u> <u>CleanTech</u> Energy efficiency Energy consumption Life cycle testing for batteries Blue economy	There is a misalignment of required testing services to productive sectors due to inherent small market size and capital infrastructure costs. MSMEs are disadvantaged due to the absence of testing services to support their research and development. Cost competitive testing is needed to further grow the cleantech sector in fields that have higher market penetration rates. Ultimately, this helps in achieving the objectives of the BNEP 2019-2030 and further strengthens the testing component of the NQI. The private sector has no interest to support new and emerging sectors unless there is commercial value There is significant room for other stakeholders to provide testing services to CleanTech and new and emerging sectors, and hence grow the scope of testing This QI component can be considered Poor to Fair
		Agriculture Water Chemical analysis Public health Medical Fertility Alcohol industry Food and beverage Animal husbandry Mining Manufacturing Construction Tourism	
Test results	Provided to client efficiently subsequent to test protocol	Conforming except for sporadic instances of administrative issues	Test results are typically provided with efficiency
Facilitation of testing	Facilitation and guidance	The NSB does provide facilitation and guidance, where applicable	This service would be better served if formalized under the NQI system
Test results accredited	Conformance to international standards, ISO 17025	Some test labs have accreditation, mostly in the medical field	There is an absence of accredited test labs for CleanTech and new and emerging sectors. Some labs are making progress toward accreditation. Due to small size of the economy and lack of demand, establishment of an accreditation authority remains infeasible and uneconomical

	Benchmark	Barbados NQI	Gap Analysis
Inspection			
Legislation	Legislation enabling investment in inspection infrastructure that conforms to QI best practices and observes WTO trade rules	No specific legislation regarding inspection. The Standards Act CAP 326A requires the NSB to maintain a lab for the purposes of examining commodities, materials, products, processes, practices and services	There exists significant gaps to support inspection services for CleanTech and new and emerging sectors. Updated and specific legislation is required
Inspection body established	Some countries have a national authority overseeing the inspection system and private bodies providing services	The NSB has been given power to provide inspection services through the Standards Act CAP 326A	There is significant room for other stakeholders to provide inspection services to CleanTech and new and emerging sectors. Oversight of the inspection system by a national inspection authority requires legislative amendments
Inspection capability	Highly trained human resources providing services demanded	Trained experts within the NSB exists	Consideration should be given to sustainability of this skillset
Inspection services	Efficient delivery of inspection service subject to inspection protocol	Along with certification competence, the NSB can similarly deliver inspection services	There is a risk demanded services may outstrip the NSB capacity to supply. A plan of action needs to be developed to encourage/facilitate entry of new players into the inspection space. Some inspection services expected to be required by CleanTech are not provided locally This QI component is somewhat developed to serve the needs of the CleanTech sector
Certification			
Legislation	Legislation enabling investment in certification infrastructure that conforms to QI best practices and observes WTO trade rules	No specific legislation regarding certification exists. The Standards Act CAP 326A gives power to the NSB to certify commodities, products, processes,	There are significant gaps to support certification activities for CleanTech and new and emerging sectors. Updated and specific legislation is required

	Benchmark	Barbados NQI	Gap Analysis
		services and quality systems and issue certification marks. To use the BNSI certification mark, a license is required	
Certification body established	Some countries have a national authority overseeing the certification system and private bodies providing services	The NSB has been given power to certify through the Standards Act CAP 326A	There is significant room for other stakeholders to provide certification services to CleanTech and new and emerging sectors
Certification schemes/services available	Services requested are available to meet stakeholder needs Delivery of new certification schemes	Services requested thus far have been met with the provision of certification schemes and services The NSB has a history of designing and executing certification schemes. Of recent note is a Safe Business Verification scheme for businesses, indicating measures have been put in place to prevent the risk of infection and transmission of COVID-19	There is a risk for services demanded to outstrip NSB capacity. A plan of action needs to be developed to encourage/facilitate entry of new players in the market place Some certification services expected to be required by CleanTech are not available locally This QI component is somewhat developed to serve the needs of the CleanTech sector. For example, a scheme of testing, inspection and certification was drafted in collaboration with the United Nations Development Programme, Barbados and the Eastern Caribbean, Multi-Country Office, Accelerator Lab for the blue economy sector as given in Box 7. Additionally, certification schemes have also been developed for the energy efficiency labelling of appliances, organic produce, and safe business operation in the COVID19 pandemic. The ability to quickly develop a certification scheme remains a key strength of the Barbados NQI
Certification processes are accredited	Bodies providing certification services are required to conform to International Standards to be accepted globally. Accreditation provides that global acceptance	Currently none of the certification bodies are accredited	There are no known accredited or certification bodies in Barbados to provide the CleanTech sector with the instruments they need to facilitate exports of their products

	Benchmark	Barbados NQI	Gap Analysis
Accreditation			
Legislation	Legislation enabling investment in accreditation infrastructure that conforms to QI best practices and observes WTO trade rules	Only addressed in local legislation with respect to education and training institutions	There are significant gaps to support accreditation services for CleanTech and new and emerging sectors. Updated and specific legislation is required to facilitate interest and investment. The NQI system to deliberate and determine the level of maturity of the accreditation component, Barbados can maintain
Accreditation body/service	A designated authority responsible for overseeing accreditation services and oversight of the national accreditation system	By design or accreditation body established due to economic infeasibility. An AFP service exists to offer services. A regional mechanism, the Caribbean Cooperation for Accreditation (CCA) scheme, exists to facilitate accreditation services through the CROSQ	Some accreditation services are provided through the AFP service and the CCA scheme Formal and legal establishment of the accreditation body/AFP service is required
Accreditation services	Accreditation service delivery	The AFP service provides some service solutions	This QI component is underdeveloped to support the CleanTech sector and meet their needs. It is not economically feasible to establish an accreditation agency in every country and hence an AFP service fills this absence
Accreditation scope coverage	Accreditation services Conformity Assessment Bodies Management System Product certification Medical NOTE: Most countries do not have full scope of coverage	Limited scope coverage through CCA scheme for Testing labs Certification bodies Inspection bodies	The scope of coverage required by CleanTech is partially satisfied. The concept of cross-border accreditation services have taken root and this exists as one mechanism to offer accreditation services to the CleanTech sector

	Benchmark	Barbados NQI	Gap Analysis
Accreditation signatory	Subscription to regional and or international mechanisms	The CCA scheme participants subscribe to the Inter American Accreditation and the ILAC	The CCA scheme is a regional mechanism, is a signatory to ILAC, is effectively governed and managed and can support CleanTech businesses toward accreditation
Metrology			
Legislation	Modern metrology legislation in alignment with the International Bureau of Weights and Measurements and Organization of Legal Metrology	Barbados' new Metrology Bill 2022 to replace the old Weights and Measures Act CAP 331 has been approved by the Cabinet of Barbados and is currently on the House of Parliament's Order Paper to be debated and approved	Satisfies the framework for metrological services to be provided to CleanTech and new and emerging sectors
National metrology institute established	A designated national authority or metrology institute that oversees the metrology system and its activities	The NMI has been designated in the new Metrology Bill 2022	The new piece of legislation satisfies the provision for establishment of an authority to oversee the metrology system
Participation in regional and or international metrology systems	Regional and international metrology systems provide technical support and guidance on building out a national metrology system	Barbados participates in the regional Caribean Metrology Cooperation (CARIMET) Technical Committee and also the InterAmerican Metrology System (SIM). Through the CROSQ, Barbados benefits from access to membership in the international International Bureau of Weights and Measurements (BIPM).	Technical participation in metrology systems appear to be somewhat active and beneficial

	Benchmark	Barbados NQI	Gap Analysis
		Barbados is also a member of the Organization of Legal Metrology (OIML)	
Metrology service capability	Basic measurands for industrial productivity include the measurands of mass, volume, force, temperature, electric current	The NMI only has two measurands that are traceable to international standards, mass and force	This QI component is underdeveloped and does not meet the needs of a wide section of the economy Challenges with the availability of technical expertise in country to perform metrological functions
Calibration and measurement capability (CMC)	Conducted by laboratories to express their expertise in being able to measure	Currently, no laboratories have indicated their publication of a CMC	The CMC is not a static value and is determined upon testing. It illustrates the level of competence and credibility of calibration labs
Key supplementary comparison (KSC)	A comparison usually carried out to meet specific needs such as measurements of specific artefacts to support confidence in calibration and measurement certificates	Some comparisons conducted to assess infrastructure status	Barbados has conducted two (2) KSCs to illustrate it infrastructural status
Quality management			
Legislation	Quality law, policy or establishing the NQI A codified document outlining the vision and actions toward national quality	Quality policy approved by the Cabinet of Barbados	Satisfies the requirement for the establishment of national quality production and a quality culture
Quality Policy implementation	Strategy, action or implementation plan	Steps toward implementation have commenced No implementation plan observed	An implementation plan is required to determine support to CleanTech and new and emerging sectors

	Benchmark	Barbados NQI	Gap Analysis
Quality management implementation services	Resources and services to assist MSMEs to implement quality management	Resources from international bodies which have been tried and tested are available to support MSMEs implement quality management Implementation support and facilitation is available from the NSB and the private sector	Established capabilities available to assist CleanTech and new and emerging sectors to implement quality management
Quality management certification services	Institutions and capability present in most countries to satisfy local demand	By design, the NSB does not provide this service. No local service provision in the private sector available	This service is not locally available to CleanTech or any sector A revisit to this design should be considered due to the inherent and ubiquitous nature of quality management

Table 7 – Gap Analysis of Barbados QI System

4.4.2. SWOT Analysis of the QI System

A SWOT analysis of the QI system was conducted which illustrates its characteristics. It provides a basis for the strategic considerations required to enhance the NQI.

Strengths	Weaknesses
• Superior standardization capabilities • Provides solutions for the business community • Participates in international QI forum • Networks with other QI institutions • QI officers well trained • Some QI components supported by regional structures	• The NQI is not well known by the society • Legislation (most components) outdated. Not aligned with global best practice • SDOs not given legal authority • ICT infrastructure lagging • Some QI services not meeting demands • Gaps in QI services offered • Weak testing and metrological capabilities • Skillset mature and aging • Costly local test services • Inability to service sectors that contribute significantly to the economy • Enforcement lacking or non-existent • Trade imbalance due to low level of market access • Large percentage of QI institutions not accredited • Lack of clarity in roles to be played by QI institutions and stakeholders
Opportunities	**Threats**
• Model legislation available to advance the QI system and empower stakeholders • Improve TR enforcement through knowledge management and capacity building • Digitization of the standards development process • Upgrade "in-factory" labs to acceptable standard • Technical assistance and technical cooperation programs available from international agencies to build-out the NQI	• Legislative and tax system does not incentivize investment and participation by private sector • Substandard and low quality products are entering the market • Competition from external QI service providers • Little awareness of QI system • Fast changing export market requirements • Costly technical equipment

Table 8 – SWOT Analysis of the QI System

4.5. The Global Quality Infrastructure Index

Notwithstanding the above, the GQII is a composite indicator that seeks to measure, on a relative basis, the level of QI development in an economy. It uses publicly available information on the QI components. It must be noted, however, that it represents a snapshot in time and may not reflect recent upgrades and improvements to the QI. The GQII can provide policymakers, QI institutions and international development cooperation bodies with an overview of the development of QI globally. The GQII allows the QI data of an economy to be analyzed and compared to other countries.

4.5.1. The GQII formula

The GQII formula referenced (Harmes-Liedtke and Oteiza Di-Matteo, 2021) incorporates the core QI components, standards, metrology, accreditation and conformity assessment. The formula uses a simple assumption that standardization, metrology and accreditation contribute equally to the QI system. Additionally, the formula has several key components and indicators intending to assess the state of QI development in country. These components and indicators were used to create the QI component benchmarks in sections 4.3. The authors' statement about the attractiveness of the formula, is that it refers solely to QI measures. The rankings of the Global Quality Infrastructure Index Report 2020 are shown in the table below.

