ISO focus
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GREEN TECH

#134

ISO focus

May-June 2019

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BUILDING "clean" tech

Photo : SCC

***Chantal Guay**, ing. P.Eng., Chief Executive Officer, Standards Council of Canada.*

At their heart, standards are about ensuring that most products, services and processes work as intended. They have the potential to improve quality of life by protecting people and the environment. They are also a powerful tool for strengthening international cooperation and supporting innovative ideas. Standards can advance innovation, and when innovative clean-technology companies succeed, the economy and environment benefit.

Ten years ago, as a visitor to Iqaluit, one of Canada's northernmost communities, I witnessed first-hand how climate change affects people and their environment. Community leaders talked to me about failing infrastructures that were increasing the already large number of challenges faced by people living in these remote areas. How do you get supplies from the South if the ice bridges or the roads that are normally frozen most of the year have thawed? How do you adapt houses built on permafrost that has now melted? How do you build new houses on ground that is frozen half the year and mud the rest of it?

A decade on, we need not travel far north to see the effects of a changing climate. Increasingly frequent extreme weather events are evident locally. In Canada in the past five years, floods and wild fires have impacted millions of people and destroyed vast forests. Disaster relief costs billions of dollars and, according to the Insurance Bureau of Canada, related insurance costs in 2018 were CAD 1.9 billion. That estimate excludes reconstruction costs not covered by insurance policies, productivity loss for affected individuals, or the further impact on communities and ecosystems.

The need to adapt to a climate that is changing is no longer a choice, it is a necessity. An opportunity exists for innovation to deliver the very best green technology and to ensure the built environment is resilient. To do this, Standards Council of Canada (SCC) is leading efforts to create Canadian standards for resilient infrastructure, to better manage changing snow loads, increasingly intense storms and flooding. We funded research at the University of Waterloo's Intact Centre on Climate Adaptation to develop best practices that will help communities be flood-resilient.

We also share our knowledge so other countries may harvest our experience and expertise. For example, we are collaborating with other Nordic countries in new research proposed under the European Union's Horizon 2020 programme to develop a standardization roadmap for empowering Arctic communities in a changing climate.

As Canada's member body to ISO, SCC is committed to helping develop international green technology standards. Canada led the development of ISO 14034, *Environmental management – Environmental technology verification (ETV)*, to help companies that are developing innovative environmental technologies verify the environmental gains they can create, thus helping them meet demand and reach new markets.

The need for solutions to one of the most complex issues facing the world today creates opportunities for innovative sectors and industries to emerge and thrive. This is why we support cutting-edge companies. For example, we are working with Questor Technology Inc. – whose solar-powered waste gas incinerators are deployed around the world to reduce greenhouse gas emissions – to address a gap in existing standards for the design and performance of incinerators. We expect this will ultimately boost global demand for Questor's technology, as well as that of other businesses in the clean combustion and pollution reduction field.

Further, we're working with CarbonCure Technologies, whose patented innovation reduces both a company's carbon footprint and the cost of concrete production. The company has pioneered a means of injecting waste carbon dioxide into concrete as it is being mixed, which helps strengthen the product while stopping the gas from entering the atmosphere. To grow its business and scale up, the company required an amendment to a standard, which it pursued successfully with support from SCC.

I am excited about SCC's contribution to reduce the impact of climate change and ensure sustainable development here and abroad. When knowledge and standards are shared and applied to improve lives and protect the environment – in the north and across all latitudes and longitudes – we support our economies, and most importantly our quality of life. It benefits everyone. Right now, we have this great opportunity to act so that our children and their children can enjoy the world now and in the future – let's join forces and make it happen. ■

Celebrating women *in standards*

ISO has prioritized Sustainable Development Goal SDG 5 (Gender Equality) as part of its commitment towards the United Nations' 2030 Agenda for sustainability during #WomensWeek in March 2019.

In March, leading up to International Women's Day, ISO focused on the women who pack the punch in standardization. This meant finding our strongest lady bosses, both at the Central Secretariat office in Geneva and around the world. The results were astounding; an outpouring of responses from women all over the world, proud to show their work and share their story.

"The more #womeninscience, the more science becomes a caring mother on Earth."

Dr Lyudmila Elshina, ISO technical subcommittee ISO/TC 71/SC 1 (test methods for concrete)

"I've always been one of just a few women. I have to stand up for myself. The main thing is to be curious and anyone can do that, man or woman."

Marie-Hélène Lesourd, IT Specialist at the ISO Central Secretariat

"This year, we will make an additional effort to identify the right policies and tools to make sure that our International Standards are not only gender neutral, but also gender responsive."

Sergio Mujica, ISO Secretary-General speaking during #WomensWeek

"I was convinced that I had a responsibility to prevent such environmental disasters from happening to other organisms."

Zelina Ibrahim, ISO technical committee ISO/TC 207 (environmental management)

"#InternationalWomenDay is a great opportunity to highlight the struggles women go through to achieve equal representation and opportunities."

Dr Puji Winarni, BSN, ISO member in Indonesia

DRIVING INTO A CLEANER FUTURE

by Robert Bartram

As governments, business and the ordinary consumer attempt to recalibrate their daily existence to avoid the consumption of fossil fuels, we are often frustrated by the sheer scale and size of the task. What, we often ask, can we do to make a difference?

Perhaps an answer has come in the advent of "clean cars". These can be defined as vehicles that are electrically propelled using either batteries or fuel cells that run on on-board hydrogen, and often a hybrid of the two. The idea of electrical cars has been mooted for years, but it is only now, with the proven effects of climate change, that enough is being done to make them a viable commercial prospect. Indeed, change is already upon us. Monthly figures published by the Society of Motor Manufacturers and Traders suggest that electric car sales in the United Kingdom have risen significantly over the past few years. While only around 500 electric cars were registered per month during the first half of 2014, this has now risen to an average of 5 000 per month during 2018 [1].

Yet their production is not straightforward and many challenges face both producers and consumers before they can be considered mainstream. The first target, as Mr Yasuji Shibata, Toyota Motor Corporation's General Manager of the Evaluation Department for Electrically Propelled Vehicles, makes clear, "is to develop the electrically propelled vehicle to the same level of performance and reliability as conventional vehicles within a reasonable budget". Closely connected to this is the requirement to guarantee car performance that meets the customer's needs, especially on fuel economy.

All charged up

More specifically, the performance of a single cell (the smallest electrical unit) – and a fuel-cell stack (all cells combined) – are two key areas of focus. Batteries also have two specific requirements: storage and output. Unlike the gasoline tank, the capacity of a battery changes with environmental temperature and deterioration. There is also the difference between the electricity supply in battery vehicles and (hydrogen) fuel-cell vehicles: battery electricity has a finite amount of electrical energy. The challenge is that, particularly in the case of vehicles such as lift trucks, electricity is being expended all the time. This means that there is less capability to respond to surges and needs of energy when moving items, such as lifting and taking ramps. In other words, there is a continuous loss of efficiency, and thus productivity.

1) Next greencar, "Electric car market statistics", **www.nextgreencar.com/electric-cars/statistics** (accessed February 2019)

Electric vehicles must have a standard plug-in connector to charge from standard power points.

A plug-in electric car refuels at a charging station by the M40 Road in Oxfordshire, United Kingdom.

While it's true that hydrogen fuel produces zero emissions, it's also true that it doesn't occur naturally on earth.

However, with a fuel-cell-powered vehicle, the car or truck is able to function at 100 % capacity until the last drop of gas. Because batteries store only a finite amount of energy, there is not a great deal of range, but with hydrogen fuel cells the range is significantly higher. The difference is approximately by a factor of two at the moment, and possibly a factor of three in the near future. This is partly because a fuel-cell-powered car has more mileage and is less susceptible to environmental weather effects, with a shorter fuelling time of three to five minutes. This contrasts markedly with a Tesla-style car, which currently only manages a 20-minute refuelling time. It is likely, therefore, that a future trend will be a true hybridization of fuel-cell and battery technology.

A number of studies have suggested that it would be very easy to saturate the market with battery-operated cars, but simply replacing gasoline automobiles with battery-operated alternatives is unlikely to be as straightforward as it first sounds. There is only just enough capacity in the electrical grid to cope with such a change. With hydrogen production, the electricity variations can be balanced through the day, which is why engineering for a mix of solutions is so important. Funnelling direct renewable energy like wind or solar, or even nuclear, into the car is unlikely to work because these sources are so distant from the car itself. But with hydrogen as a fuel, electricity can be deployed at the outlet from where it is available.

Environmental friend or foe ?

A word should also be said about environmental safety, and the danger of failing to distinguish between “ green ” and “ clean ” fuels. If one takes, for example, biofuel, it is certainly green – but definitely not clean. Much focus has quite rightly been placed on carbon dioxide emissions, but the two hundred or so other pollutants of an internal combustion engine in the city car have been ignored, which are significantly more detrimental to human health. Carcinogens, for instance, are very much present in a biodiesel engine exhaust and pollute as much as a regular diesel engine.

