TTCIC & TTMA WEBINAR ENERGY EFFICIENCY IN MANUFACTURING

Best Practices in Energy Management

International and regional standards

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Sustain Innovate Collaborate

INTRODUCTION

Ricardo Mahadeo

Mechanical engineer. 25+ years in the local contracting and energy sector.

Director, TOSL Engineering Ltd

Director, WasteXchange Ltd

TOSL Engineering

Reliability-focused EPC for energy and industrial clients since 1982: electrical, instrumentation, automation, rotating equipment, predictive maintenance, fabrication, energy efficiency and plant upgrades.

WasteXchange

A software platform for the circular economy: tracks and quantifies waste transactions to enable reuse, recycling or safe disposal. Able to support all projects which require waste as the raw material.

Energy is one of the few major cost lines a manufacturer controls directly.

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THE BUSINESS CASE

Potential Impact

Energy as a share of production cost



0% 5% to 20% is energy 100%

Cement 30 to 40%, glass, paper at 20 to 30%,
5% - discrete/light manufacturing where labour and materials dominate - garments, printing, furniture

EFFICIENCY

The first fuel

The IEA's term. Energy you don't use is cheaper than any energy you can buy or generate

PRICING

Rising

Gas $$ are going up, electricity is under review. Efficiency s a competitive edge.

FINANCE

Evidence

Lenders and export customers ask for proof of managed energy and carbon.

CONTROL

Yours

Unlike raw material or FX, energy cost can be controlled.

Source: IEA, Multiple Benefits of Energy Efficiency for Business

EVOLUTION

Energy Efficiency – Project vs System thinking

Project thinking



An audit ticks a KPI, no capex follows.

Savings fade within two years.

Energy is a maintenance problem.

No benchmarks in the business.

Solid small boundaries

System thinking



A core function, like HSE or HR.

Plan, act, measure, improve (consistently).

Savings verified every year.

Targets and KPIs across the org.

Large fluid boundaries

INTERNATIONAL STANDARDS

The ISO 50000 family

One standard for certification
4 enablers

CERTIFIABLE

50001

Energy management systems

Policy, planning, targets, operations, checking, review. Built on Plan Do Check Act. Integrates with ISO 9001 and 14001.

50002

Energy audits

How to scope, run and report an audit.

50004

Implementation

Practical guidance for standing up an Energy Management System (EnMS).

50006

Baselines and EnPIs

Indicators that measure real improvement.

Energy KPI’s

50015

Verification, with IPMVP

Proof of savings a bank will accept.

International Performance Measurement and Verification Protocol

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BUILDING LEVEL

The ASHRAE suite

ISO 50002 is the general audit framework.
ASHRAE is US-based, HVAC-focused, with defined audit levels.

90.1

Minimum energy requirements for commercial building design and operation.

55

Thermal comfort conditions for design, operation and commissioning.

62.1

Minimum ventilation rates for acceptable indoor air quality.

135

BACnet. Open protocol so building automation from different vendors interoperates.

189.1

High-performance green buildings. Builds on 90.1, 62.1 and 55, and folds in LEED practice.

BEYOND MINIMUM

Advanced Energy Design Guides

30%, 50% and zero energy targets.
Free at ashrae.org.

WHAT APPLIES TO YOU

Standard = Should

Standards

How buildings **should** be built to save energy cost effectively. Written by technical bodies: CROSQ, ASHRAE, IES, ISO. Voluntary.

Code = Must

Codes

How buildings **must** be built. Mandatory, enforceable, adopted by government.

STANDARD PUBLISHED | ~2 YEAR LAG | CODIFIED AND ADOPTED

Codes lag standards by about two years; the time it takes to codify an edition.
CROSQ -CARICOM Regional Organisation for Standards and Quality

Caribbean parallel: CARICOM regional energy efficiency building code (CREEBC) is the regional model code. Mandatory only once a member state adopts it.

ISO 50001 IN PRACTICE

Plan, Do, Check, Act

PLAN 01

Policy and commitment. Energy review: where does it go? Baseline, EnPIs, significant users, action plans.

DO 02

Implement. Operational controls, training, and efficiency written into design and procurement.