Economy	GQII 2020	Rank GQII 2020	Rank GQII Metrology	Rank GQII Standardization	Rank GQII Accreditation
Germany	99.5	1	2	2	2
Finland	88.9	27	22	28	38
Denmark	86.2	42	35	41	42
Chile	83.6	45	47	49	40
Israel	80.6	48	55	33	65
Cuba	57.3	99	63	74	139
Dominican Republic	57.1	101	119	102	77

Economy	GQII 2020	Rank GQII 2020	Rank GQII Metrology	Rank GQII Standardization	Rank GQII Accreditation
Trinidad and Tobago	57.1	102	99	96	105
Jamaica	56.9	103	91	105	97
Guyana	46.3	132	104	150	123
Barbados	42.2	138	104	115	151
Saint Lucia	40.5	141	104	124	149

Table 9 – GQII 2020 Global Rankings and Sub-Rankings

As a SIDS, Barbados is ranked 138 out of 184 countries. Its strongest ranking is in metrology which may be due to Barbados' membership in the international body for metrology, BIPM, through the regional secretariat CROSQ. Its ranking in standardization does not reflect the current status, as several International Standards would have been adopted and published as Barbados National Standards since the GQII 2020 report was published. Barbados does not have an accreditation body by design, as it is considered uneconomical due to the nature and size of the economy. The world now accepts this as a reality in several countries, which has led to the concept of cross-border accreditation services. Within CARICOM, this has been operationalized with the CCA scheme, where accreditation bodies in Jamaica and Trinidad have been identified and designated as accreditation bodies to the community.

Barbados' placement globally for the GQII versus its exports of goods and services is shown below.

figure

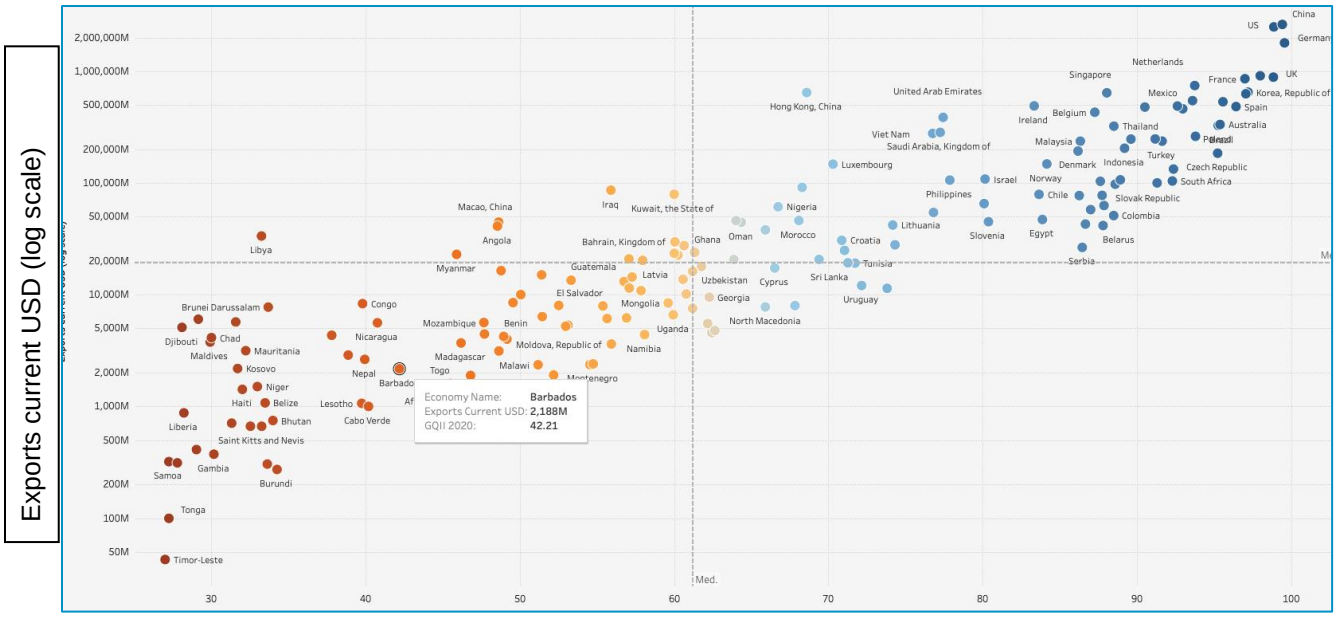


Figure 21 – GQII 2020 versus exports

4.5.2. Barbados Ranking in the GQII

In general, Barbados' position in the GQII ranking is in line with the country's size and level of development. One can see that Barbados QI is moderately developed in comparison to other countries. Also, the index value is in line with the export volume.

The Global Quality Infrastructure Index Report 2020, published in March 2021, confirms a key finding from their previous report, "*a country's QI development status correlates strongly with its economic performance (GDP per capita), export performance and competitiveness*[2]."

Limitations and caution were given by the authors to not simply interpret the data to mean countries should aim for the highest level of QI possible. At the same time, the numbers of the GQII must be interpreted in each specific context and need to be combined with

[2] Harmes-Liedtke, U. Oteiza Di Matteo J.J. 2021 ResearchGate online publications The Global Quality Infrastructure Index Report 2020, p 3.

qualitative information. The GQII does not claim to map QI worldwide precisely, but serves as the best proxy to map the development of the NQI system.

4.6. SWOT Analysis of the Barbados NSB

A SWOT analysis of the Barbados NSB was conducted and provides an information window on its characteristics and strategic considerations for its reform.

Strengths	Weakness
• Sound relationship with central government • Relative autonomy of the NSB • Strong capacity within SDOs to develop standards for their industry/sector • Good relationship with industry • Good track record of providing QI solutions to stakeholders • Vision and mission of BNSI are important to nation-building and achieving the UN SDGs • Ability to conduct training and assessments • Capable and competent staff • Membership and association in international and regional bodies provide information and technical cooperation which benefit local productive sectors • The NSB is a facilitator of business and business development and plays no role in regulation and enforcement responsibilities • Good track record at developing and implementing standards at regional and international levels	• Education on the role of QI in society is low. A significant number of stakeholders are not aware of what the NSB does • the NSB mandate is not clear to the public • Weak legislative framework to support new sectors of the economy • Governance structure is slow to respond to the needs of an emerging economy • Inadequate resources: staffing, physical facilities; equipment, budget and financial • Large gaps in its infrastructure • limited testing and metrology infrastructure • No Quality Policy implementation plan
Opportunities	**Threats**
• Low focus on the implementation of standards service • Participation in regional, hemispheric and international QI institutions offers the opportunity to advance QI components that support Barbados' industries to trade (e.g. standards and the Circular Economy) • Quality infrastructure support increases Barbados' opportunity to access markets for its goods and services based on International Standards in trade agreements • Political will and government policy opens up new areas of QI support for emerging sectors e.g. the Green Economy	• Lack of responsive legislative updates to keep goods and services competitive • Underdeveloped components of the NQI • Misalignment of human resources • Poor business continuity management and succession planning • No dedicated sales, communication, PR and marketing functions • Regional and international competition • Government budgetary cuts • Global economic trend (present crisis) – reduced economic activity affects QI services offered • Inadequate resources (Financial and Human) • Increased pressure to meet the demands of clients

• Provision of information services to stakeholders (developed Information Services Centre) • Establishing Memoranda of Understanding with global QI and other relevant organizations • Provision of services in testing, calibration, research and consultancy to domestic producers and exporters • Provision of services for certification of products and systems for export and alternative energy markets • Provision of information on markets and consumer preferences in export markets • Build awareness and educate the public on Standards, Quality and the NQI • Development and implementation of standards for the new and emerging sectors • Income generation from training in standards and trade-related areas • Digitization of some components of the QI system	• Low level of awareness of QI services • Limited market to offer QI services

Table 10 – SWOT Analysis of the Barbados NSB

4.7. A Forward Looking Preview of the QI and NSB

With the current status of the QI assessed, Barbados must now look toward the future and determine where it wants its QI to be positioned in the short to medium term. The BNSI has put forward an excerpt of its National Quality Policy as to where it envisioned the NQI of Barbados to be within the next five (5) years (see Annex C).

5. Proposed CleanTech Quality Infrastructure

5.1. Fundamental Supporting Elements of CleanTech QI

5.1.1. Quality Awareness and Promotion

Although the QI system may impressively transform a national economy, without the awareness, promotion and education about quality, standards and the quality infrastructure system, the speed of transformation is not likely to be rapid. The two pivotal stakeholder groups critical in facilitating the transformation through buy-in are the citizenry and the political directorate.

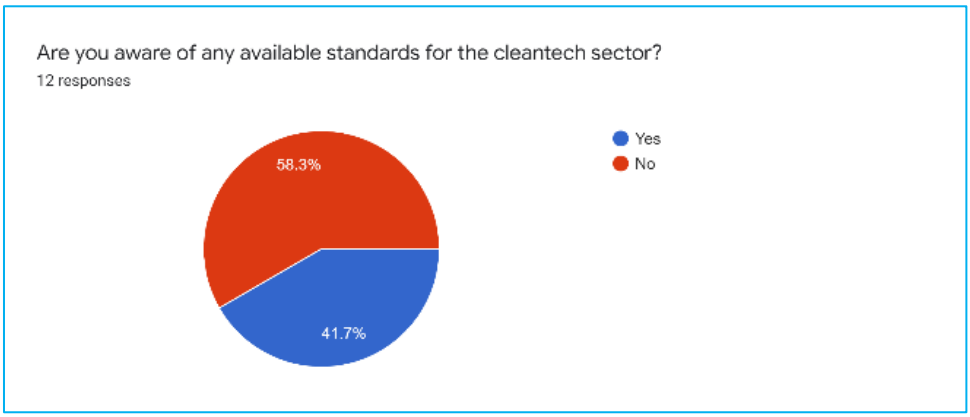


Figure 22 – Awareness of Standards

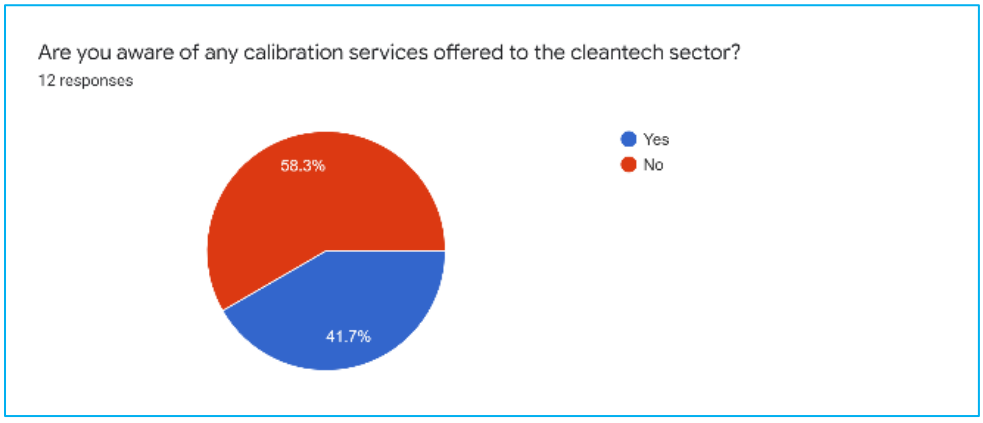


Figure 23 – Awareness of Calibration Services

Whilst the CleanTech businesses were somewhat familiar with current CleanTech programs and the government policies that needed to be put in place, they were quite unfamiliar with CleanTech QI service support. This presents an opportunity for both the NSB and BLOOM to design and implement a targeted campaign to the CleanTech sector.

5.1.2. Education, HR Training & Development

An educated and competent populace is critical to an operable quality infrastructure system. Therefore, human resource training and development is one of the priority fundamental supporting elements to a quality infrastructure.

National strategies that are dedicated and focused on supporting productive sectors with a trained workforce that includes awareness and promotion of the benefits of a quality infrastructure system would be ideal.

The NSB confirms in the fiscal year 2021/22 that the Barbados government allocated approximately 20% of its expenditure to the Ministry responsible for education. More recently, in the Barbados Parliament, the Appropriations Bill for fiscal year 2022/23 indicates the Barbados government has allocated 19.05% of its expenditure to the Ministry responsible for education. And while this is an impressive number compared to other NSBs in Central America, with approximately 8% expenditure, divergence was observed between the NSB, indicating it has trained human resources in-country and some deficiencies in the delivery of QI support services. This in no way marries with the low level of education on QI amongst the general public.