Fuel-cell cars using hydrogen as a fuel can achieve a higher overall fuel cycle (well-to-wheel) average efficiency than an internal combustion engine using a biofuel such as biodiesel. Indeed, the biggest advantage of a hydrogen-powered fuel-cell vehicle is that it only produces water and air, which are not harmful to the environment. But while it’s true that hydrogen fuel produces zero emissions, it’s also true that it doesn’t occur naturally on earth. Producing it involves processes such as electrolysis, for which electricity is needed. And all too often, that energy still comes from fossil fuels.

So how can International Standards help overcome these multifarious challenges ? It goes without saying that, as with all areas of standardization, it means that the same products can be held to the same level of performance and reliability, regardless of where they are produced. It also means that the amount of resources required to develop a unique product will be reduced for each country, thereby providing environmental protection. In general, the main obstacle to international standardization is harmonization among manufacturers. After battery-powered vehicles, some countries are now shifting their focus to cars using hydrogen fuel-cell technology. There is a huge and rapidly growing market out there, so harmonization of International Standards has become a key priority.

The world’s first hydrogen-powered taxi fleet “Hype” proudly displays its logo at its launch event in 2015.

Fuel standards

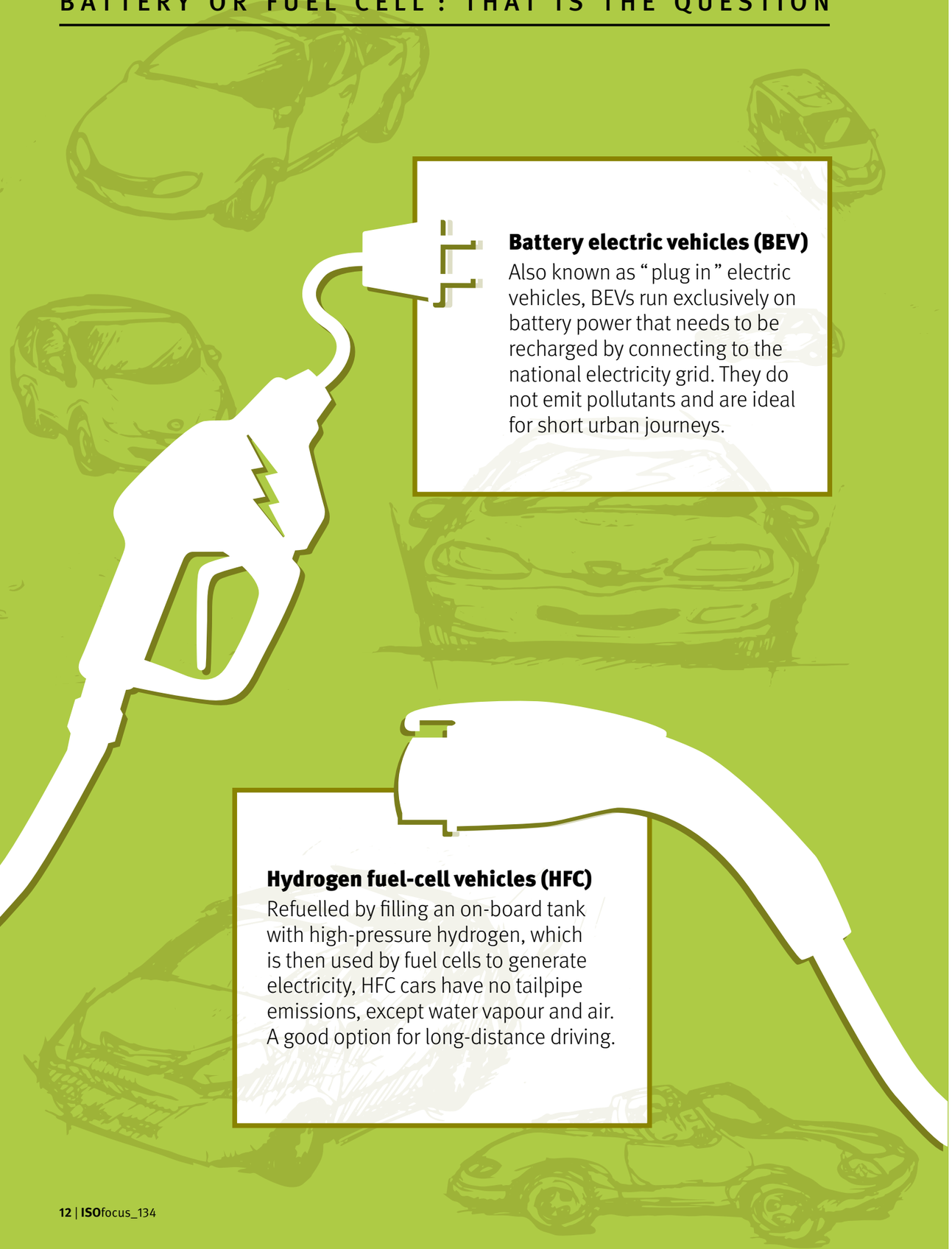
Specifically, ISO 17268 covers gaseous hydrogen land-vehicle refuelling connection devices. The hydrogen refuelling connector is standardized by this ISO standard for the countries which have a fuel-cell vehicle market. This means that consumers can obtain hydrogen from any hydrogen fuel-cell station in China, Europe, Japan, Korea, the United States and so on. ISO 23828 also relates to fuel-cell road vehicles and is used as a measurement for energy consumption for vehicles fuelled with compressed hydrogen. Fuel economy is measured by this method and is referred to in the international Global Technical Regulation GTR15. Fuel economy measured in this way will be used by governments to qualify the vehicles and manufacturers implementing this method as one indicator for improving vehicle efficiency.

Every day, obstructions like traffic lights and changing speed limits mean that the power demands of a car drivetrain vary rapidly. So do fuel-cell vehicles have the pulling power we expect ? ISO 20762 has been designed to test the maximum power of a hybrid electrical vehicle (HEV) for system power. ISO 23274-1 made it possible to measure fuel consumption without the “ misleading ” influence of the charge level of the battery when starting from a different “ state of charge ”. It meant, too, that the state of charge can be tested under different cycles, loads and temperatures.

ISO technical committee ISO/TC 197, which is mandated to devise standards on hydrogen technologies, is chaired by Andrei V. Tchouvelev, one of the world’s leading experts on hydrogen safety and regulations, codes and standards. Tchouvelev has worked for 35 years in the field of hydrogen and, after moving to Canada from his native Russia, co-founded the Canadian Hydrogen Safety Program in 2003. His committee does not deal directly with cars, but has created a family of fuelling standards, so everything related to the interface between fuelling station dispenser and hydrogen-fuelled cars falls under this remit. There are general requirements and also more specific ones concerning components like the dispenser, compressor, valves, fittings and fuelling hoses.

Engine of fuel-cell vehicle “ Mirai ” by Toyota.

Electric car sales in the United Kingdom have risen to an average of 5 000 per month during 2018.



Battery electric vehicles (BEV)
Also known as “ plug in ” electric vehicles, BEVs run exclusively on battery power that needs to be recharged by connecting to the national electricity grid. They do not emit pollutants and are ideal for short urban journeys.

Hydrogen fuel-cell vehicles (HFC)
Refuelled by filling an on-board tank with high-pressure hydrogen, which is then used by fuel cells to generate electricity, HFC cars have no tailpipe emissions, except water vapour and air. A good option for long-distance driving.

A global playing field

A number of countries have also signed up to the European Union’s Alternative Fuels Infrastructure Directive (AFID) and series of standards, of which hydrogen is one of the alternative fuel infrastructure options. The bulk of the preparatory work for the standardization base under AFID mandate was undertaken by ISO/TC 197 and examined dispensing points, fuel quality and connectors. This committee also participates in Phase 2 of the global technical regulation (GTR 13) on hydrogen and fuel-cell vehicles. It ensures that the International Standards’ requirements that the committee develops are in harmony with the global technical regulation requirements. It is complicated, though, despite there being many stakeholders working together to develop the necessary requirements for a level playing field.

“ People want to move mountains now and quickly, but may lack the sufficient technical knowledge and evidence, ” says Tchouvelev. There are added complications, he says, because “ we live in such a fast-paced world… and the Fourth Industrial Revolution is a challenge for standardization ”. There is a chicken-and-egg dilemma of sorts, he continues, of *when* to develop an International Standard to ensure safety and performance, yet not restrict technology, as fuel-cell cars and fuelling infrastructure have been under development now for 15 years.

The genie is out of the bottle – it’s not just passenger cars but also trains, buses and trucks, and other heavy-duty applications including marine, aviation and aerospace. For instance, a heavy-duty truck may require 80 kg of on-board storage, while a regular fuel-cell car stores about 5 kg. So now, in addition to light-duty vehicles, standards have to be developed for much higher on-board storage quantities and address the need to refuel as quickly as possible using much higher flows. Besides these capacity issues, both fuel cells and batteries face scaling challenges potentially limiting their independent larger-scale mobility applications. These include thermal and water management and increased-size balance of plant for cooling. For this reason, hybridization of fuel-cell and battery technologies may be very attractive. Requirements of manufacturers for standards to address these issues are all relatively new, and International Standards will need to continue apace with developments for fuel-cell and battery electric vehicles to find their way permanently to our streets. ■

Beyond *technology*

The same disruptive technologies that are changing our lives and revolutionizing virtually every sector of the economy can be used to create a more sustainable world. By setting the standards that frame these initiatives, ISO/TC 207 helps scale solutions to our most urgent environmental challenges.