CHECK 03

EnPIs against baseline. Verification analysis, internal audit, corrective action.

ACT 04

Management review of policy, resources and results.

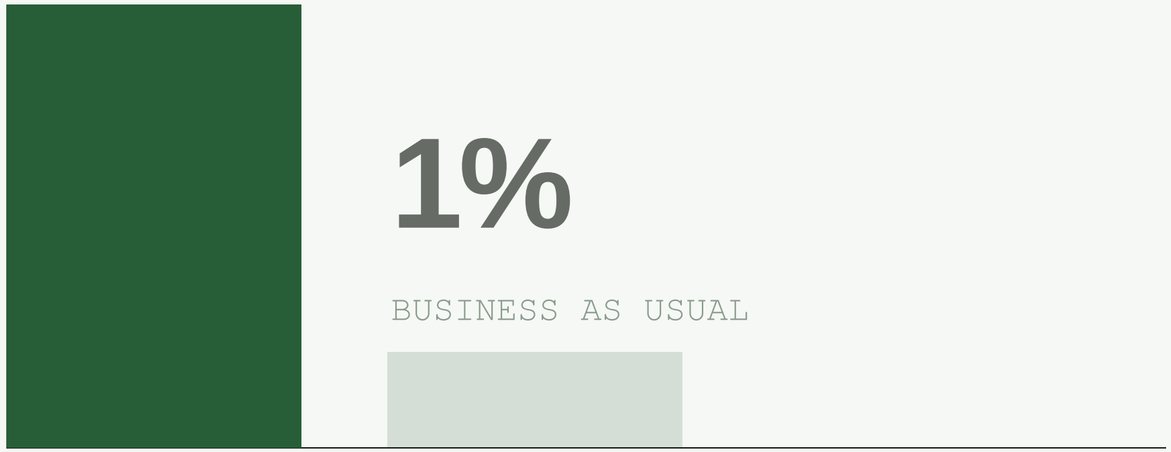
VERIFIED RESULTS OF ISO 50001 ADOPTERS

What to expect

Verified energy performance improvement per year.

4.5%

WITH AN EnMS



1%

BUSINESS AS USUAL

10 to 20%

typical savings in the first five years of a working system.

Early savings come from operations and maintenance, not capital.

Certification is optional. The savings come from running the system.

50001 Ready gives you free self-guided tools.
energy.gov/ISO50001

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THE REGIONAL LANDSCAPE

CARICOM’s Initiatives

C-SERMS TARGETS, BY 2027

47%
renewable contribution to power-Supply -

33%
cut in energy intensity - Demand -

Regional Energy Efficiency Strategy

A CARICOM-wide push to unlock efficiency potential through codes and standards. Actual is 12% as per last report, 2022.

Installed Capacity: Hydro ~290 MW (mostly Suriname), solar ~290 MW (Jamaica leads; T&T's 112 MW is the big addition), wind ~100 MW (almost all Jamaica), bagasse* ~60–70 MW, geothermal ~0 operational - *new* momentum is solar.

C-SERMS	Caribbean Sustainable Energy Roadmap and Strategy.
CROSQ	Writes the regional energy standards.
CCREEE	Technical hub in Barbados. Supports delivery.
TTBS	National gateway that adopts them here.

Standards are written regionally, countries responsibility to adopt them.

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THE REGIONAL PICTURE

Standards becoming law

THE REGIONAL SUITE

CREEBC building code

Based on IECC 2018, with ASHRAE 90.1 as the commercial path. Envelope, cooling, lighting, water heating. Applies to plants, warehouses and offices.

Labelling and MEPS

Fridges, air conditioners and lamps, through the CARICOM labelling scheme. MEPS ban the worst performers.