5.1.3. Market Surveillance, Verification, and Enforcement

Market surveillance, verification and enforcement (MVE) activities are one of the mechanisms regulators use to ensure the protection of consumers and equitable, fair trade while achieving societal goals. MVE programming may take several forms dependent on the approach of the regulators. Some may opt for pre-market approval processes, which reduce the demand for local market surveillance. Others may approach

their regulatory functions from the other spectrum based on the maturity of the QI system and support services available. Whichever approach is taken, it all requires close inter collaboration of the QI institutions.

MVE activities also protect start-ups and entrepreneurs from low-cost substandard products seeking to flood the market. The CleanTech businesses surveyed, indicate they had little confidence in the MVE authorities, with over 58% believing they were ineffective to protect the sector. A further 33% thought the regulation and enforcement authorities were non-existent in their work programming.

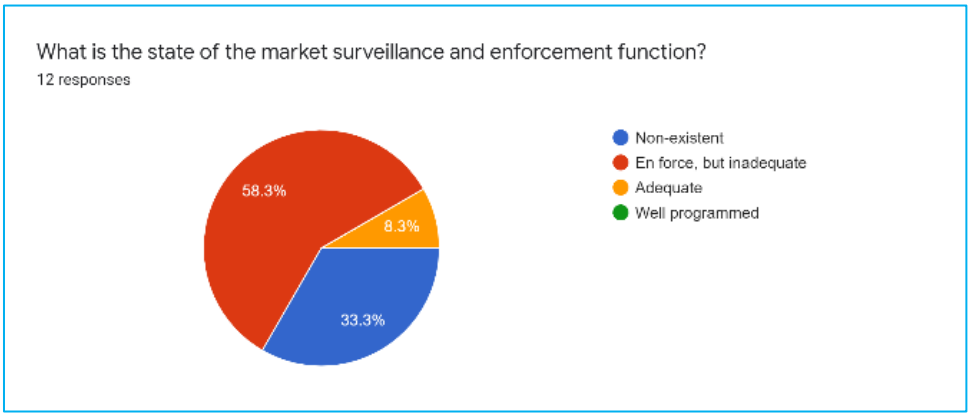


Figure 24 – State of Regulation and Enforcement

5.1.4. Technical Regulations

Regulatory action, where warranted, can be an effective tool to address deficiencies in the market. For commodities, products and services, the statutory tool employed is termed a Technical Regulation (TR). A TR is a regulation with technical components that either directly references a standard or has excerpts of the requirements of a standard. A TR is not to be confused with Standards, as compliance with a TR is obligatory while Standards inherently have voluntary requirements.

TRs also serve as legitimate objectives. As previously mentioned, they include public health, safety of persons, prevention of deceptive practices, protection of the environment and national security, where energy security in some countries is considered a national security matter. The issuance of TRs has shown in the past to cause sectors of the

economy to improve the quality of their goods and services. There is an absence of TRs for most consumer products and services, including CleanTech products. The regulator of consumer products has failed in the eyes of the business sector, with over 91% having no confidence in their work.

5.1.5. Trade Facilitation and Market Access

The fundamental basis underpinning trade is standardization. For trade to be mutually acceptable, the parties must agree on the definition of what is being traded. In this regard, the product is best standardized where the parties all accept the product definition. In addition to standardization, additional business support services are required to move a product from domestic production to export acceptability. These business support services are what amount to trade facilitation with the ultimate aim to afford a product the opportunity to access a foreign market.

The NSB has responsibility for standards-related trade facilitation where it functions as the national Technical Barriers to Trade (TBT) Enquiry Point (EP) under WTO arrangements. The EP services to its productive sectors include: -

- Notification of laws, standards and guides that are developed, or being developed by other WTO members, with the aim to facilitate market penetration or defend local production
- Coordination of productive sector stakeholders such as the private sector, regulators, trade and business support organisations (BSOs), policymakers and others in the harmonious development of sectors of the economy.

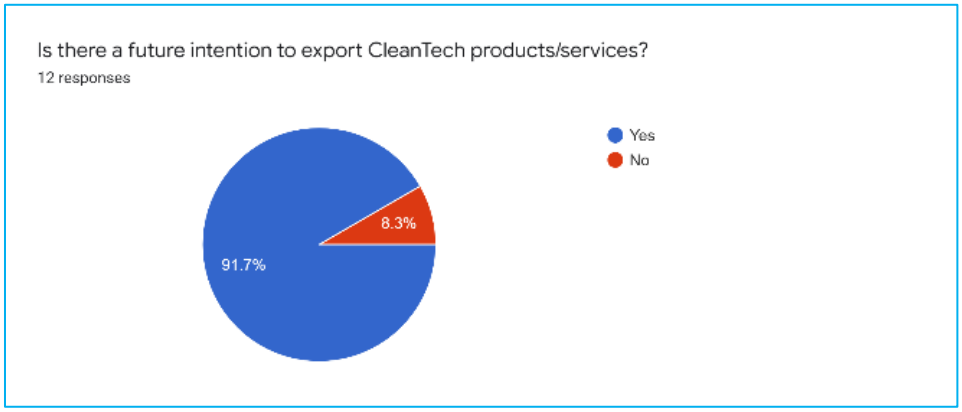


Figure 25 – Future Intention to Export

Just over 91% of CleanTech businesses have signaled their future intention to export. It is, therefore, incumbent upon the EP to provide the necessary trade-related data to allow the CleanTech sector to make informed decisions regarding export.

5.2. Supporting QI Legislative Amendments

Legislative support to new and emerging sectors of the economy is necessary. This serves to remove barriers to conducting business easily, while enabling the sector to function effectively, being cognizant of its societal obligations and fair trade. In this regard, there is an absence of targeted and specific legislation supporting the development of the QI for the CleanTech sector. The survey instrument applied to BLOOM cluster members, other stakeholders in the CleanTech sector, and policymakers indicates general legislative amendments that ought to be pursued. Some are given in the CleanTech Policy Readiness Assessment Report and are referenced in this report. Specific QI legislative amendments should include those treating to each QI component, modernizing its structures, enabling the private sector to invest and compete and defining roles, responsibilities, and the hierarchical structure of the NQI.

5.3. Supporting QI Policy Amendments

Further to legislative support, policy amendments have already been recommended in the CleanTech Policy Readiness Assessment Report. Additional policy guidance

enabling QI support to the CleanTech sector would be ideal. The CleanTech sector advanced some policy amendments related to QI, hence the following ought to be considered: -

- A policy directive mandating QI institutions provide legal and regulatory support to businesses, particularly start-ups and emerging sectors
- The National Quality Policy be mandated in key sectors of fundamental importance to life, governance and economic activity.

The CleanTech businesses surveyed were quite vocal and passionate about getting regulatory support, as they have no staff to conduct this activity, and it can be daunting in the maze of applicable legislation. Every one of the survey respondents indicated a need for this service. Encouragingly, two-thirds of the survey respondents indicated they were aware of the range of policies supporting CleanTech.

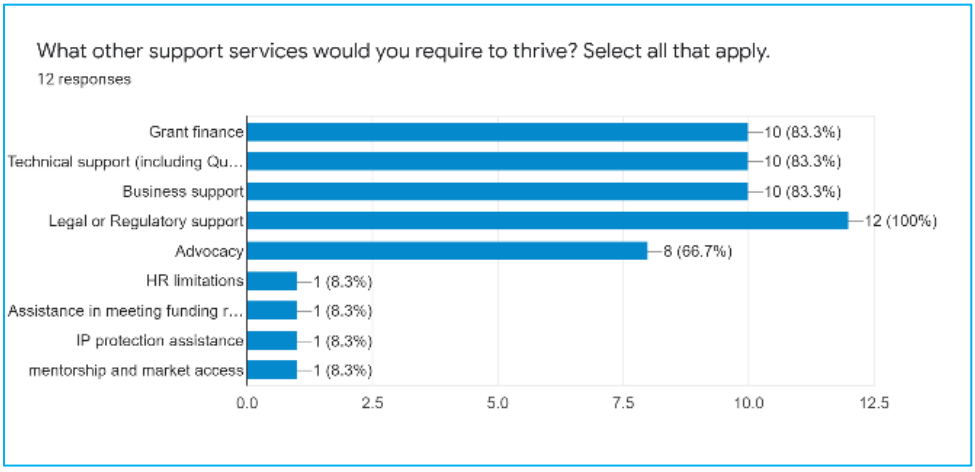


Figure 26 – Support Services Required

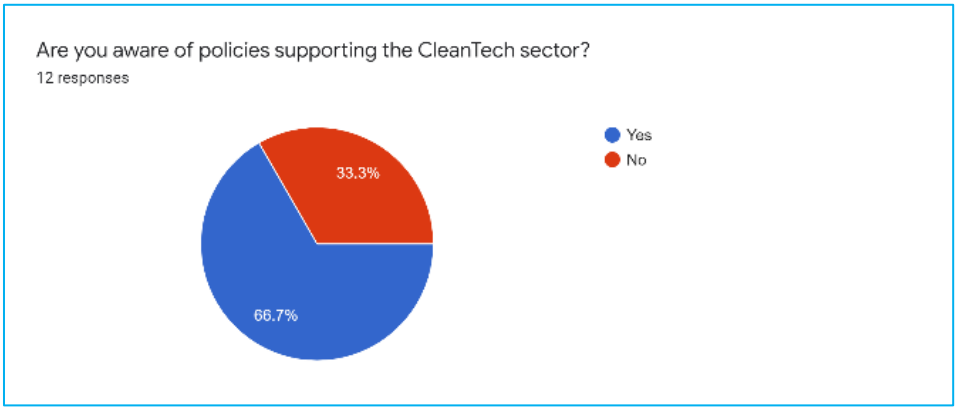


Figure 27 – Awareness of CleanTech Policies

5.4. Implementing Amendments

5.4.1. Quality Infrastructure Assessment Framework

The QI assessment framework is a complex concept. It takes aspects of many parts of the QI system, and seeks to make sense from sometimes disparate and unconnected pieces of information, which can then be organized within a framework to begin to make comparisons and determinations. For this QI assessment framework, consideration was given to all available information about QI supporting CleanTech, the supporting structure around which the QI can be built, and making an informed judgment. This led to the following: -

- Reviewing of the QI structures and models
- Exploring the status of the components of the NQI
- Exploring the fundamental supporting elements of the NQI
- Conducting broad consultation with stakeholders
- Securing existing QI data
- Reference to the Global Quality Infrastructure Index
- Conducting legislative and policy review
- Establishing indicators to capture when progress is being made in the QI
- Presenting the ideas, beliefs and rules of the Barbados QI system

- Identifying actors in the QI system, local, regional and international. Their roles and responsibilities
- Illustrating the NQI ecosystem map
- Identifying processes for QI products and services, and to remove barriers to accessing them
- Assessing quality management implementation in the CleanTech sector
- Proposing the removal of barriers to access QI services
- Benchmarking and assessing Barbados' QI components
- Illustrating maturity levels of a QI system
- A SWOT analysis of the QI system
- A SWOT analysis of the NSB
- Reviewing the market surveillance and enforcement function
- Exploring the technical regulation dimension
- Exploring market access and trade facilitation support
- Identifying supporting legislative amendments
- Identifying supporting policy amendments
- Identifying ten (10) priority standards
- Reviewing the Draft National Quality Policy of Barbados
- Identifying other standards of relevance for the cleantech sectors.

5.4.2. CleanTech Quality Infrastructure Recommendations

The CleanTech quality infrastructure assessment provides a look at the status of the QI system, supporting elements and cross-cutting issues. It puts forward an analysis leading to a judgement in relation to advancing recommendations.

Recommendations for improving standardization
1) Update the Standards Act The main purpose of updating the legislation governing standardization is to enable broader participation and representation in standardization. The updated legislation should seek to facilitate the entry of SDOs, formally, into the NQI. Clear assigning of roles and responsibilities, hierarchy and

authorities. The prime QI institution overseeing Standardization and the NQI institutions would be listed. Sector associations confirming to be part of the NQI to be registered and given support from the prime QI institution.

2) Standards implementation services

The main purpose of updating this service is to make it more accessible and widely available. While this service has the potential to be in such high demand that it outstrips capacity of the NSB to deliver, one solution lies in training and building capacity in other BSOs, private consultants, management consultants and other capable resources, who would then be able to deliver the service to CleanTech and other stakeholders.