Just a decade ago, the term "green business strategy" evoked visions of fringe environmentalism and a high cost for minimal good. Recently, however, a new common wisdom has emerged that promises the ultimate reconciliation of environmental and economic concerns.

This new vision sounds great, yet is it realistic? *ISOfocus* sits down with Sheila Leggett, who began her term in 2018 as Chair of ISO technical committee ISO/TC 207, *Environmental management*, building on a distinguished career as a biologist, ecologist, industry consultant and environmental legislator. Having served on Canada's Natural Resources Conservation Board and, later, the National Energy Board, Leggett's experience is broad and her knowledge detailed.

The idea that a renewed interest in environmental management will result in a more sustainable world has widespread appeal. It is not surprising that ISO/TC 207 standards are so much in demand. Their standards portfolio, after all, tries to spur innovation and create business opportunities – for the good of all. Here, Leggett gives the lowdown on environmental management, and how a strategy good for the world can also be good for your bottom line.

***ISOfocus*: To what extent is ISO/TC 207 on pace with green technologies? Can you tell us a bit about how the different standards contribute (particularly ISO 14034 on EVT)?**

Sheila Leggett: ISO/TC 207 is system-based, which means it focuses on creating frameworks for standardization, rather than following specific green technologies. All of our work in environmental management systems is done through the lens of sustainable development.

ISO 14034, *Environmental management – Environmental technology verification (ETV)*, is a great example of how experts within ISO/TC 207 identified a market need and developed a standard to meet current and future requirements. This environmental technology verification standard provides independent verification of the performance of new environmental technologies and allows developers to demonstrate performance of their technology to the market.

***Sheila Leggett**, Chair of ISO technical committee ISO/TC 207,* Environmental management.

ISO/TC 207 is system-based and focuses on creating frameworks for standardization.

With so many different technologies in the marketplace, it was agreed that an internationally recognized performance standard would level the playing field for technological innovators, provide credible, independent assessment of environmental technologies, and result in the achievement of sustainable environmental targets. Recently published, this standard has already been adopted by 39 countries.

What are the main challenges in making sure that ISO/TC 207 standards are used throughout the world? What is the added value of participating in international events such as COP24?

In my view, the main challenge in making sure the ISO/TC 207 standards are used is raising awareness about this set of standards and illustrating the value from their application. For example, we recently heard from one company that applying the ISO 14000 family of standards to its business has helped it to develop a new product from what was previously considered waste materials. This additional product increased its market base and reduced its waste volumes.
Another challenge we see is that the uptake of ISO 14000 standards is largely dependent on geographical location. We are putting great effort into understanding why this should be the case, and what further actions we can take to encourage broader acceptance. One of our goals, therefore, is to ensure that the standards are applicable globally. We are fortunate to have strong representation from both developing and developed countries within our technical committee, as well as from countries with economies in transition.
From that perspective, the added value of participating in international events such as COP24 is the increased visibility they bring us, by showcasing standards that are directly relevant to the important policy discussions being held. The ISO/TC 207 standards are a set of tools that can be used to provide stability and certainty in the field of environmental management systems. Assessing and controlling the environmental impact of an organization's activities, products or services is an important area of growing awareness to a broad range of organizations. Gaining exposure for the ISO 14000 standards through a wide range of events also provides us with valuable feedback on the current standards, ideas for future updates and the market need for potential additional standards within the field of environmental management systems.

To what extent has ISO/TC 207 adapted its strategy (business plan) in order to meet the market demand for greener products and services (and green sustainable development-oriented policies)?

Over the past two years, we have reviewed and updated our strategic business plan. In the process, we confirmed that ISO/TC 207 standards have a role in the sustainable growth of the economy, including green economy activity. Our updated plan references – and was informed by – the United Nations Sustainable Development Goals (SDGs), which are designed to shift the world onto a more sustainable path in just over a decade. Of the 17 SDGs, at least 14 are directly or indirectly addressed by the scope of ISO/TC 207's work in standardization. Part of our vision is that the implementation of the ISO 14000 standards offers a significant and positive contribution to achieving/delivering the SDGs. In setting this as part of our vision, we believe that our strategies will help meet the market demand for sustainable development, which will include greener products and services.

You have some great new projects on the go, including green financial projects and guidelines for incorporating ecodesign. Please tell us a bit about these and what future projects you will be working on.

Examples of new areas we have been working on include standards for climate adaptation and green finance, including green bonds. We are excited to be discussing potential collaborations with the recently announced technical committees ISO/TC 322 and ISO/TC 323, which are focused on sustainable finance and the circular economy, respectively. We are also having similar discussions with the International Electrotechnical Commission's technical committee IEC/TC 111 that looks more specifically at environmental standardization for electrical and electronic products and services.

You have 85 countries participating in the work of ISO/TC 207 (with another 37 as observers). How do you all do such a good job of keeping the momentum going?

We are fortunate to have a great many countries committed to the objectives and mandate of ISO/TC 207. Spurred on by this positive energy, participating countries put forward their most dedicated experts who generously share their talents and expertise to determine, within the ISO 14000 framework, the areas that most urgently require the updating of existing standards or the development of new work. It is the commitment and dedication of some of the best minds in the field that keep our motivation alive. ■

Turning up the heat on clean cooking solutions

by Ann Brady

Household air pollution still blights the lives of people living in the poorest parts of the world, cutting lives short, damaging the environment and putting huge burdens on healthcare systems. Clean cookstoves and fuels would go a long way to solving many of these challenges. One expert explains why ISO standards are an essential ingredient.

Cooking nutritious and tasty food for your family is at the heart of every home. The heat, the smell, the sizzle – all arouse atavistic pleasures and the kitchen, no matter how big or small, is regarded as the focal point of a home. Our appetite for TV food programmes, cookery books and celebrity chefs is ubiquitous.

In some of the world's poorest regions, however, cooking and preparing family meals can have fatal consequences. Although great progress has been made in reducing global poverty, for billions of people, the new technologies sweeping the globe have largely passed them by.

Toxic emissions

According to the World Health Organization (WHO), about three billion people worldwide cook meals for their families on inefficient and dangerous stoves, using biomass fuels – such as wood, charcoal, dung – on open fires, and on cookstoves that produce dangerous emissions, and in rooms that lack proper ventilation. The toll on women and children, in particular, has been high, with millions dying from lung and heart ailments caused by indoor fumes.

The WHO says household air pollution (HAP) is the noxious combination of smoke, particulate matter and other emissions from this solid fuel combustion. These common cooking practices are resource-intensive and highly dangerous. They are the leading cause of global exposure to HAP.

Clean cooking stoves and fuels would not only improve health and, therefore, livelihoods, they would also be an effective way to protect forests. According to a report in *The Guardian* last year, in Malawi, demand for charcoal, which is widely used for cooking as it burns more quickly and cleanly than firewood, has led to rapid deforestation. Despite a ban on the production, transport and sale of charcoal unless it is sustainably sourced, illegal trade is booming. To counter this, in villages around Malawi, women are being trained to make energy-efficient clay stoves and sell them locally.

The report says that these "improved cookstoves", which burn charcoal or wood more efficiently than traditional cooking fires, are gaining popularity. And another stove, a metal charcoal model designed by US social enterprise Envirofit, is also gaining traction, which the organization says cooks food in half the time and produces fewer toxic emissions.

The adoption and adaptation of national standards is a critical next step, as the standards need to be applied to have real impact.

In a blog published by the World Economic Forum, Ron Bills, the Chief Executive Officer and Chairman of Envirofit, writes: "Until recently, most solutions for fighting HAP were focused on replacing traditional stoves with improved biomass stoves. While this is a good short-term solution, it is best used as a stepping-stone for families until cleaner fuels are available." He also points out that the need for greater global access to modern energy is one of the United Nations Sustainable Development Goals, a set of 17 goals that pave the way for a fairer, safer and healthier future for mankind. "Their seventh goal is to 'ensure access to affordable, reliable, sustainable and modern energy for all'."

About 3 billion
people worldwide cook meals for their families on inefficient and dangerous stoves, using biomass fuels.

Progress and advances

Considerable progress has been made in finding solutions and ISO standards have played a significant role and raised the benchmark by setting new clean cooking performance targets. Ranyee Chiang, Chair of technical committee ISO/TC 285, *Clean cookstoves and clean cooking solutions*, and formerly the Director of Standards, Technology and Fuels at the Clean Cooking Alliance, is an expert in cookstove quality and helps to develop and implement standards, regulation and labelling. She explains that advances have been made in technology for cookstoves and fuels, with an increasing number of models that have significantly lower emissions than traditional stoves and open fires.

"The stoves and fuels adopted over recent years," she says, "have also been trending towards higher-performing technologies, which are a result of our increased focus on testing and standards." And to ensure that technologies are performing as expected in homes, Chiang says that field tests have been carried out on these new technologies. This also has the added benefit of gathering input on users' preferences and needs. Like any other consumer product, cookstove and fuel alternatives need to be convenient, easy to use and safe.