Belize and Saint Lucia piloted the labels
Jamaica - Testing centre for refrigerators and air conditioners;
Trinidad & Tobago - Testing centre for lamps

CCREBC	CARICOM regional energy efficiency building code
MEPS	Minimum energy performance standards

INDIVIDUAL COUNTRIES

Jamaica	Adopted CREEBC as JS 309, the 2024 energy conservation code. Voluntary for now, with industry pushing for mandatory.
Region+Belize, Trinidad & Tobago	2024 edition (adapted from IECC 2024) circulated for regional public inquiry including TTBS. Belize advancing adoption alongside its new mandatory National Building Code (2025)
Jamaica, Barbados, St. Lucia	National cooling strategies with MEPS and labelling for A/C and refrigeration.
Barbados, Grenada, St. Lucia	Barbados targets 100% renewables by 2030. Grenada and St. Lucia now have independent regulators.
Trinidad and Tobago	Fiscal route so far, through the 150% allowances, with the price signal arriving via gas and electricity reviews. Comment on Regional Energy Efficiency Building Code

TRINIDAD AND TOBAGO

TT Incentives

150%

Tax allowance

For engaging an MEEI-certified ESCO to design and install energy-saving systems. In force since 2011.

150%

Wear and tear allowance

On solar PV, wind and solar water heating, plus duty exemptions and zero-rated VAT on key equipment.

75%

ESCO depreciation

Accelerated, on audit equipment. Note: the public certification register is not yet operational.

50+

Declaration signatories

Energy Chamber Efficiency Declaration, including NGC, bpTT, Shell, Yara and TOSL.

OPPORTUNITY Joint TTMA, TTCIC and Energy Chamber advocacy to operationalise ESCO certification.

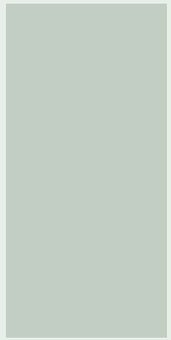
THE EFFECT OF STANDARDS

Investment example using AC

5-ton office unit, about 3,000 cooling hours a year, at the T&TEC B1 rate of TT$0.61 (~US$0.09)/kWh..

THE MINIMUM, ASHRAE 90.1

SEER 14



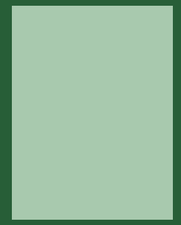
12,900

kWh per year

Capex	US$4,000 (~TT$27,000)
Running cost	~ TT$7,870 (~US$1,170)/yr

BEST PRACTICE, INVERTER

SEER 20 to 22



8,200

kWh per year, 36% less

Capex +75%	US$7,000 (~TT$47,000) for 22+
Running cost (36%)	TT$5,000 (~US$740)/yr

Saves about US$425, TT$2,870 per unit each year. Payback around 7 years.

SEER: seasonal energy efficiency ratio.
Figures illustrative.

BENCHMARKS

Reference ranges by facility (International numbers)

FACILITY	REFERENCE	WHERE THE SAVINGS USUALLY ARE
Bakery	400 to 600 kWh/t	Oven heat recovery and insulation, burner tuning, oven loading, refrigeration controls
Brewery	~32 kWh/hL	Wort vapour heat recovery, refrigeration optimisation, CO_2 recovery, boiler economiser
Soft drink bottling	~11 kWh/hL	Blow-moulder air recovery, compressed air leaks, chiller setpoints, line idle controls
Chocolate	~345 kWh/t	Conching and tempering scheduling, cooling tunnel and dehumidification control, heat recovery
Dry foods	46 to 263 kWh/t	Fryer and roaster heat recovery, VSDs on fans and pumps, compressed air, motor upgrades
Offices	218 kWh/m²/yr median ~115 top decile	A/C setpoints and scheduling, inverter units, LED retrofit, BMS controls, shading

Benchmark each production line separately to avoid hiding waste.

WHERE TO START

A 12-month pathway

MONTH 0 to 2

Commit and measure

- Appoint a champion.
- Pull 24 months of bills. One utility bill hides details.
- Walk the plant. ID the quick wins. Meter the big ones.
- Baseline normalised for production and weather, then manage by kWh per unit made.

MONTH 2 to 5

Audit

- ISO 50002. Set baseline and EnPIs.
- Quick wins first: leaks, controls, schedules.
- Fund the programme from its own savings.
- Train and reward people who find waste.

MONTH 5 to 9

Implement + Verify

- Run the low-cost measures.
- Build the case for capital, or a performance contract.
- Verify in IPMVP or ISO 50015 terms

MONTH 9 to 12

Systematise

- Write policy, named permanent team, SOPs for the big users, monthly EnPIs.
- Energy on the executive agenda like safety. Annual management review, then raise the targets.
- Verify savings, then review.