3) Standards development capability

The main purpose of this intervention is to ensure sustainability of the standards development skillset. This skillset is typically learnt on the job. Skilled resources lie within the NSB and a few SDOs, but are demographically of a high age bracket. To maintain national capability, a strategic or sustainability plan is required to ensure younger professionals have the opportunity to be trained and utilized within the national QI system. This capability should also be targeted toward the BLOOM CleanTech executive/management.

4) Standards development participation

The main purpose of this intervention is to capture the technical knowledge of CleanTech stakeholders to effectively draft or participate in International Standards development for the same. This recommendation seeks to have the BLOOM CleanTech cluster actively participate in developing standards for its sector.

5) Financial sustainability

The main purpose of this intervention is to contribute to the financial sustainability of standardization. This recommendation seeks to have the BLOOM CleanTech cluster contribute funding to the standardization process in part, as the outputs are meant directly for its members to benefit. Additionally, partially funding the process affords the NSB space to offer a wider range of standardization services to CleanTech stakeholders.

6) Standards utilization

The main purpose of this intervention is to accrue the benefits of implementing a standard. This recommendation seeks to guide BLOOM CleanTech cluster to utilize the standards developed, and hence accrue the benefits from global best practice.

Recommendations for improving testing

1) Update legislation

The main purpose of this intervention is to eliminate significant gaps in enabling legislation, and support testing for CleanTech, and new and emerging sectors. There is minimal specificity in current

legislation treating to testing to satisfy a modern, relevant QI system intending to broaden participation, encourage private investment and expand the scope of testing to support CleanTech and new and emerging sectors.
2) Align supplier side testing services with testing needs The main purpose of this intervention is to facilitate the alignment between testing needs and testing services. To address this misalignment, an intervention needs to be applied and a national consensus on the identified solution(s) implemented. The national consensus can be formalized through the NQI arrangement and applicable regulation(s). Legislative instruments should be used to incentivize the private sector to collaborate and spur investments in infrastructure.
3) Formalize testing facilitation service The main purpose of this intervention is to encourage QI testing institutions to give serious consideration to the establishment of a formal country agreement, through the NQI, between testing institutions and overseas accredited testing bodies to provide testing services not available in the country. This serves to meet the needs of CleanTech and other sectors.
4) Improve the credibility of test results The main purpose of this intervention is to facilitate the acceptance of local test results globally. The accepted mechanism for this is the accreditation of test labs in conformance with International Standards. A program of systematic support is required to facilitate the transition of test labs to accreditation status.
Recommendations for improving certification
1) Update legislation The main purpose of this intervention is to establish a national certification authority, enable private sector investment in certification services and eliminate significant gaps in enabling legislation that supports certification for CleanTech, and new and emerging sectors. The new legislation should conform to current best practices regarding the quality infrastructure system, and is specific in treating to a modern, relevant QI system intending and expanding the scope of certification to support CleanTech and new and emerging sectors.
2) Availability of certification services The main purpose of this intervention is to facilitate the consistency of the provision of certification services. To address the risk that the demand for services outstrips the capacity of the NSB to deliver, an action, business or sustainability plan needs to be put in place to build capacity in other stakeholders. Additionally, this plan would partially address the issue of requested services not being locally available.
3) Improve the credibility of certification certificates

The main purpose of this intervention is to facilitate the acceptance of local certification certificates. The accepted mechanism for this is the accreditation of conformity assessment bodies in conformance with International Standards. A program of systematic support is required to facilitate the transition of certification bodies to become accredited.

4) Availability of management system certification

The main purpose of this intervention is to encourage a revisit by the NSB and private sector to the provision of certification services for management system standards (such as ISO 9001). Currently, there are no entities who provide this service. While legislation would treat to a more enabling environment for the private sector to consider the provision of this QI service, further incentives in the legislation ought to be applied due to the multiplier effect that management system certification can afford CleanTech products and services.

Recommendations for improving inspection

1) Update legislation

The main purpose of this intervention is to establish a national inspection authority, enable private sector investment in inspection services and eliminate significant gaps in enabling legislation that supports inspection services for CleanTech, and new and emerging sectors. The new legislation should conform to current best practices regarding the QI system, is specific in treating to a modern, relevant QI system intending to broaden participation, encourage private investment and expand the scope of inspection services to support CleanTech and new and emerging sectors.

2) Inspection capability

The main purpose of this intervention is to facilitate the sustainability of the provision of inspection services. There is a limited, trained cadre of competent personnel to deliver inspection services. To address this deficiency, training and capacity building are needed to expand the pool of inspectors, and minimize the risk that the demand for services outstrips the capacity to supply. An action, business or sustainability plan is required to be put in place to build capacity.

3) Efficient provision of inspection services

This intervention is intended to address the business aspects of proving the QI service in a timely manner. This recommendation treats to the responsiveness of the QI system enabling the efficient provision of inspection services. In business, time is money, and therefore, inspection services, once clearly communicated to the inspection body are not so terribly complex that they cannot be designed and rolled out within less than three (3) business days

Recommendations for improving accreditation

1) Update legislation

The main purpose of this intervention is to establish a national accreditation authority, enable private sector investment in accreditation that supports accreditation services for CleanTech and new and

emerging sectors. The new legislation should conform to current best practices regarding the quality infrastructure system, is specific in treating to a modern, relevant QI system intending to broaden participation, encourage private investment and expand the scope of accreditation services to support CleanTech, and new and emerging sectors.

Recommendations for improving metrology

1) Improve metrology services capabilities

The main purpose of this intervention is to expand metrology services which are demanded by CleanTech, and new and emerging sectors. A resolution to this requires significant investment in equipment, practices, processes and human resources to effectively deliver more metrology services.

2) Increase range of calibrations and measurement capabilities

The main purpose of this intervention is to expand upon the range of calibrations and measurement capabilities offered. To increase the range of uncertainty measurements offered, the NMI requires internationally traceable artefacts, training and capacity building, practice, building experience and uncertainty measurement qualification before the service can be delivered. In Barbados, there is a severe shortage of this expertise. The increased range of uncertainty measurements may allow the CleanTech sector to export/trade.

Recommendations for improving quality management

1) Establish law on quality

The main purpose of this intervention is to establish quality in law that enables a culture of quality in productive processes. This enabling legislation eliminates the significant absence in the delivery of quality by all sectors of the economy. The new legislation enables the quality policy and should conform to current best practices regarding the management of quality, is specific in treating to QMS, intending to broaden participation, encourage private investment and expand the scope of quality management services offered to support CleanTech and new and emerging sectors.

2) Publication of Quality Policy Implementation Plan

The main purpose of this intervention is to lay out the sequence of activities and actions required to implement the Quality Policy. Development and publication of the Quality Policy Implementation Plan direct a common national effort toward achieving the quality policy goals and objectives and clearly indicates the level of support to be offered to CleanTech, and new and emerging sectors of the economy.

3) Implement quality management in QI institutions

The main purpose of this intervention is to improve the responsiveness and service delivery by QI institutions. Business Process Reengineering should be included in the quality management implementation to improve responsiveness of the QI institutions.

4)	**Formalize the registration of quality management professionals** The purpose of this intervention is to establish a database of qualified quality management professionals. This recommendation seeks to formalize, within the NSB, a database of professionals who are able to deliver quality management services to the CleanTech sector. The database would be publicly available.

Table 11 – Recommendations to Improve the QI System

Recommendations addressing QI promotions and awareness	
1)	**Develop and implement a communications strategy: A targeted education and awareness campaign** The main purpose of this intervention is to increase the level of education and awareness about the - NQI, its components elements, QI institutions and their services - certification, the benefits of certification - accreditation, accreditation services, how to search accreditation body databases to determine those entities that are accredited - metrology, legal metrology, obligations of the seller, calibrations and traceability - quality management, how can quality management help me get my products into foreign markets, is quality management difficult for small businesses to implement - standards information and application This intervention would address the very high percentage of CleanTech sector who don't know they are uneducated and unaware of the NQI around them.
Recommendations addressing education, human resource training and development	
1)	**Reallocate education funding and training to QI skillset** The main purpose of this intervention is to redirect a percentage of education's resources to build new HR capacity, maintain existing QI skillset and plan for future HR needs. This recommendation would treat to the divergence seen between the percentage of Gross Domestic Product (GDP) spent on education and the lack of trained HR needed to operate the QI. The recommendation would need to be actioned by several entities, the Ministries responsible for Education, Labour and also the TVET Council.
2)	**Standardization and training services** The main purpose of this intervention is to put forward training and standardization services identified by the CleanTech sector. Specific matters identified for training include conducting a gap analysis and standards training. QI institutions should put forward a calendar of training events for stakeholders to access.

Recommendations addressing market surveillance, verification and enforcement
1) Training The main purpose of this intervention is to deliver content that improves the knowledge and skillset of the regulators. This recommendation is critical to effective knowledge transfer to the regulators so that they can perform their vital role in the QI system to the satisfaction of the society.
2) Establish a regulatory support service The purpose of this intervention is to establish support services within regulatory agencies for the productive sectors of the economy. CleanTech, and new and emerging sectors particularly need this support to traverse and overcome the complex maze of applicable legislative and statutory instruments to be in compliance with the law.
3) Establish a regulatory dialogue series The main purpose of this intervention is to make the regulatory bodies more accessible to CleanTech and new and emerging sectors. The dialogue series can also function as an effective tool for direct communication between regulators and the CleanTech sector to enhance regulatory programming.
Recommendations for addressing the technical regulation regime
1) Establish a Technical Regulation regime policy The main purpose of this intervention is to establish a TR regime policy that is well known and understood. This recommendation would see a government policy articulated that clearly lays out how the initiation, development, notification, publication, implementation, systematic review and enforcement of technical regulations is conducted. This articulated policy would give confidence to the CleanTech sector and Barbados' trading partners, along with the opportunity to plan for pending regulations.
2) Implement a Good Regulatory Practice (GRP) framework This main purpose of this intervention is to improve the TR framework such that it conforms to international best practice, and is transparent in its regulation development. A GRP Guide for the CARICOM was recently developed and peer-reviewed by Barbados to ensure its applicability and conformance to best practice. This regional GRP guide is one ready-made solution.
Recommendations addressing trade facilitation and market access
1) Enquiry Point services The main purpose of this intervention is to bring the CleanTech sector on board to receive the EP services. This recommendation would see the NSB reach out to the CleanTech sector and register them to the EP services such that they have access to an ICT portal on trade-related information. The EP would also push information and data out to CleanTech stakeholders on trade opportunities and matters for their consideration.

Table 12 – Recommendation to Address Fundamental Supporting Elements

5.4.3. Stakeholder Roles

To successfully implement the required legislative and policy amendments relevant to QI, there needs to be a Responsibility Assignment Matrix identifying the main policymaker, their responsibility, a champion, and other supporting actors. It may be ambitious to propose a timeframe for completion as the solution remains in the sphere of the political directorate.