These new ISO targets replace the five-tier framework under ISO's International Workshop Agreement with a new six-tier system that more clearly represents key performances of cookstoves and relates them to relevant health and environmental impacts. The targets are expected to serve as the basis for national policies and programmes on cookstoves, and to incentivize manufacturers and developers to continually improve stove quality and design.

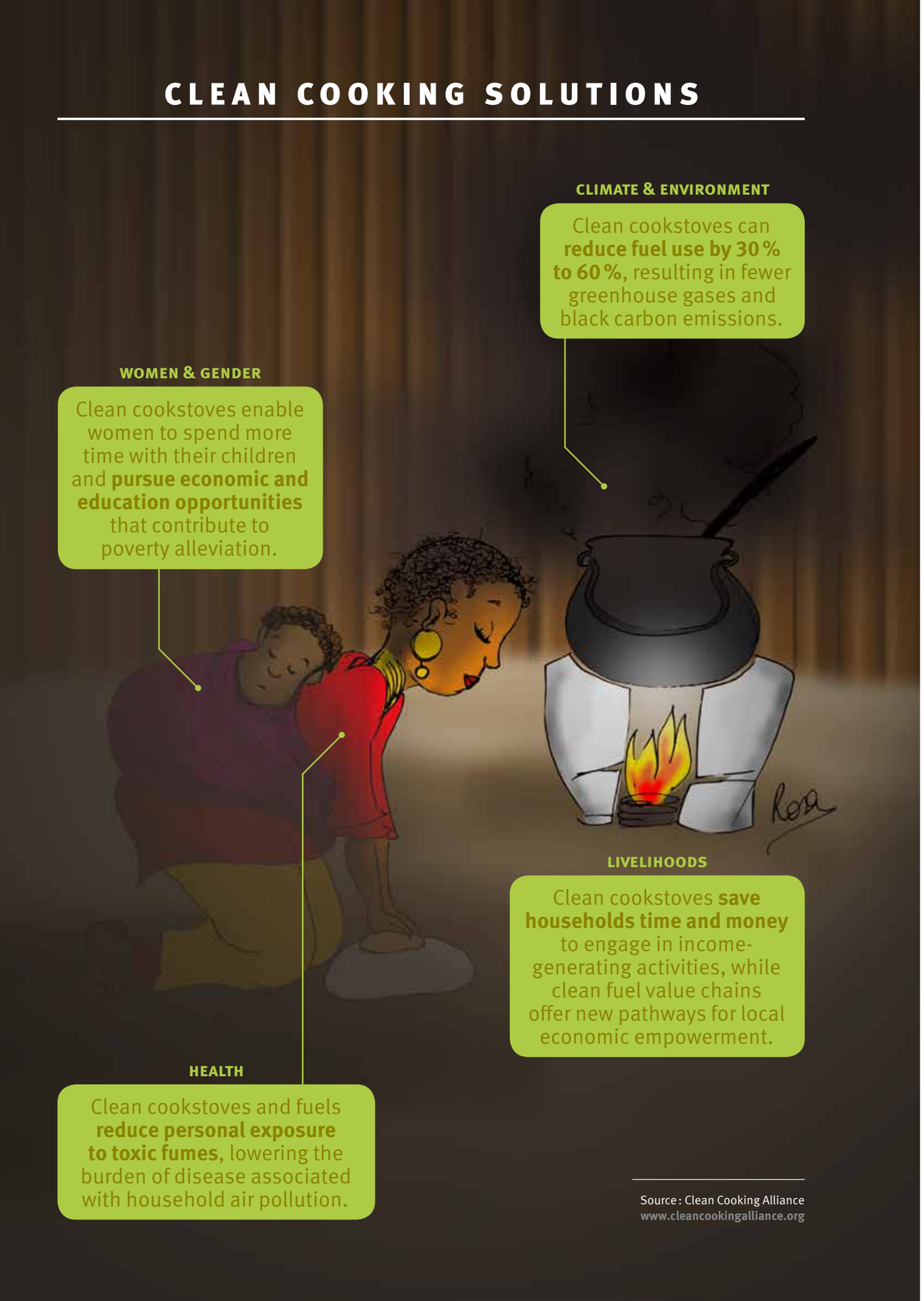
According to Chiang, the three ISO standards published in 2018 for the clean cooking sector have reflected the lessons learned from the 2012 International Workshop Agreement, growing experience with testing, research on the linkages between technology and benefits, and experience in communicating with lay audiences and consumers. "The IWA was important to improve the use of technology testing results, and that has helped to inform and strengthen the new ISO documents," she says.

Three standards

First to be published was International Standard ISO 19867-1 (laboratory testing) which specifies updated methodology for conducting testing of emissions, efficiency, safety and durability in a way that is both reliable and feasible in low-resource environments. In the same series, ISO/TR 19867-3 (voluntary performance targets) is a technical report that provides an updated framework to communicate test results and potential benefits to users in a simple and standardized way, to ensure that test results will not be misunderstood or misrepresented.

Supporting these documents is another technical report, ISO/TR 21276, which provides the terms and definitions to ensure that the standards community and the broader clean cooking sector have a shared understanding of commonly used terms. Chiang says: "In order to encourage further technology improvements and communicate benefits to consumers, these three documents will be critical. The sector has already begun using them, as well as documenting additional lessons learned."

Collaboration, as in other fields, is critical to making headway in clean cooking solutions and, here again, standards are pivotal. According to Chiang, the last few years of the International Standards' progress have been focused on international collaboration. "With these three documents published – and one more, ISO 19869 on field testing, is close – the work will shift to the country level, with governments, businesses, testing centres and non-profits implementing and adapting the standards." Last year, ISO/TC 285 also shifted from a co-secretariat (ANSI and KEBS) to KEBS alone, which further represents the increasing leadership role for developing countries within ISO.



Behaviour change

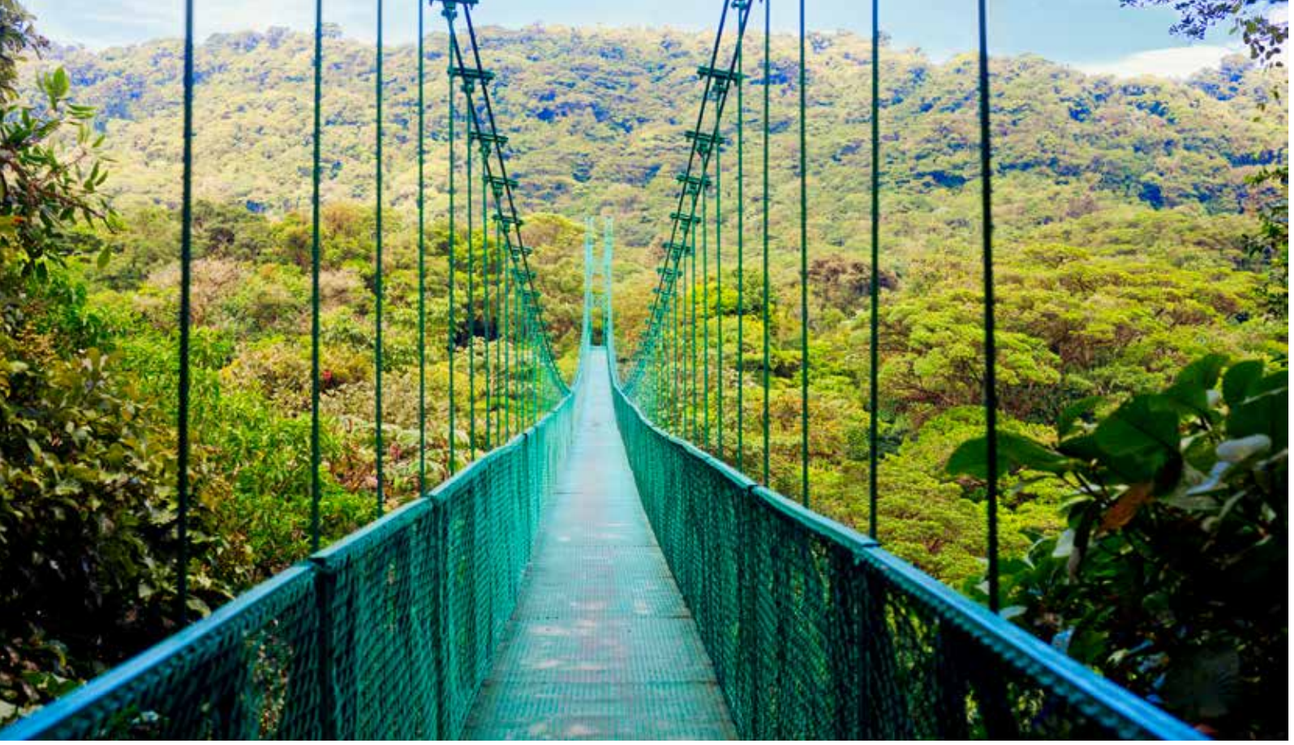
One example of progress that Chiang is particularly enthusiastic about is Ghana, which she says links together standards, technology performance and consumer awareness. "The Energy Commission in Ghana, in partnership with the Clean Cooking Alliance, conducted market research on how consumers understand stove emissions, efficiency and the benefits of different technology options. The results of this market research were used to design a label that the Energy Commission has proposed to the Ghana legislature for approval to use in the Ghanaian marketplace."