FREE TOOL The DOE 50001 Ready Navigator: a self-paced checklist of about 25 tasks. energy.gov/ISO50001

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KEY TAKEAWAYS

Audits to find savings. Build Systems to keep them.

01 Efficiency is low-hanging fruit

02 ISO 50001 manual. 50002, 50006 and 50015 tools. Certification is optional.

03 Standards are minimums. Codes are where the rubber hits the road.

04 The region has moved: CROSQ standards, CREEBC, CCREEE support, TTBS adoption.

05 The 150% allowance can de-risk step one, once ESCO certification is live.

Thank you. Ricardo Mahadeo

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APPENDIX

Benchmark sources

All free to access.

Singapore BCA building energy benchmarking report

www1.bca.gov.sg

ENERGY STAR Portfolio Manager, free benchmarking tool

energystar.gov/buildings/benchmark

CIBSE Guide F and TM46, benchmarks by building type

cibse.org/knowledge-portal

BIER 2023 water and energy benchmarking study

bieroundtable.com/publication

US DOE Better Plants, food and beverage resources

energy.gov/cmei/ito

LBNL, efficiency opportunities in the brewery industry

osti.gov/servlets/purl/881595

Food industry energy review, 2024, with chocolate and beverage EnPIs

sciencedirect.com, S2590174524001399

US DOE 50001 Ready, free EnMS on-ramp

energy.gov/ISO50001

APPENDIX

Sources for the regional slides

Public and free.

CLAIM	SOURCE
C-SERMS targets: 47% renewable capacity, 33% intensity cut by 2027	caricom.org, 41st Special COTED
Regional strategy, CROSQ standards, labelling scheme	caricom.org, energy.crosq.org
CCREEE technical hub, Bridgetown, in force 2018	ccreee.org/about-us
CREEBC based on IECC 2018, ASHRAE 90.1 compliance path	codes.iccsafe.org, JAMECC2024
Jamaica adopted CREEBC as JS 309, currently voluntary	bsj.org.jm, DJS 309
Belize: CREEBC proposed compulsory, Feb 2026	bbs.gov.bz, SI 80 of 2025
National cooling strategies with MEPS and labelling	energy-base.org, C-COOL
Barbados 100% renewables by 2030	Barbados energy policy, World Bank
Grenada PURC 2016, St. Lucia NURC 2016, World Bank facility 2025	purc.gd, nurc.org.lc, worldbank.org
T&T 150% allowances, TTBS role, price reviews	energy.gov.tt, gottbs.com, ric.org.tt

Abbreviations

TECHNICAL

EnMS	Energy management system
EnB, EnPI	Energy baseline, energy performance indicator
PDCA	Plan, do, check, act
M&V, IPMVP	Measurement and verification, and its international protocol
ESCO	Energy service company
ASHRAE	American Society of Heating, Refrigerating and A/C Engineers
IECC, ICC	International energy conservation code and code council
MEPS	Minimum energy performance standards
SEER, COP	Seasonal energy efficiency ratio, coefficient of performance
HVAC, BMS	Heating and cooling, building management system
VSD, EUI	Variable speed drive, energy use intensity

ORGANISATIONS AND PROGRAMMES

CARICOM	Caribbean Community
C-SERMS	Caribbean sustainable energy roadmap and strategy
CROSQ	CARICOM Regional Organisation for Standards and Quality
CCREEE	Caribbean Centre for Renewable Energy and Energy Efficiency
CREEBC	CARICOM regional energy efficiency building code
JS 309	Jamaica energy conservation code
TTBS, MEEI	T&T Bureau of Standards, Ministry of Energy
T&TEC, RIC	T&T Electricity Commission, Regulated Industries Commission
NGC, CEC	National Gas Company, Caribbean Energy Chamber
TTMA, TTCIC	T&T Manufacturers' Association, T&T Chamber of Industry and Commerce
DOE, LBNL	US Department of Energy, Lawrence Berkeley National Laboratory
BIER, BCA, CIBSE	Beverage industry roundtable, Singapore building authority, UK building services institution