Legislative and/or policy amendment	Main policy maker	Champion	Supporting actors
Training and support services provided to MSMEs in new and emerging sectors that are important to the economy	Industry Ministry	Export Barbados (BIDC)	YES, SBDU, BNSI
A policy directive mandating QI institutions to provide legal and regulatory support to CleanTech businesses, particularly start-ups and emerging sectors	Commerce Ministry	SBDU	Regulators, DCCA, QI institutions
The National Quality Policy be mandated in key sectors that are of fundamental importance to life, governance and economic activity.	Commerce Ministry	BNSI	Private sector, Relevant ministries, Regulators
Establish a Technical Regulation regime policy	Commerce Ministry	DCCA	RPU, Commerce ministry, BNSI
Implement a Good Regulatory Practice framework	Commerce Ministry	BNSI	DCCA RPU Commerce Ministry
Establish law on quality, bringing the NQI into effect	Commerce Ministry	BNSI	Industry Ministry, DCCA Private sector Export Barbados (BIDC) Foreign Trade Ministry

Legislative and/or policy amendment	Main policy maker	Champion	Supporting actors
			QI institutions
Legislative updates modernizing the QI system	Commerce Ministry	BNSI	Industry Ministry DCCA Private sector Export Barbados (BIDC) Foreign Trade Ministry QI institutions
Legislative updates removing restrictions on waste that can be used as feedstock by CleanTech sector	Environment Ministry	EPD	Sector association BLOOM Industry Ministry Export Barbados (BIDC) BNSI EPD, SSA
Material Circulation and Value Extraction (extracted from CleanTech Policy Readiness Assessment Report) drives demand for standards, testing and certification	Environment Ministry	SSA	BNSI, DCCA, EPD, Sector association, Industry Ministry
Providing financial support to MSMEs to gain the relevant management system or product certification	Industry Ministry	Export Barbados (BIDC)	BNSI, SBDU, Finance Ministry
Establish RE level for Commercial Properties (extracted from CleanTech Policy Readiness Assessment Report) drives demand for clean energy and QI services	Energy ministry	EECU	BREA, Electric utility BNSI BCCI Sector association
Establish RE level for Residential Properties (extracted from CleanTech Policy Readiness Assessment	Energy ministry	EECU	BREA BSA Electric utility BNSI

Legislative and/or policy amendment	Main policy maker	Champion	Supporting actors
Report), drives demand for clean energy and QI services			BCCI Sector association
Allocate percentage of state procurement to MSMEs who are certified	Commerce ministry	SBDU	Finance Ministry Industry Ministry BNSI

Table 13 – Responsibility Assignment Matrix for Legislative and Policy Amendments

5.4.4. Critical Factors for Success

The mission of the BLOOM Barbados CleanTech Cluster is to "*develop a highly competent ecosystem for sustainable energy companies by providing our cluster members access to high quality business intelligence, matchmaking and business incubation services*." This is achieved through the UNIDO assignment "*For provision of services related to consulting support for clean-tech readiness and quality infrastructure assessments and policy dialogues in Barbados*" whose objectives are listed as: -

- The strengthening of public-private dialogue
- The creation of an enabling policy and regulatory framework
- The enhancement of quality infrastructure for clean-tech products and services.

Within the context of this Quality Infrastructure Assessment Framework the critical success factors are given below in Table 14.

Objective	Critical Success Factors
Strengthen public-private dialogue	Establish high-level Quality directorate (e.g. National Quality Council) Establish digital platform for QI dialogue/events Conduct systematic QI dialogue/events Implement QI dialogue action points Quality mandates in business, government and society Provision of support services by state actors

Objective	Critical Success Factors
	Leverage fiscal incentives enhancing MSME conformance to standards and certification
Creation of an enabling policy and regulatory framework	QI institution and political directorate buy-in QI Champion Develop Regulatory Impact Assessment (RIA) Ministerial and Cabinet presentation/support Close working relationship with legal drafting department Consultation with private sector/stakeholders Designate regulatory authorities Establish legal and technical requirements Effective regulatory programming
Enhancement of quality infrastructure	Deploy comprehensive diagnostic QI assessment tool Establish country-wide demand for QI services Benchmark international QI practices Set dynamic maturity levels of QI services Develop roadmap for implementation of QI enhancements Implement National Quality Policy Implement Communications strategy (including training and capacity building) Mobilize finance Implement QI development project

Table 14 – Critical Factors for Success

6. Potential Role of BLOOM

Noting the potential QI structures and mapping one of them to CleanTech sector is possible. There exists the possibility within a national QI structure to have more advanced sub-fields of the QI structure. For example, the Liquefied Petroleum Gas sub-sector has a more advanced QI structure compared to the national QI structure. In the LPG sub-sector, the private sector defers standards development to the NSB, but testing, inspection and certification services are provided by firms within the sector. Significant investment in human resources and plants allows the industry to provide quality testing services for its own needs. This allows them to trade their products domestically without health and safety regulatory action, as the industry demonstrates its regulatory compliance by meeting international standards.

Comparatively, the local condiment sector conforms to a less advanced fully-integrated QI structure, as there is no capability within the sector to provide food quality, safety and hygiene testing to an acceptable standard. A government testing laboratory provides those services and results are overseen by the regulator, the Ministry of Health and Wellness. The condiment sector suffers, at times, from the unavailability of certain tests to facilitate exports as the government laboratory may not perform the required test locally. Hence, to satisfy their customers and contracts, the local condiment sector is burdened with the high costs of shipping samples overseas for testing along with the lengthy time for results to be returned.

The potential role of BLOOM in support of the CleanTech cluster regarding Standards development, QI assurance and Enforcement is examined below. We propose that the platform for communication and networking, sharing-arrangements, start-up support, joint marketing and branding, capacity building, and Research and Development on innovative prototypes and evolving business models, give serious consideration to what is detailed in the Concept Paper for CleanTech Platform Solution.

6.1. Standards Development

The international benchmark for publication of standards is 24 to 36 months. The local NSB is way ahead of the global average and has many strengths in this QI component. It also has a mature and well-established standards capability. Similar to the other SDOs previously mentioned, BLOOM should defer standardization to the NSB, which demonstrates a high competence and history of stakeholder satisfaction, but maintain some understanding and capacity for standards development. The trained resource person(s) can then liaise with the NSB to trigger the development of standards for the sector. Built capacity within BLOOM does not necessarily mean that it is expected to develop the standards solely, but that with knowledge of the standards development process, that knowledge can be used to support the primary standards developer and hence realise a more efficient output in a timely manner.

6.2. QI Assurance

Considering that in today's business environment quality is fast becoming an expected in-built trait demanded by consumers, there is scope for BLOOM to be an advocate, a facilitator and trainer of quality management for the sector. This role allows BLOOM to efficiently address and eradicate product deficiencies within the sector and guide new entrepreneurs to the benchmark expected within the industry.
Additionally, BLOOM may also offer other types of services from a QI perspective: -

- Directing technical and quality support
- Awareness and information on quality infrastructure news
- Propose legislative and policy amendments specific to the NQI
- Sector-specific training leading to a qualification.

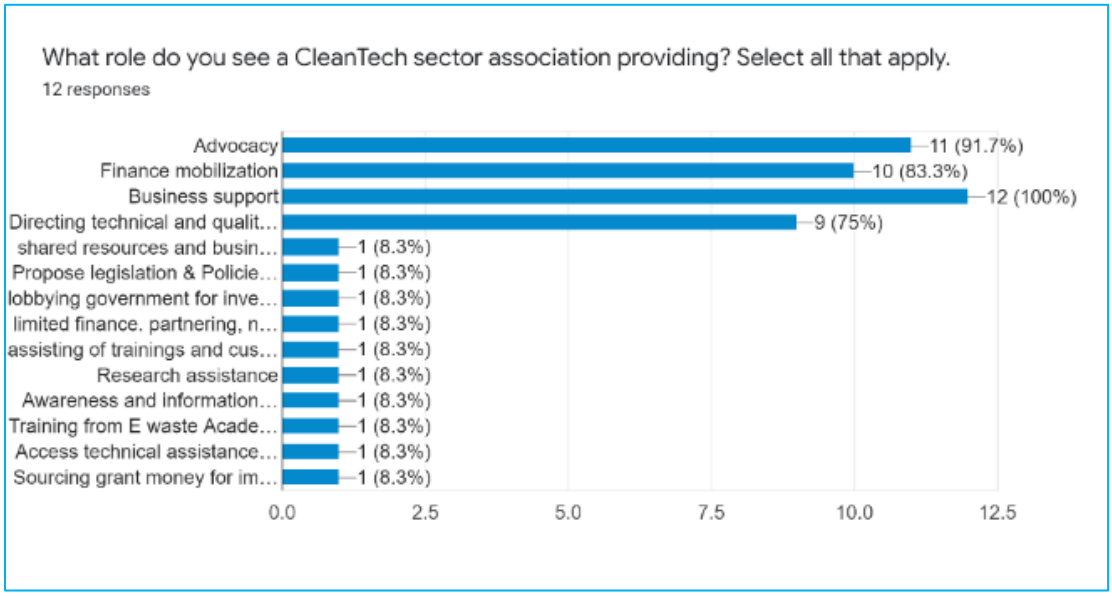


Figure 28 – Sector Association Services Expected

These needs articulated were supported by the CleanTech sector businesses who participated in the survey.

6.3. Enforcement

As previously stated, enforcement activities should be reserved for matters of legitimate objectives where there is a need to prevent deception of persons, ensure the safety of persons, protect public health, protect the environment and address matters of national security. With respect to CleanTech products and services, only in cases where the product is likely to violate legitimate objectives, when there are substandard competitive products entering the market, or a market failure should enforcement be considered.

Ensuring these legitimate objectives and societal goals through the UN SDGs is the role of a civil government. And while there are models where the government assigns another entity, private or public, to function as a regulator, enforcement programming requires significant resources in the form of human resources, training, capacity building and institutional strengthening. It is, therefore, not recommended for BLOOM to take up this role.

Nevertheless, with the use of the proposed concept for a platform (Component-1) solution for CleanTech and the expected vast amounts of information flowing through the portal, it would be more advantageous for BLOOM to take up the role of monitoring and surveillance within the CleanTech sector as this aligns with the other roles proposed above. Monitoring and surveillance are not likely to require significant resources. Where BLOOM then has a significant concern, it can seek the assistance of the regulator to resolve the matter.

7. Description of Priority Standards for the Local CleanTech Industry

To commence the process of improving the quality of CleanTech products and services to a world-class level, ten (10) priority standards have been identified. These standards range from management systems standards to product standards, to standards supporting business. While the identification of the priority standards is useful, there is a myriad of standards the cleantech sectors needs to be aware of as they develop new products and services.

7.1. Standard 1 − Quality Management Systems

The world's most populous and effective quality management system is the ISO 9001 standard on Quality management systems – Requirements. It can be implemented in any size organization. Quality is an inherent trait expected by consumers globally, and the CleanTech sector would do well to give serious consideration to its implementation. The targeted stakeholders amount to 25% of the CleanTech sector that has not yet given consideration to its implementation.

7.2. Standard 2 − Environmental Management Systems

ISO 14001: 2015 Environmental management systems – Requirements with guidance for use is the leading standard addressing environmental management practices that helps organisations reduce the negative impact of their operations on the environment. Conformance to ISO 14001 also satisfies SDG 11 – Sustainable cities and communities, SDG 12 – Responsible consumption and production, SDG 13 – Climate action and SDG 14 – Life below water and SDG 15 – Life on land.

7.3. Standard 3 – Environmental Labelling and Declarations

This standard, ISO 14021: 2016 Environmental labels and declarations – Self-declared environmental claims (Type II environmental labelling), provides the mechanism and means for CleanTech startups and entrepreneurs to compete on the global scale with the ability to issue environmental labels and make declarations regarding their product. It

provides an evaluation and verification method to substantiate environmental claims made.

7.4. Standard 4 – Environmental Technology Verification

As environmental technology expands and improves, there is a demand for verification to illustrate that the technology does what it claims to do. The standard is ground-breaking as it allows environmental technology worldwide to be given some measure of credibility. The verification requirements are given in ISO 14034: 2016 Environmental management systems – Environmental technology verification.

7.5. Standard 5 − Innovation Management

Innovation is one of the fundamental elements of the CleanTech sector and new and emerging sectors. Innovation provides a pathway for solving a problem in a different and distinct manner and should eventually lead to commercialization. ISO 56002: 2019 Innovation management – Innovation management systems – Guidance offers help in this regard.

7.6. Standard 6 − Intellectual Property Management

Startups and entrepreneurs are always concerned with how to protect and manage their innovations to the extent that a method or process is available to help manage their intellectual property, which is the engine of competitiveness that drives growth. ISO 56005: 2020 Innovation management – Tools and methods for intellectual property management − Guidance is the standard to assist in this regard, it also assist in achieving UN SDGs 4, 8 and 9.

7.7. Standard 7 − Framework for Implementing the Principles of a Circular Economy

The world has finally agreed that the concept of a circular economy needs to be ubiquitous and accelerated due to the issues of waste management, climate change and other concerning issues from the traditional linear industrial economy. And while the global community of standardizers are actively working to develop an International Standard,

other countries have taken the lead in this matter. BS 8001: 2017 Framework for implementing the principles of a circular economy in organizations – Guide serves this function.

7.8. Standard 8 − Service Excellence

No business can be successful without satisfied customers. Hence, serving one's customers in a manner where their experience is superior compared to one's competitors is a desired goal. ISO/TS 24082: 2021 Service excellence – Designing excellent service to achieve outstanding customer experiences is the standard that does just that for the CleanTech sector.