Chiang says the Clean Cooking Alliance has supported the standardization progress by bringing stakeholders together and facilitating discussions on International Standards. "The Alliance has also supported capacity building at testing centres, national standards activities, as well as market development, consumer behaviour change, research and investment, with all of these areas working together to accelerate the clean cooking market."

So what steps are being taken to build on this progress and to ensure that it is sustainable? Chiang says the adoption and adaptation of national standards is a critical next step, as the standards need to be applied to have real impact. "Training laboratory technicians and national governments on the new methods and standards is also very critical and ongoing," she says. She adds that many of the ideas in the standards documents are new, so they also need to be tested out with the lessons learned incorporated into the next review cycle.

Chiang says: "I hope that the clean cooking sector can continue to support testing centres, implement policy tools and publish test results for clear and accurate communication to policy makers, donors and consumers. These actions will ensure that standards are implemented effectively and enable continued improvement of technologies and fuels for cooking."

As the WHO points out, clean cooking is also integral to ten of the Sustainable Development Goals, including those that focus on health, climate action and gender equality – which, of course, benefits the entire planet. ■



The green heart of **Costa Rica**

Hosting 6 % of the world's biodiversity on its tiny land mass, it's no wonder Costa Rica is committed to protecting the environment. Now, the next milestone on the political agenda is achieving carbon neutrality. Mauricio Céspedes, Executive Director at INTECO, ISO's member for the country, explains how.

In 2015, Costa Rica hit a remarkable milestone when it generated the country's electrical power from 100 % renewable energy sources during 285 consecutive days. This was another feather in the cap for our small Central American republic, which already emerged as a leader in ecotourism in the late 1990s. The Costa Rican Institute of Electricity (ICE) has since revealed that the country had 300 days in which renewables met its entire demand for electricity, beating its own previous record.

You might be tempted to ask how a country of just 51 000 km^2 and five million inhabitants managed such a feat. Helped by its geographical situation and its geological and topographical conditions, Costa Rica focused on its most abundant resource : water. The country's power mix is dominated by hydropower (75.3 %), but also includes geothermal (12.84 %), wind (10.08 %), biomass (0.77 %) and solar (0.01 %), according to ICE statistics.

Today, the various activities have been regrouped in one single policy. Under its National Strategy on Climate Change, Costa Rica is committed to becoming the first carbon-neutral country in the world. This national strategy manifests our country's pledge to continue setting objectives for the rest of the world to follow, as we did in 1948 when we abolished the military or by being the first tropical country to reverse the deforestation process in the late 1980s.

Firm green steps

So what is carbon neutrality ? It's when the net greenhouse gas emissions a country or organization releases to the environment remain equal to zero. To realize this goal, Costa Rica aims to compensate its carbon emissions with equivalent doses of oxygen so that, when we do eventually meet our target, we can be satisfied that our country has no part in global warming or the deterioration of air quality. This commitment sweeps across all sectors of the economy, including one of our country's most representative exports – coffee.

The right to a healthy and ecologically balanced environment for all was enshrined in the Constitution by amendment in 1994.

Since 2014, the NAMA Café project is helping to transform coffee production into a low-carbon industry. Coffee was chosen because it is one of the most important sources of greenhouse gas emissions in the agricultural sector. Among other things, some coffee mills have already introduced innovative technologies for treating pulp and husks (two waste products of coffee production) to control and avoid their methane emissions.

Some say our environmental aspirations have grown out of our fertile soils and inhabit the spirit of every Costa Rican. In fact, the right to a healthy and ecologically balanced environment for all was enshrined in the Constitution by amendment in 1994. Today, our carbon neutrality goal has drawn all economic sectors in a participatory process that includes private companies, government bodies, non-governmental organizations and academia.

Standards as strategic allies

Indeed, a vital component of Costa Rica's pledge to create a greener society is its dedication to maintaining a competitive market. To meet this goal, it has implemented programmes at both the governmental and organizational level. For example, the Instituto de Normas Técnicas de Costa Rica (INTECO), our national standards body, released a standard for organizations to follow in order to become carbon neutral.

Now in its third edition, INTE B5:2016, *Standard for demonstrating carbon neutrality. Requirements*, seeks to enhance organizations' competitiveness through improved environmental performance based on good emissions management, technological advancements and optimized use of natural resources and raw materials. This standard is committed to the principles of ISO International Standards and includes references to Costa Rican adoptions of many ISO standards on greenhouse gases.

The decarbonization of society consists of activities that limit, minimize or correct environmental damage to water, air and soil, as well as problems related to waste, noise and ecosystems. This includes cleaner technologies that reduce environmental risk, pollution and resource wastage, and the use of environmentally friendly goods and services. Such a complex process required a normative framework that could integrate the economy, technology, cost, environmental issues and sustainability into one single field.

Photo: Panoramio by David Broad

The Cachí hydroelectric plant now has capacity to generate almost 160 MW after expansion works were carried out.

Framework for sustainability

These considerations led to the national adoption of the ISO 14064 series of standards for the quantification, monitoring and reporting of greenhouse gases, which has been instrumental in helping organizations create an inventory of their emissions. Developed by ISO's technical committee ISO/TC 207, *Environmental management*, it has become an integral part of the country's carbon neutrality programme. In line with national legislation on environmentally friendly products, Costa Rica also turned to the ISO 14020 suite of standards on environmental labelling and declarations, by the same ISO committee, which INTECO included in its portfolio by national adoption. These have had a tremendous impact on the entire field of green technologies, fostering the development of a nationwide environmental labelling programme.

These standards and others by ISO/TC 207 have contributed significantly to our carbon-neutral goal because they are practical, effective and can be used by organizations of all types and sizes at any stage of development. Although they do not directly discuss carbon neutrality, these standards highlight the importance of good environmental management for business competitiveness. They also provide a framework in which environmental actions can be continually improved to reach the country's goals of sustainable development.

Wind turbines stretch along a dusty road near Tierras Morenas, Guanacaste.

Photo : INTECO

***Mauricio Céspedes**, Executive Director at INTECO.*

For just as Costa Rica's demilitarization many years ago was designed to favour sustainability and development, so the decarbonization of the country's economy serves a similar purpose. Indeed, there is increasing recognition of how a shift to renewables can act as a catalyst for sustainable development and achieving the United Nations' Agenda 2030 and its 17 Sustainable Development Goals (SDGs). Currently, the Costa Rican government is making big efforts in this direction. As part of this national resolution, INTECO advocates the use of globally recognized standards as essential tools to help government, industry and consumers attain these sustainable goals. Based on international consensus, they provide a solid benchmark for decision makers to have a positive impact on our environment.
Finally, ISO 50001 on energy management systems, which INTECO adopted in 2017, is another essential standard that served as the basis for developing more specific standards on energy efficiency in compliance with our national policy on energy savings. The standard's appeal is that it will help a greater number of Costa Rican businesses implement sound energy practices, thus contributing to our overarching goal of carbon neutrality.

Carbon copy

Can Costa Rica's model be exported elsewhere? I, for one, believe it can, but in order to do this, countries need to establish domestic policies that foster a culture in which citizens show active commitment towards achieving their environmental goals. In Costa Rica, this formula has resulted in the protection of 25.6 % of the country's total land mass.

The decarbonization of society includes cleaner technologies that reduce environmental risk, pollution and resource wastage.

Environmental education has also been key to sustainable development and Costa Rica has been one of the acknowledged leaders in efforts to promote environmental learning. As so much of the social and economic support for education in Costa Rica has centred around conservation issues, environmental education has become a point of intersection between the government and the people. In fact, the National System of Conservation Areas (SINAC), which comes under the Ministry of Environment and Energy (MINAE), has been working on this for years, accruing a wealth of experience on biodiversity and marine issues.
Costa Rica has specialists in many fields of biology, including biosphere, wetlands and heritage sites. Educational projects funded by public/private alliances have been equally successful in increasing national awareness. However, these projects need to be constantly evolving to have significant long-term impact.

Challenges ahead

While Costa Rica has certainly made impressive environmental progress over the years, positioning itself as a pioneer in nature conservation, there are still many challenges ahead. For example, we need to establish a prevention, control and mitigation system for those climate change impacts that are generated by human activity. Environmental control and quality must engage a wide range of social stakeholders and all our public institutions to be truly effective.
To be fair, our efforts to coordinate the environmental agenda have increased with the creation of specialized sub-groups, but these must synchronize better with existing inter-sectorial groups. This includes a more prominent involvement of environmental groups at decision-making levels. Politicians, business leaders, teachers and other people in leadership positions must strengthen their engagement in order to gain a better understanding of the issues at stake, so they are able to participate more fully in the decision-making process.
Given the scale of the task, is the plan to transform Costa Rica's energy dependence realistic? Ultimately, the widespread adoption of clean energy is a gradual process, but with research and development in carbon-free technologies and standards to help us, we hope one day to get rid of fossil fuels once and for all. ■

The move to GREEN

Environmental technologies have a promising future in meeting the needs of a sustainable planet. Here are a few of the ways in which ISO standards are supporting the trend.

Clean cooking solutions stop millions of women from choking on harmful fumes when cooking the family meal.

ISO 19869 *
(field testing methods for cookstoves)

ISO 19867-1
(laboratory testing for cookstove emissions)

ISO/TR 19867-3**
(guidance on voluntary performance targets for cookstoves)

ISO/TR 21276**
(vocabulary)

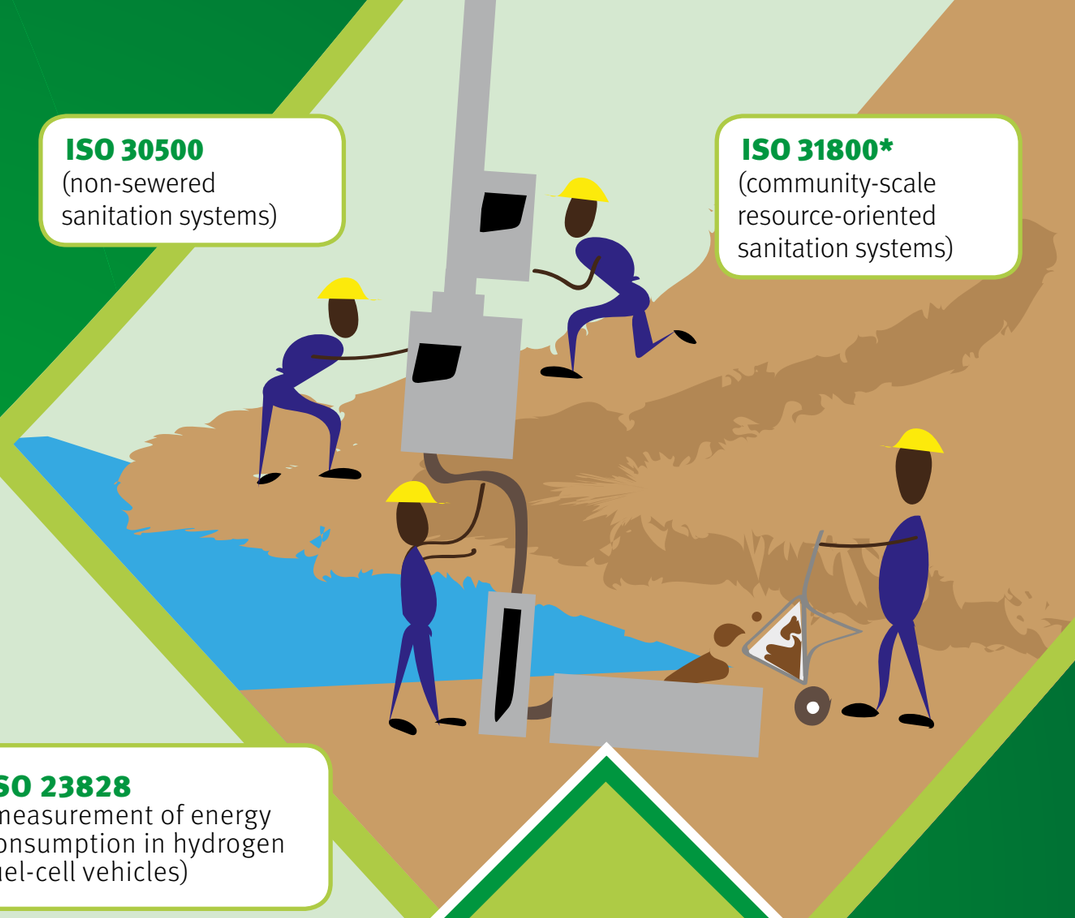
Clean cars prevent the emission of polluting fossil fuels into the atmosphere.

ISO 17268
(gaseous hydrogen land-vehicle refuelling connectors)

ISO 20762
(power for propulsion of a hybrid electric vehicle)

ISO 23274-1
(measurement of fuel consumption in hybrid electric vehicles)

ISO 23828
(measurement of energy consumption in hydrogen fuel-cell vehicles)



ISO 30500
(non-sewered sanitation systems)

ISO 31800*
(community-scale resource-oriented sanitation systems)

Clean sanitation systems provide safe toilets in places without sewers.

* Under development
** TR : technical report

Design solutions
for sustainable technology

Manufacturing for the metals and mining industry is no easy task, and one that Reliance Hexham has tackled with determination for three decades. With new sustainable technologies and practices, the Australian company offers design solutions to create specialized hard-wearing equipment that also spells ecological excellence.

The Australian mining industry dates back to the gold rushes of the 1850s, making it one of the country's most well-established sectors. Australia also has one of the most dynamic and innovative aluminium and steel sectors in the world, with some two million tonnes of aluminium and 5.3 million tonnes of steel produced annually.

As one of the world's largest mining industries, Australia has ongoing demand for high-tech equipment that is tough, durable and safe – but often energy-intensive and ecologically unsound. The industry's steady investment in research and innovation, and the deployment of greener technologies will ultimately make mining cleaner and safer. One Australian company is spearheading the move towards greater productivity, worker safety and ecological best practice – sustainably.

Established in New South Wales, Reliance Hexham is an experienced mining and metal-processing equipment supplier specialized in custom solutions that may require specific design, manufacture or refurbishment processes. In today's competitive landscape, the company has turned to ISO standards to keep ahead of the game – with great success in terms of quality, worker safety and environmental protection, as Lauren Meldrum, HSEQ Manager at Reliance Hexham, explains.

***ISOfocus*: What is the strategic value of International Standards to a company like Reliance Hexham?**

Lauren Meldrum: With a customer base spanning both national and international locations, we find ISO management system standards extremely valuable as they are widely recognized and used across multiple countries and sectors. Many large corporations and government entities demand certification to these standards as a prerequisite for working with their suppliers and contractors. Holding these certifications ensures we are eligible to tender and complete work for those organizations, as well as giving them increased confidence in our systems to service their customers' needs.

For the industry segment we serve, and target in our strategies, having our management system certified also guarantees that we meet the basic requirements expected of us as suppliers. Because our system is process-based, we can also provide a quality plan, make continual improvements drawn from the system and sustain the gains and traceability required by our current and future customers.

What is the role of ISO standards for the successful support of innovation and the dissemination of green technologies?

Working in a small company in a regional area of New South Wales, we are acutely aware of our immediate environmental responsibilities. Our operation is in an old factory building, which has some heritage aspects, along with being on a major road transport junction and the Hunter River, so we need to keep up to date with various green technologies.

About Reliance Hexham

In just over a decade, Reliance Hexham has invested in new technologies in almost all aspects of its operation, helping to turn it into the modern and progressive company it is today.

2008 – Heat treatment furnaces

Converting to gas furnaces has meant the removal of the old 3 000 l oil tank, eliminating not only a major safety hazard but a major environmental hazard, too.

2014 – Tablet devices

Initially implemented as a quality improvement tool to create consistency across audits and inspections, the tablet devices have also driven the move towards a paperless system.

2017 – Lighting

All on-site lighting was replaced with LED lights. These are not only more efficient, they have improved visibility for the workforce, creating a safer work environment.

2018 – Air compressor

Replacing the company's 20-year-old air compressor with a new, more energy-efficient model had the added benefit of reducing water in its air lines through a built-in "air dryer" system. This means increased reliability of air tools and improved quality in areas such as protective coating where air-powered spray guns are used.

2019 – Solar power

Completion of a large-scale 97.5 kW solar power installation estimated to produce an average of 350 kWh per day, contributing to over 80 % of the site's energy consumption.

2019 – New spray booth

Just ordered! The new pressure-controlled closed environment will help keep a check on air pollution from protective coating activities as well as the quality of the coating itself.

We continually review areas for improvement using risk-based thinking and record the details and required actions in our risks and opportunities documentation. Our management review meetings, which look at our processes from a higher level, are a key area where green technologies are identified for implementation. These are largely related to our local environment and we have taken steps and invested in green technologies and management system controls within our processes and procedures.

Can you say how these ISO standards help Reliance Hexham support the company's sustainable development goals?

Embedding the requirements of ISO management system standards throughout our processes, particularly with regard to the environment and workplace health and safety, helps to ensure that these aspects are considered at every stage of our operations. From design and manufacture, to repairs and testing, and procurement, the risks and impacts in these areas shape the decision-making process and drive improvement.

Photo : Reliance Hexham

The 200T Test Rig, which is used to conduct proof load and destructive tests for design validation.

Photo : Reliance Hexham

***Lauren Meldrum**, HSEQ Manager at Reliance Hexham.*

The standards we are integrating within the Reliance Hexham management system for quality, health and safety, and environmental issues will give us all a clear line of sight, not only to improve our processes but to drive the profitability of our operations forward, while reducing our environmental and downstream impacts, including our carbon footprint.

Our strategic plan has been strengthened using the specific requirements of ISO management system standards, underpinned by additional notes and appendix guidance on strategic analysis techniques such as SWOT (Strengths, Weaknesses, Opportunities and Threats), PESTEL (Political, Economic, Societal, Technological, Environmental and Legal) and interested parties analysis.