7.9. Standard 9 − Business Continuity Management

Planning and preparing for events that may cause business disruption is the goal of business continuity management. ISO/TS 22332: 2021 Security and resilience – Business continuity management systems – Guidelines for developing business continuity plans and procedures helps in this regard.

7.10. Standard 10 − Energy Management

To assist in the control and management of energy use, the ISO 50001: 2018 Energy management systems – Requirements with guidance for use was developed. Energy consumption is one of the biggest matters of concern for businesses.

7.11. Other Standards of Relevance to the CleanTech Sector

In addition to the ten (10) priority standards, there are others of relevance to the CleanTech sector that must be noted. A list of standards is, therefore, given in Annex B to highlight to the cleantech sector the applicable benchmarks in the market. They are sector specific covering all of the fields in the BLOOM Barbados CleanTech Cluster. The relevance of these standards are validated through direct and indirect support they lend

to: (1) the implementation of the BNEP 2019; (2) MSMEs who need guidance on the applicable benchmarks in their field; and (3) building capacity in the NQI.

The realization of the objectives of the BNEP lie in part on the success of the cleantech sector because it contributes significantly to the future energy mix of Barbados. It appears there is a reinforcing effect between the cleantech sector, the BNEP and the NQI. The effective implementation of the BNEP rely on standards which establish the minimum requirements for the energy mix (solar PV, solar thermal, e-transportation, energy storage, marine power, energy efficiency, bio-energy, wind power, and waste to energy). MSMEs and new and emerging sectors, more so than others, need equity that standards provide to level the playing field. The technical knowledge in these standards fast track research and product development and time to market for cleantech products being developed locally. Additionally, as new technology emerges and matures, standards can be referenced to determine whether supplier´s products are conforming to international standards. The potential for development and maturity of the NQI occurs as new standards are established for the cleantech sector. Building capacity in the NQI starts with the requirements given in these standards. The repository in Annex B, therefore, indicates to the QI institutions those standards of relevance needed to support the growth of the cleantech sector.

Stakeholders can use this repository to guide their procurement to ensure that cleantech technologies, components and services meet international benchmarks and perform as intended.

Annex A — Abstract of the 10 Priority Standards

ISO 9001: 2015 Quality management systems – Requirements

This International Standard specifies requirements for a quality management system when an organization:

a) needs to demonstrate its ability to consistently provide products and services that meet customer and applicable statutory and regulatory requirements; and

b) aims to enhance customer satisfaction through the effective application of the system, including processes for improvement of the system and the assurance of conformity to customer and applicable statutory and regulatory requirements.

All the requirements of this International Standard are generic and are intended to be applicable to any organization, regardless of its type or size, or the products and services[3] it provides.

ISO 14001: 2015 Environmental management systems – Requirements with guidance for use

This International Standard specifies the requirements for an environmental management system that an organization can use to enhance its environmental performance. This International Standard is intended for use by an organization seeking to manage its environmental responsibilities systematically which contributes to the environmental pillar of sustainability.

This International Standard helps an organization achieve the intended outcomes of its environmental management system, which provide value for the environment, the organization itself and interested parties. Consistent with the organization's

[3] In this International Standard, the terms “product” or “service” only apply to products and services intended for, or required by, a customer

environmental policy, the intended outcomes of an environmental management system include:

a) enhancement of environmental performance;
b) fulfilment of compliance obligations;
c) achievement of environmental objectives.

This International Standard is applicable to any organization, regardless of size, type and nature, and applies to the environmental aspects of its activities, products and services that the organization determines it can either control or influence considering a life cycle perspective. This International Standard does not state specific environmental performance criteria.

This International Standard can be used in whole or in part to systematically improve environmental management. Claims of conformity to this International Standard, however, are not acceptable unless all its requirements are incorporated into an organization's environmental management system and fulfilled without exclusion.

ISO 14021: 2016 Environmental labels and declarations – Self-declared environmental claims (Type II environmental labelling)

The proliferation of environmental claims has created a need for environmental labelling standards that require that consideration be given to all relevant aspects of the product's life cycle when such claims are developed.

Self-declared environmental claims may be made by manufacturers, importers, distributors, retailers or anyone else likely to benefit from such claims. Environmental claims made regarding products may take the form of statements, symbols or graphics on product or package labels, or in product literature, technical bulletins, advertising, publicity, telemarketing, as well as digital or electronic media, such as the Internet.

In self-declared environmental claims, the assurance of reliability is essential. It is important that verification is properly conducted to avoid negative market effects such as

trade barriers or unfair competition, resulting from unreliable and deceptive environmental claims. The evaluation methodology used by those who make environmental claims should be clear, transparent, scientifically sound and documented so that those who purchase or may potentially purchase products can be ensured of the validity of the claims.

This International Standard specifies requirements for self-declared environmental claims, including statements, symbols and graphics, regarding products. It further describes selected terms commonly used in environmental claims and gives qualifications for their use. This International Standard also describes a general evaluation and verification methodology for self-declared environmental claims and specific evaluation and verification methods for the selected claims in this International Standard.

This International Standard does not preclude, override, or in any way change legally required environmental information, claims or labelling, or any other applicable legal requirements.

ISO 14034: 2016 Environmental management systems – Environmental technology verification

The objective of environmental technology verification (ETV) is to provide credible, reliable and independent verification of the performance of environmental technologies. Environmental technology is a technology that either results in an environmental added value or measures parameters that indicate an environmental impact. Such technologies have an increasingly important role in addressing environmental challenges and achieving sustainable development.

ETV contributes to the protection and conservation of the environment by promoting and facilitating market uptake of innovative environmental technologies, especially those that perform better than relevant alternatives. ETV is particularly applicable to those environmental technologies whose innovative features or performance cannot be fully assessed using existing standards. By providing objective evidence, ETV provides an

independent and impartial confirmation of the performance of an environmental technology based on reliable test data. ETV aims to strengthen the credibility of new, innovative technologies by supporting informed decision-making among interested parties.

This document specifies principles, procedures and requirements for environmental technology verification (ETV).

ISO 56002: 2019 Innovation management – Innovation management systems – Guidance

This document provides guidance for the establishment, implementation, maintenance, and continual improvement of an innovation management system for use in all established organizations. It applies to:

a) organizations seeking sustained success by developing and demonstrating their ability to effectively manage innovation activities to achieve the intended outcomes;

b) users, customers, and other interested parties, seeking confidence in the innovation capabilities of an organization;

c) organizations and interested parties seeking to improve communication through a common understanding of what constitutes an innovation management system;

d) providers of training in, assessment of, or consultancy for, innovation management and innovation management systems;

e) policymakers, aiming for higher effectiveness of support programs targeting the innovation capabilities and competitiveness of organizations and the development of society.

All the guidance within this document is generic and intended to be applicable to:

a) all types of organizations, regardless of type, sector, or size. The focus is on established organizations, with the understanding that both temporary organizations and start-ups can also benefit by applying these guidelines in all or in part;

b) all types of innovations, e.g., product, service, process, model, and method, ranging from incremental to radical;

c) all types of approaches, e.g., internal and open innovation, user-, market-, technology-, and design-driven innovation activities.

It does not describe detailed activities within the organization but rather provides guidance at a general level. It does not prescribe any requirements or specific tools or methods for innovation activities.

ISO 56005: 2020 Innovation management – Tools and methods for intellectual property management – Guidance

Every organization involved with innovation initiatives addresses intellectual property in one form or another, because intellectual property is inextricably linked with innovation. Intellectual property ("IP") refers to unique, value-adding creations of the human intellect that result from human ingenuity, creativity and inventiveness. IP is a type of property, while intellectual property rights (“IPR”) are the rights arising from different forms of IP.

There is no universally appropriate IP strategy since an IP strategy should be tailored to the needs of an organization's business and innovation strategies. IP strategy is diverse depending on the context of the organization, such as external and internal issues, including the maturity of the organization’s innovation management.

Therefore, the IP strategy should be flexible enough to adapt and change over time. In other words, the depth and breadth of an IP strategy should be adaptable to the changing context of the organization over time.

Efficient management of IP is critical to supporting the process of innovation, is essential for organizations' growth and protection, and is their engine for competitiveness.

This document proposes guidelines for supporting the role of IP within innovation management. It aims to address the following issues concerning IP management at strategic and operational levels:

— Creating an IP strategy to support innovation in an organization;

— Establishing systematic IP management within the innovation processes;

— Applying consistent IP tools and methods in support of efficient IP management.

This document can be used for any type of innovation activities and initiatives.

BS 8001: 2017 Framework for implementing the principles of a circular economy in organizations – Guide

While there have been several standards that support waste prevention, resource efficiency, eco-design and remanufacturing, and recognising there is no one standard that focuses entirely on the concept of the circular economy and resource management, BS 8001 was developed.

Its practical framework and guidance for organizations to implement the principles of the circular economy has been written in way that can be used wherever they are in the world. It is intended to apply to any organization, regardless of location, size, sector and type. The document would also be useful to those with varying levels of knowledge and understanding of the circular economy. It provides practical ways to secure smaller 'quick-wins', right through to helping organizations re-think holistically how their resources are managed to enhance financial, environmental and social benefits.

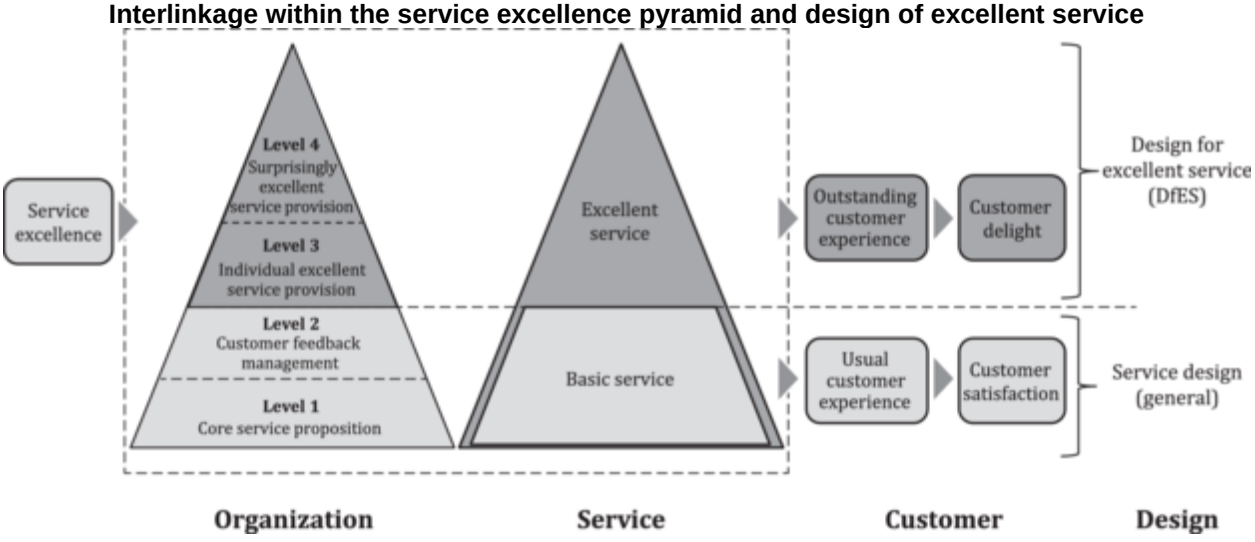
ISO/TS 24082: 2021 Service excellence – Designing excellent service to achieve outstanding customer experiences

In today's competitive world, customer expectations have changed and are constantly evolving and growing. In order to maintain and increase their customer base, organizations must create better and more differentiated customer experiences. For this reason, it is essential for organizations to understand customer expectations, needs, wishes, problems and experiences. These are used as inputs for service design.

Excellent service is key to achieving an outstanding customer experience, which leads to customer delight. Building a better and continuous relationship with customers through excellent service differentiates the organization from its competitors.

ISO 23592 defines service excellence as an organization's capability that enables "individual excellent service provision" (Level 3) and "surprisingly excellent service provision" (Level 4) in the service excellence pyramid shown in Figure 1. Compared to "service excellence" as an organization's capability, this document describes "excellent service" as an offering with individual and surprisingly excellent service performed between the organization and the customer. This facilitates the creation of outstanding customer experiences by the organization to achieve customer delight. The delivery of excellent service requires a foundation comprising a "core service proposition" (Level 1) and "customer feedback management" (Level 2) to ensure customer satisfaction, as shown in Figure 1. These are described in International Standards such as ISO 9001, ISO 10002 and ISO/IEC 20000-1.

Interlinkage within the service excellence pyramid and design of excellent service



This document specifies principles and activities for designing excellent service that achieve outstanding customer experience. It applies to all organizations delivering services, such as commercial organizations, public services, and not-for-profit organizations.

ISO/TS 22332: 2021 Security and resilience – Business continuity management systems – Guidelines for developing business continuity plans and procedures

A business continuity plan provides guidance and information to assist teams in responding to a disruption in order to meet expectations regarding delivery of products and services. The organization should create plans and procedures to address communications, emergency management, incident response, crisis management, recovery and restoration.

Business continuity plans and procedures should be consistent with organizational goals and objectives, and business continuity objectives, and detail the actions that teams will take during a disruption in order to:

— activate the response;

— manage the immediate consequences of a disruption;

— continue or recover prioritized activities within predetermined time frames utilizing, if appropriate, the agreed business continuity strategies and solutions;

— monitor the impact of the disruption and the organization's response to it;

— deliver products and services at agreed capacity.

The purpose of this document is to provide organizations with:

— detailed methods to develop business continuity plans and procedures;

— a structured approach to collect and organize information to develop plans and procedures;

— advice for maintaining plans and procedures over time to establish a continual improvement environment.

This document provides guidelines for developing and maintaining business continuity plans and procedures. It is applicable to all organizations, regardless of type, size and

nature, whether in the private, public, or not-for-profit sectors, that wish to develop effective business continuity plans and procedures in a consistent manner.

ISO 50001: 2018 Energy management systems – Requirements with guidance for use

The aim of this document is to enable organizations to establish the systems and processes necessary to continually improve energy performance, including energy efficiency, energy use and energy consumption. This document specifies the energy management system (EnMS) requirements for an organization. Successful implementation of an EnMS supports a culture of energy performance improvement that depends upon commitment from all levels of the organization, especially top management. In many instances, this involves cultural changes within an organization.

This document specifies requirements for establishing, implementing, maintaining and improving an EnMS. The intended outcome is to enable an organization to follow a systematic approach in achieving continual improvement of energy performance and the EnMS.

This document:

a) is applicable to any organization regardless of its type, size, complexity, geographical location, organizational culture or the products and services it provides;

b) is applicable to activities affecting energy performance that are managed and controlled by the organization;

c) is applicable irrespective of the quantity, use, or types of energy consumed;

d) requires demonstration of continual energy performance improvement, but does not define levels of energy performance improvement to be achieved;

e) can be used independently or be aligned or integrated with other management systems.

Annex A provides guidance for the use of this document.

Annex B – Repository of Standards Relevant to the CleanTech Sector

No	Standards
	Solar Thermal
1	ISO 9459-1:1993 Solar heating — Domestic water heating systems — Part 1: Performance rating procedure using indoor test methods
2	ISO 9459-4:2013 Solar heating — Domestic water heating systems — Part 4: System performance characterization by means of component tests and computer simulation
3	ISO 9459-5:2007 Solar heating — Domestic water heating systems — Part 5: System performance characterization by means of whole-system tests and computer simulation
4	ISO 24194:2022 Solar energy — Collector fields — Check of performance
5	ISO 9806:2017 Solar energy — Solar thermal collectors — Test methods
6	ISO/TR 10217:1989 Solar Energy — Water Heating Systems — Guide To Material Selection With Regard To Internal Corrosion
7	ISO 22975-1:2016 Solar energy — Collector components and materials — Part 1: Evacuated tubes — Durability and performance
8	ANSI/ASHRAE 96-1980 (RA 1989) Methods of Testing to Determine the Thermal Performance of Unglazed Flat-Plate Liquid-Type Solar Collectors
9	IAPMO S1001.1-2013 (R2019) Design and Installation of Solar Water Heating Systems
10	CAD ICC 900/SRCC 300-2020 Standard for Solar Water Heating Systems (Caribbean Application Document)
11	ICC 901/SRCC 100-2015 Standard for Solar Thermal Collectors
12	ASTM E861-13(2021) Standard Practice for Evaluating Thermal Insulation Materials for Use in Solar Collectors
13	IAPMO IGC 86-2002 Passive solar water heaters
14	IAPMO PS 96-2002 Passive direct solar water heaters
15	EN 12976-1:2022-03 Thermal solar systems and components - Factory made systems - Part 1: General requirements
16	EN 12976-2:2019-11 Thermal solar systems and components - Factory made systems - Part 2: Test methods
17	EN 12977-1:2018-07 Thermal solar systems and components - Custom built systems - Part 1: General requirements for solar water heaters and combisystems

No	Standards
18	EN 12977-2:2018-07 Thermal solar systems and components - Custom built systems - Part 2: Test methods for solar water heaters and combisystems
19	EN 12977-3:2018-07 Thermal solar systems and components - Custom built systems - Part 3: Performance test methods for solar water heater stores
	Solar PV
1	IEC 61215-1:2021 Edition 2.0 (2021-02-23) Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1: Test requirements
2	IEC 61215-1:2021 Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1: Test requirements
3	IEC 61215-2:2021 RLV Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 2: Test procedures
4	IEC 61701:2020 Photovoltaic (PV) modules - Salt mist corrosion testing
5	IEC 61724-1:2021 Edition 2.0 (2021-07-21) Photovoltaic system performance - Part 1: Monitoring
6	IEC TS 61724-2:2016 Photovoltaic system performance - Part 2: Capacity evaluation method
7	IEC TS 61724-3:2016 Photovoltaic system performance - Part 3: Energy evaluation method
8	IEC 61730-1:2016 Photovoltaic (PV) module safety qualification - Part 1: Requirements for construction
9	IEC 61853-1:2011 Photovoltaic (PV) module performance testing and energy rating - Part 1: Irradiance and temperature performance measurements and power rating
10	IEC 61853-3:2018 Edition 1.0 (2018-08-30) Photovoltaic (PV) module performance testing and energy rating - Part 3: Energy rating of PV modules
11	IEC 62446-1:2016/AMD1:2018 Edition 1.0 (2018-08-10) Amendment 1 - Photovoltaic (PV) systems - Requirements for testing, documentation and maintenance - Part 1: Grid connected systems - Documentation, commissioning tests and inspection
12	IEC 62446-2:2020 Edition 1.0 (2020-03-18) Photovoltaic (PV) systems - Requirements for testing, documentation and maintenance - Part 2: Grid connected systems - Maintenance of PV systems
13	IEC 62253:2011 Photovoltaic pumping systems - Design qualification and performance measurements
14	IEC TS 63163:2021 Terrestrial photovoltaic (PV) modules for consumer products - Design qualification and type approval
15	ASTM E948-16(2020) Standard Test Method for Electrical Performance of Photovoltaic Cells Using Reference Cells Under Simulated Sunlight

No	Standards
16	ASTM E1597-10(2019) Standard Test Method for Saltwater Pressure Immersion and Temperature Testing of Photovoltaic Modules for Marine Environments
17	ASTM E1799-12(2018) Standard Practice for Visual Inspections of Photovoltaic Modules
18	ASTM E1802-12(2018) Standard Test Methods for Wet Insulation Integrity Testing of Photovoltaic Modules
19	ASTM E1830-15(2019) Standard Test Methods for Determining Mechanical Integrity of Photovoltaic Modules
20	ASTM E2047-10(2019) Standard Test Method for Wet Insulation Integrity Testing of Photovoltaic Arrays
21	ASTM E2766-13(2019) Standard Practice for Installation of Roof Mounted Photovoltaic Arrays on Steep-Slope Roofs
22	EASTM 2908-12(2018) Standard Guide for Fire Prevention for Photovoltaic Panels, Modules, and Systems
23	ASTM E3010-15(2019)e1 Standard Practice for Installation, Commissioning, Operation, and Maintenance Process (ICOMP) of Photovoltaic Arrays
24	ASTM E3325-21 Standard Practice for Sampling of Solar Photovoltaic Modules for Toxicity Testing
e-Transportation	
1	ISO 6469-1:2019 Electrically propelled road vehicles — Safety specifications — Part 1: Rechargeable energy storage system (RESS)
2	ISO 6469-2:2022 Electrically propelled road vehicles — Safety specifications — Part 2: Vehicle operational safety
3	ISO 8714:2002 Electric road vehicles — Reference energy consumption and range — Test procedures for passenger cars and light commercial vehicles
4	ISO 12405-4:2018 Electrically propelled road vehicles —Test specification for lithium-ion traction battery packs and systems — Part 4: Performance testing
5	ISO 15118-1:2019 Edition 2.0 (2019-04-02) Road vehicles - Vehicle to grid communication interface - Part 1: General information and use case definition
6	ISO 15118-2:2014 Edition 1.0 (2014-03-31) Road vehicles -- Vehicle-to-Grid Communication Interface -- Part 2: Network and application protocol requirements
7	ISO 15118-4:2018 Edition 1.0 (2018-03-07) Road vehicles - Vehicle to grid communication interface - Part 4: Network and application protocol conformance test
8	ISO 15118-5:2018 Edition 1.0 (2018-03-07) Road vehicles - Vehicles to grid communication interface - Part 5: Physical and data link layer conformance tests

No	Standards
9	ISO 17409:2020 Electrically propelled road vehicles — Conductive power transfer — Safety requirements
10	ISO 21782-1:2019 Electrically propelled road vehicles — Test specification for electric propulsion components — Part 1: General test conditions and definitions
11	ISO 21782-2:2019 Electrically propelled road vehicles — Test specification for electric propulsion components — Part 2: Performance testing of the motor system
12	ISO 21782-3:2019 Electrically propelled road vehicles — Test specification for electric propulsion components — Part 3: Performance testing of the motor and the inverter
13	ISO 21782-4:2021 Electrically propelled road vehicles — Test specification for electric propulsion components — Part 4: Performance testing of the DC/DC converter
14	ISO 23273:2013 Fuel cell road vehicles — Safety specifications — Protection against hydrogen hazards for vehicles fuelled with compressed hydrogen
15	ISO 23828:2022 Fuel cell road vehicles — Energy consumption measurement — Vehicles fuelled with compressed hydrogen
16	IEC 61851-1:2017 Edition 3.0 (2017-02-07) Electric vehicle conductive charging system - Part 1: General requirements
17	IEC 61851-23:2014 Edition 1.0 (2014-03-11) Electric vehicle conductive charging system - Part 23: DC electric vehicle charging station
18	IEC 62196-1:2022 Edition 4.0 (2022-05-03) Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles - Part 1: General requirements
19	IEC 62196-2:2016 Edition 2.0 (2016-02-18) Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles - Part 2: Dimensional compatibility and interchangeability requirements for a.c. pin and contact-tube accessories
Energy Storage Systems	
1	IEC 61427-1:2013 Secondary cells and batteries for renewable energy storage - General requirements and methods of test - Part 1: Photovoltaic off-grid application
2	IEC 61427-2:2015 Secondary cells and batteries for renewable energy storage - General requirements and methods of test - Part 2: On-grid applications
3	IEC 62485-1:2015 Edition 1.0 (2015-04-15) Safety requirements for secondary batteries and battery installations - Part 1: General safety information
4	IEC 62485-2:2010 Edition 1.0 (2010-06-16) Safety requirements for secondary batteries and battery installations - Part 2: Stationary batteries
5	IEC 62485-3:2014 Edition 2.0 (2014-07-10) Safety requirements for secondary batteries and battery installations - Part 3: Traction batteries