Spanning various industries and sectors, these strategic analysis techniques highlighted the need to start implementing International Standard ISO/IEC 27001 on information security management systems. Published in conjunction with the International Electrotechnical Commission (IEC), this standard helps ensure our IT security is up to scratch. We believe that all these ISO standards will do a lot to future-proof Reliance Hexham and contribute to a sustainable and valuable business.

Can you describe the use made by Reliance Hexham of ISO's management system standards? How would you describe the company's approach to their use?

ISO's management system standards have imposed a framework for consistency across all our departments. Their high-level structure (HLS), which consists of a set of core texts spanning the entire ISO management system concept, has been used to guide the agenda of our management review meetings, which has been helpful in ensuring that all areas are covered in a structured way.

Tradesperson conducting an assessment of goods received for recertification.

We are pleased to have contributed to the second edition of *The Integrated Use of Management System Standards* handbook published in late 2018, which helps organizations of any size or sector embed the requirements of multiple management system standards in one integrated system. We reviewed all the common HLS requirements, consolidated them and then integrated these into our business processes. Now, our people can concentrate on their work processes rather than worry about fulfilling the requirements of the standards.

It's common sense and also means we don't have to quote specific clauses from the standards when completing internal audits and talking continual improvement with process owners and process participants. Part of my job is to ensure our system conforms to the requirements of the management system standards whilst continuing to meet our business needs on a daily basis.

We have found our production department getting on board and taking ownership of their processes and other documented information, making full use of the dedicated tablet devices. In so doing, they are improving their ability to not only solve immediate problems, but also bring to light areas where we could improve the upstream and downstream activities within our process-based management system.

These standards include the concept of risk-based thinking as a proactive, preventive and planned approach to managing our risks. Our engineers already use Design Failure Mode and Effects Analysis (DFMEA) in the engineering process, a systematic technique for assessing system reliability, but we have since identified potential improvements not just within our internal processes but with our supply chain and suppliers as well. Discussions with our suppliers and how they interface with our processes have found mutually beneficial ways to share in risk reduction and achieve more consistent quality outcomes.

What concrete benefits result from the use of ISO's management system standards?

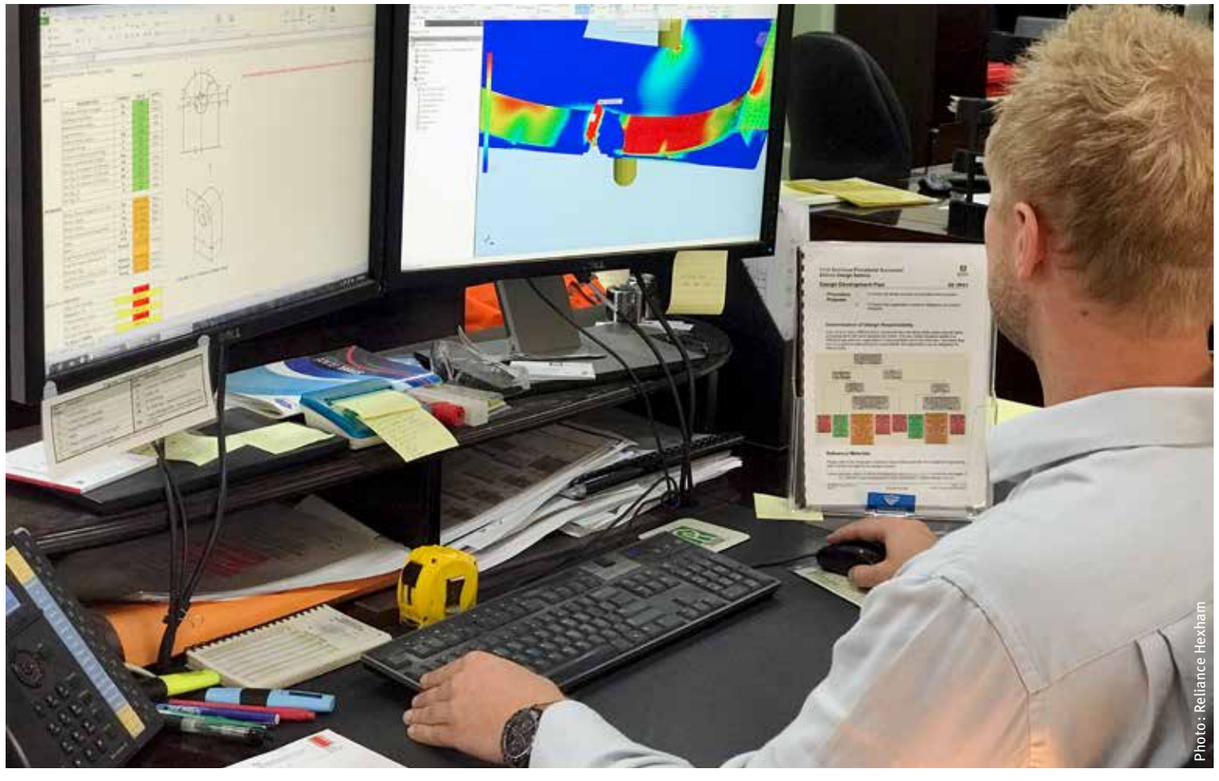
Implementing an integrated management system has improved our processes significantly by helping to reduce costs and increase sales. One example is the 80 % reduction in warranty jobs in 2018 when compared to 2013, as well as an over 70 % reduction in job reworks.

These stunning achievements are due in large part to our team of professionally qualified engineers, who are at the forefront of helping clients better define their engineering needs. The Design Development Plan used to control the process has been heavily influenced by ISO management system standards, ensuring the quality, safety and environmental aspects of the design are addressed at each stage of the process. Our engineering software enables our engineers to create concepts, drawings, 3D models and perform Finite Element Analysis (FEA) on their design to ensure it is correct prior to approval for manufacture.

Finally, our testing laboratory, which is accredited to ISO/IEC 17025 for the competence of its testing and calibration, provides clients with an in-house testing facility to deliver full design validation for new and existing designs. The development of smart quality inspections on tablet devices includes customized prompts and questions that appear based on the user's previous answers. This has ensured consistency across checks and inspections, regardless of the person who is conducting them.

Our sales have been positively impacted as we can now advertise a point of difference from our competitors through the traceability and documentation we provide to our customers. This enables us to fulfil our due diligence and duty-of-care requirements, as well as giving customers peace of mind that their equipment is fit for purpose.

It seems that ISO has transformed itself since our first "brush" with standards some years ago. There was a time when we were forced to "meet the standard requirements", but now it's more about how we integrate those requirements into our business processes that will ensure the intention of the standards is realized. Getting our people more engaged in the integrated system reinforces our commitment to quality, safety and the environment, and affirms the company's culture that "this is how we do things at Reliance Hexham". ■



Mechanical engineer conducting Finite Element Analysis (FEA) on a modification to an existing design.

TRENDS AND CHALLENGES IN ICT

Every year, a dozen organizations come together to focus on global standards collaboration in the area of information and communication technology (ICT). This year's meeting – GSC-22 –, was held in Montreux, Switzerland, on 26-27 March 2019. Among a broad range of topics, expert speakers brought special focus to the potential of artificial intelligence (AI) and smart sustainable cities.

Hosted jointly by ISO and the International Electrotechnical Commission (IEC), this 22nd edition attracted participants from around the world, with notable representation from countries where ICT is set to play a strong role in the future. Discussing new trends and challenges for using AI technologies to make city infrastructure and operations more reliable, members focused particularly on the development of guidelines and standards that enable seamless data exchange and interoperability.

The convergence of technologies brings new complexities, creating a greater need for clarity through

International Standards. Capitalizing on synergies, ISO and IEC's joint technical committee on information technology (ISO/IEC JTC 1) boasts a comprehensive scope of work that helps advance standards efforts in areas of mutual interest. This collaboration is able to take advantage of common goals to provide standards that have broader applicability and will empower the ICT industry worldwide.

A newly published brochure entitled *IEC, ISO and information communication technology* helps organizations make sense of ICT.

Read the new ICT brochure on iso.org.

INSPIRING ROMANIA'S YOUTH

Sergio Mujica at the Bucharest University of Economic Studies.

ASRO marked 90 years of Romanian standardization with a commemorative event in the country's capital, Bucharest, in late 2018. The event brought together representatives from the standards arena, including ISO Secretary-General Sergio Mujica.

Participants were given a rundown of progress made on important issues, such as the impact of standards on the country's economy and the adaptation of quality infrastructure policies. Attending a panel discussion on the importance of countries' involvement in standards development, Sergio congratulated Romania for its significant contribution to international standardization.

Panellists placed the spotlight firmly on education and how to make standards attractive for the younger generation. The ISO Secretary-General later joined a student lecture on the use of standards in the Fourth Industrial Revolution at the Bucharest University of Economic Studies. There, he delivered an eloquent speech highlighting the crucial role of standards in today's competitive world and the many benefits they bring.