No	Standards
6	IEC 62509:2010 Edition 1.0 (2010-12-16) Battery charge controllers for photovoltaic systems - Performance and functioning
7	IEC 62660-1:2018 Edition 2.0 (2018-12-12) Secondary lithium-ion cells for the propulsion of electric road vehicles - Part 1: Performance testing
8	IEC 62660-2:2018 Edition 2.0 (2018-12-12) Secondary lithium-ion cells for the propulsion of electric road vehicles - Part 2: Reliability and abuse testing
9	IEC 62660-3:2022 Edition 2.0 (2022-03-01) Secondary lithium-ion cells for the propulsion of electric road vehicles - Part 3: Safety requirements
10	IEC 62932-2-1:2020 Edition 1.0 (2020-02-18) Flow battery energy systems for stationary applications - Part 2-1: Performance general requirements and test methods
11	IEC 62933-2-1:2017/COR1:2019 Edition 1.0 (2019-01-08) Corrigendum 1 - Electrical energy storage (EES) systems - Part 2-1: Unit parameters and testing methods - General specification
12	IEC TS 62933-2-2:2022 Edition 1.0 (2022-04-26) Electrical energy storage (EES) systems - Part 2-2: Unit parameters and testing methods - Application and performance testing
13	IEC TR 62933-2-200:2021 Edition 1.0 (2021-09-03) Electrical energy storage (EES) systems - Part 2-200: Unit parameters and testing methods - Case study of electrical energy storage (EES) systems located in EV charging station with PV
14	IEC TS 62933-3-1:2018 Edition 1.0 (2018-08-29) Electrical energy storage (EES) systems - Part 3-1: Planning and performance assessment of electrical energy storage systems - General specification
15	IEC TS 62933-5-1:2017 Edition 1.0 (2017-07-12) Electrical energy storage (EES) systems - Part 5-1: Safety considerations for grid-integrated EES systems - General specification
16	IEC 62933-5-2:2020 Edition 1.0 (2020-04-16) Electrical energy storage (EES) systems - Part 5-2: Safety requirements for grid-integrated EES systems - Electrochemical-based systems
Bio-energy	
1	ISO 13065:2015 Sustainability Criteria for Bioenergy
2	ISO 17225-1:2021 Solid biofuels — Fuel specifications and classes — Part 1: General requirements
3	ISO 20675:2018 Biogas — Biogas production, conditioning, upgrading and utilization — Terms, definitions and classification scheme
4	ISO 23590:2020 Household biogas system requirements: design, installation, operation, maintenance and safety
5	ASTM E3325-21 Standard Practice for Sampling of Solar Photovoltaic Modules for Toxicity Testing

No	Standards
6	ASTM E3066-20 Standard Practice for Evaluating Relative Sustainability Involving Energy or Chemicals from Biomass
7	ASTM E3237-19 Standard Specification for Undenatured Ethanol from Biomass for Use in Industrial Applications
Hydrogen Technologies	
1	ISO/TR 15916:2015 Basic considerations for the safety of hydrogen systems
2	ISO 16110-1:2007 Hydrogen generators using fuel processing technologies — Part 1: Safety
3	ISO 16110-2:2010 Hydrogen generators using fuel processing technologies — Part 2: Test methods for performance
4	ISO 22734:2019 Hydrogen generators using water electrolysis — Industrial, commercial, and residential applications
5	ISO 26142:2010 Hydrogen detection apparatus — Stationary applications
Marine Power	
1	IEC TS 62600-2:2019 Edition 2.0 (2019-10-18) Marine energy - Wave, tidal and other water current converters - Part 2: Marine energy systems - Design requirements
2	IEC TS 62600-103:2018 Edition 1.0 (2018-07-19) Marine energy - Wave, tidal and other water current converters - Part 103: Guidelines for the early stage development of wave energy converters - Best practices and recommended procedures for the testing of pre-prototype devices
3	IEC TS 62600-202:2022 Edition 1.0 (2022-04-07) Marine energy - Wave, tidal and other water current converters - Part 202: Early stage development of tidal energy converters - Best practices and recommended procedures for the testing of pre-prototype scale devices
Wind Power	
1	IEC 61400-1:2019 Edition 4.0 (2019-02-08) Wind energy generation systems - Part 1: Design requirements
2	IEC 61400-2:2013 Edition 3.0 (2013-12-12) Wind turbines - Part 2: Small wind turbines
3	IEC 61400-4:2012 Edition 1.0 (2012-12-04) Wind turbines - Part 4: Design requirements for wind turbine gearboxes
4	IEC 61400-12-1:2017 Edition 2.0 (2017-03-03) Wind energy generation systems - Part 12-1: Power performance measurements of electricity producing wind turbines
5	IEC 61400-24:2019 Edition 2.0 (2019-07-03) Wind energy generation systems - Part 24: Lightning protection
Circular Economy (All standards under development)	

No	Standards
1	ISO/CD 59004 Circular Economy – Terminology, Principles and Guidance for Implementation
2	ISO/CD 59010 Circular Economy — Guidance on the transition of business models and value networks
3	ISO/CD 59020 Circular Economy — Measuring and assessing circularity
4	ISO/WD 59040 Circular Economy — Product Circularity Data Sheet

Annex C – List of Additional Stakeholder Consultations

Firm *	Contact person(s)	Interview date	Site visit	Contact details
Mesopartner	Dr. Ulrich Harmes-Liedtke	2022/01/27		uhi@mesopartner.com
InkTech Inc.	Deandro Alleyne	2022/03/22	✓	info@inktechbb.com
The Caribbean Environmental Management Bureau	Simea Crawford	2022/03/24		team@cembi.org
LNW Environmental Inc.	Leigh Weatherhead	2022/03/21		lnwenvironmental@gmail.com
Diceabed Inc.	Stephen Foster	2022/03/26	✓	info@diceabbed.com
Caribbean E-Waste Management Inc.	Malikca Cummins	2022/03/21	✓	mcummins@cewmi.com
Red Diamond Compost	Joshua Forte	2022/03/24	✓	joshua@reddiamondcompost.com
On Solar Solutions Inc.	Julian Clarke	2022/03/24		onsolarsolutions@gmail.com
Barbados National Standards Institution	Hadyn Rhynd (Acting Director)	2022/04/07		hadyn.rhynd@barbados.gov.bb

CARICOM Regional Organisation for Standards and Quality	Deryck Omar (CEO)	2022/04/12		deryck.omar@crosq.org

* Stakeholder included in the component-4 consultation were also included.

Annex D – Excerpts of the Barbados National Quality Policy

Background

1. The BNSI is a state-owned company responsible for developing standards for Barbados. Its mandate includes the facilitation of trade, increasing the international competitiveness of Barbadian goods and services, the protection of consumers and the collective advancement of the sectors of the economy. These objectives are achieved through the development of the country's quality infrastructure, namely: the development of standards, revision and amendment of these standards as necessary; testing of products for conformity to these standards; certification of products to national standards and calibration of measures (including mass, volume, temperature, length).

2. There is currently no structured national policy on the quality of products or the delivery of services in Barbados. The Government of Barbados has, however, recognized that enhanced industrial and export activity must be based on the production of goods and services that meet the highest level of international standards by design and quality, and which are produced at costs that would allow them a competitive edge in the international market. This, however, is only possible if goods and services produced in Barbados are guided by a national quality policy that sets out a structured framework of quality standards that would satisfy international best practices and standards established by all international standards and quality bodies.

4. The term National Quality Infrastructure (NQI) has become an acceptable term, internationally. It is the totality of the infrastructure (public and private) required to establish and implement Standardization, Metrology (legal, industrial and scientific), Testing, Certification (product and system) and Accreditation services necessary to provide demonstrable and acceptable assurance that products and services meet the defined requirements demanded by consumers, authorities or the market place.

5. The modernization of the Barbados National Standards System has been the subject of a study that was aimed at the development of a National Quality Infrastructure (NQI) model for Barbados. Recommendations based on conclusions of the study indicated that the Barbados Government should consider the development of a National Quality Policy (NQP) as a top priority.

Objectives of the NQP

6. The NQP is intended to provide direction to the Government regarding quality, standards and technical regulations with respect to both goods and services. It is also intended to provide the policy and institutional framework needed for the implementation of quality initiatives in virtually all segments of the Barbadian society and economy. The specific objectives of the policy will be to:

(i) Strengthen the national metrology system and to promote metrology in the country's overall activities;

(ii) Expand the use of accreditation in the national regulatory environment;

(iii) Strengthen the national technical regulatory system;

(iv) Facilitate the use of conformity assessment of services providers from the private and public sector not only as a stimulant to cross border trade where applicable, but also as a mechanism for holding service providers to satisfactory performance levels in the domestic space; and

(v) Provide a national quality promotion strategy to assist Barbados in becoming more globally competitive using international standards in technical regulations and conformity assessment to avoid the creation of technical barriers to trade.

7. The proposed policy will therefore inform all areas relating to quality and standards. These areas include:

Metrology
Metrology, which is the science of measurement, is a necessary, although insufficient by itself, condition for quality. It is an important pillar of the technical infrastructure needed for efficient trade internationally and the National Quality Infrastructure.

Accreditation
Accreditation status to an institution is an expression of confidence in the institution's mission and goals, the quality of the facility and standards; the quality of the academic programs and the level and appropriateness of its resources.

Testing
Testing is indispensable for the determining of quality and in quality assurance for providing the proof of conformity with requirements. There are many testing facilities and laboratories functioning in Barbados, both in the public and private sectors. These are used for conformity assessment purposes in Health, Manufacturing, Forensic Research, Veterinary Services, Agricultural Services, Building and Construction and Trade and Commerce.

Inspection and Certification
Certification refers to processes, namely, assessment and verification of conformity to standards and technical regulations. Certification not only ensures and assesses compliance to a standard, but also provides an official certification mark or a declaration of conformity. Certified products or services generally give a marketing advantage to the producers of those goods and services against those whose products/services are not certified.

8. The Ministry of Energy and Business Development supports the development of a national policy on quality by the BNSI, as it is recognized that quality and standards are necessary for Barbadian commerce to evolve and compete in a global economic environment. Barbados needs to have access to a supporting internationally recognized quality infrastructure that can provide the independent attestation of product or service quality to access developed markets. Barbados' need for a National Quality Policy is also driven by increased consumer awareness and technical change occurring at home and abroad.

9. The benefits of a national NQP will provide a framework to:

- Ensure compliance with regional and international trade agreements such as the World Trade Organisation (WTO) Agreements on Technical Barriers to Trade (TBT) and Sanitary and Phytosanitary Measures (SPS) through market surveillance;
- Enhance the competitiveness of domestic goods and services in international markets;
- Engage in faster, more efficient and responsive standards development;
- Satisfy identified demands for legal and industrial metrology;
- Allow the performance conformity assessments;

- Create an environment to conduct testing and calibration on a broader scale, thereby reducing costs accrued by utilizing foreign facilities;
- Ensure fair trade between domestic and imported goods and services; and
- Introduce the NQI's applications that increasingly contribute to Barbados' economic and social, environment and sustainable development.

10. Other drivers of the national quality policy will address:

a) The need to protect the health and safety of citizens and the environment;

b) The promotion of a rational and sustainable development agenda;

c) The attainment of national benchmarks;

d) The need to respond to the increasing contribution of services to the economy of Barbados;

e) The transition to a Green Economy;

f) The need for both a cadre of employers and entrepreneurs, and a body of skilled labour that is cognizant of a quality culture and reflects this in its work ethic and in its level of service delivery and productivity; and

g) The increasing sophistication and demands of the populace.

11. The deployment of quality as a competitive strategy will bring greater awareness in the country, resulting in the continual improvement of said quality and increased productivity. This approach will enable Barbados to position itself well beyond the boundaries of mere compliance with technical global trading requirements. It would also allow it to become a fully integrated competitive trading partner, exploiting numerous opportunities presented.

12. An effective implementation of the policy will, however, require a collaborative effort between the public sector and the private sector, coordinated by the BNSI. It will require the production of goods and services to be set within a technical, regulatory framework that meets international requirements. Technical Regulations lay down compulsory requirements for products or service characteristics or their related processed and producing methods and have specific administrative provisions and conformity assessment requirements with which compliance is mandatory with regard to safety, health, environmental control and consumer protection. They reflect the values of a government and the society it serves, as well as represent the country's measures to deal with specific economic, social and political issues and values. Technical regulations can significantly affect the conduct of trade among countries.

13. A well-structured National Technical Regulatory Framework is important for sustaining and expanding the economy as a competitive player in the world trading system. Such is intended to benefit the economy in balancing regulatory and trade interests, reducing unintended defects, eliminating technical barriers to trade, improving the quality and consistency of technical regulations and complying with international requirements. The regulatory framework would require Barbados to become committed to honoring international agreements such as the WTO TBT Agreement, which is intended to remove or minimize barriers to trade, including regulations relating to sanitary and phytosanitary measures and food control.

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