MEXICO'S GENDER AGENDA

Standards are presumed to be gender-neutral; that is, they are developed without recognizing the differences between male and female standards users. Yet including the social, physical and biological differences of gender in standards development is of key importance, since not doing so may put individuals at a disadvantage or in danger.

To redress the imbalance, Mexico's national standards body (DGN) is looking at standardization through the prism of gender with a view to making them more inclusive in the future. The project, which began late last year, addresses the importance of weaving explicit specification on gender issues into standards.

An inaugural workshop was hosted by DGN in December 2018 to raise awareness of the implications of standards and gender. The discussions among governments, industry and standards makers are just the first among a number of events to ensure standards are designed with all in mind.

MAKING THE MOST OF MARKETING AND COMMUNICATION

Across two days, more than 90 delegates representing 46 different national standards bodies (NSBs) converged for the ISO Marketing and Communication Forum in Geneva, Switzerland, in April 2019.

Alongside external keynote speakers from the international arena, such as the World Economic Forum and John Wiley & Sons, a global publishing company specializing in scientific literature, the event allowed participants to present innovative projects. NSBs were also able to discuss their challenges, share successes and learn from each other's experiences in the fields of marketing and communication.

Leading the discussions, ISO's marketing and communication team shared their expertise through a series of lively roundtable exchanges in what was deemed a most productive, enjoyable and stimulating event.

ISO ROLLS OUT HEALTHCARE BROCHURE

ISO has just published an update of its brochure *ISO and health*, which contains a snapshot of the most important ISO standards used in the health industry to ensure our medical treatments and products are safe and secure.

Released to coincide with World Health Day, observed by the World Health Organization on 7 April each year, the new publication highlights a selection of standards that improve the quality of care, reduce healthcare costs and protect the health and safety of patients worldwide.

Under the banner of "Universal Health Coverage", this year's World Health Day couldn't have been more consistent with ISO's goals, which are about ensuring all people and communities have access to quality health services wherever they need them. Through its portfolio of 1 400 standards focusing on health, ISO offers solutions that support the full spectrum of services needed throughout a person's life – from medical devices to health organization management, to health informatics and traditional medicines.

ISO and health is part of a series of thematic brochures showcasing how ISO contributes to creating a fairer, more equitable world through standards.

Photo : Gates Archive/Shawn Koh

An Eco-San toilet is installed at the Yixing Huankeyuan Primary School in Yixing City, Jiangsu Province, China, in September 2018.

The high-tech world of toilets

by Rick Gould

Well over half the world's population does not have access to safe sanitation. For many people, this means the indignity and risks that come of having no toilets. The answer, it seems, lies in new sustainable treatment plants. ISO and the Gates Foundation have joined forces to show how clean toilets and standards can change people's lives forever.

In 2010, the United Nations (UN) formally declared that access to clean water and safe sanitation are fundamental human rights. Aligned to this, the UN's Sustainable Development Goal SDG 6 states that everyone should have access to safe sanitation by 2030. This, in turn, would eliminate open defecation, which billions must still endure. According to the Joint Monitoring Programme for Water Supply and Sanitation, the official United Nations mechanism tasked with monitoring progress towards SDG 6, 2.3 billion people lack any form of sanitation at all, whilst over two hundred million tonnes of human waste go untreated each year.

In the developed world, most if not all people take advanced, interconnected sewerage and wastewater treatment systems for granted, whilst in the developing world, 90% of sewage ends up in lakes, rivers and oceans. This causes pollution which creates a health hazard for animals, plants and people. "Sixty per cent of the human race does not have access to safely managed sanitation," reveals Sun Kim, a Program Officer at the Bill & Melinda Gates Foundation and Chair of project committee ISO/PC 318, in charge of developing a standard for community-scale sanitation systems.

Moreover, clean water and sanitation are closely connected since uncontrolled sewage frequently contaminates water resources, with often devastating consequences. "If we don't have safe sanitation, then clean water will get tainted," observes Kim. Shockingly, 1.8 billion people globally use a source of drinking water contaminated with faeces. Hence, it is not surprising that, according to the World Health Organization (WHO), unclean water and poor sanitation are the world's second biggest killer of children. So how can we solve this conundrum?

Non-sewered solutions

Building conventional types of interconnected sewers and waste treatment systems is one answer to the problem, yet these require huge amounts of money and time to build – two resources that are not so easily available in the developing world. Is there a way to create non-sewered systems that do all the things these big systems do without the cost and infrastructure? "We believe the answer is yes," says Sun Kim. In fact, ISO and the Gates Foundation are achieving this together through the work of ISO/PC 318, whose secretariat is held by the national standards bodies of the United States and Senegal under an ISO twinning arrangement.

Managed sanitation systems without interconnected sewers are known as non-sewered sanitation systems. Following significant support from the Gates Foundation, ISO began by developing International Workshop Agreements (IWAs) on the subject. The Gates Foundation promotes and sponsors research and investment in areas such as education, agriculture, global health and sanitation for the developing world, whilst ISO can help get targeted specifications to market in less than a year using the fast-track process offered by an IWA.

Although IWAs often evolve into fully fledged ISO standards, they provide much-needed solutions in the meantime. The *ISOfocus* (#126) of January/February 2018 already described the work on IWA 24, which specifies general safety and performance requirements for the design and testing of non-sewered sanitation systems. It then served as the basis for ISO 30500, an International Standard for small-scale, safe, self-contained and self-sufficient toilets complete with faecal treatment, that came out towards the end of last year.

Shockingly, 1.8 billion people globally use a source of drinking water contaminated with faeces.

ISO/PC 318, meanwhile, developed IWA 28 for community-scale systems that can treat the waste from tens of thousands to hundreds of thousands of people using stand-alone toilets that function "off the grid". IWA 28 specifies requirements for the design, performance, testing, certification and operation of independent, self-contained and energy self-sufficient units known as faecal sludge treatment units (FSTUs). ISO/PC 318 is now in the process of converting IWA 28 into an ISO standard, the future ISO 31800.

Framing the technology

But before we reach that milestone, let's take a look at the history behind this IWA. After developing the concept of FSTUs, the Gates Foundation approached researchers and industry to give shape to the idea. "We worked with TÜV SÜD to create a private standard for FSTUs, which we then proposed as a seed document for ISO 31800," explains Kim. TÜV SÜD is a German engineering and technology organization which specializes in performance testing for technology development, verification and certification.

Villagers line up with plastic canisters to get safe water from a public water well in Nyarusiza, Uganda.

ISO/PC 318 developed IWA 28 for areas with sizeable populations such as larger towns and cities. Many urban areas in the developing world might have rudimentary systems to collect and transport large amounts of faecal material but may lack the means to treat the waste, with the result that it is then dumped into the environment. IWA 28 describes the processes, procedures, specifications and test procedures underpinning the equipment that can deal with the faecal sludge safely, reliably, sustainably and efficiently.

In essence, IWA 28 provides a framework that dovetails with the circular economy and embodies them both safely and sustainably. To that end, IWA 28 specifies requirements to ensure that there are the means in place to receive, store and then process faecal sludge in the FSTU. The minimum requirements include the need to use the faecal material as a fuel and for energy recovery, together with controls and limits on any air emissions, odour, noise and effluent. There are also requirements for the end products of process, for example when the treated faecal sludge is converted to material that farmers can use as a fertilizer.

For its part, "ISO 31800 is 'technology agnostic' and not specific to any one technology, such as sludge combustion, anaerobic digestion or other forms of biological or thermal system," adds Kim. "We even have a research partner developing a technology that uses supercritical water oxidation. It depends on what is suitable for the environmental conditions, as long as the design of FSTU uses faeces as a fuel to kill pathogens, using the calorific value of the faecal sludge," he adds.

Photo: Gates Archive/Samantha Reinders

The Pollution Research Group's Faecal Sludge Lab is a professional research facility housed in the University of KwaZulu-Natal's School of Engineering.

Managed sanitation systems without interconnected sewers are known as non-sewered sanitation systems.


Photo : Gates Archive/Sam Phelps

The Janicki Omni Processor was installed in Dakar, Senegal, in 2015 and now treats the faecal sludge of up to a hundred thousand people.

All-in-one treatment

The engineering firm Sedron Technologies from the USA is represented in ISO/PC 318 and developed the first prototype FSTU that evolved in synergy with IWA 28. Known as the "Omni Processor" (see Box on page 49), this technology uses sewage sludge as a fuel to both dry the sludge and then complete the process within the FSTU. This unique technology is fast on its way to revolutionizing the waste-processing industry. For example, a pilot plant was installed in Dakar, Senegal, in 2015 and has been successfully operating at that location ever since.

The aim now is to create standards to support a variety of technologies, in the hopes of replicating the Dakar success story. IWA 28 specifies very stringent requirements for process control, functionality, environmental impacts and certification. So what is the rationale for this? "The idea is to strike a balance between technical requirements to ensure pathogens are neutralized, together with the likelihood of acceptance in as many countries as possible, and supporting local customers such as utilities, governments and businesses," explains Kim.

The forthcoming ISO 31800 will also help ensure that the performance of FSTUs is maintained for the long haul. "While the standard is written for the initial evaluation of manufactured FSTUs, elements of the performance requirements could be used to monitor the system's long-term performance too," he adds.

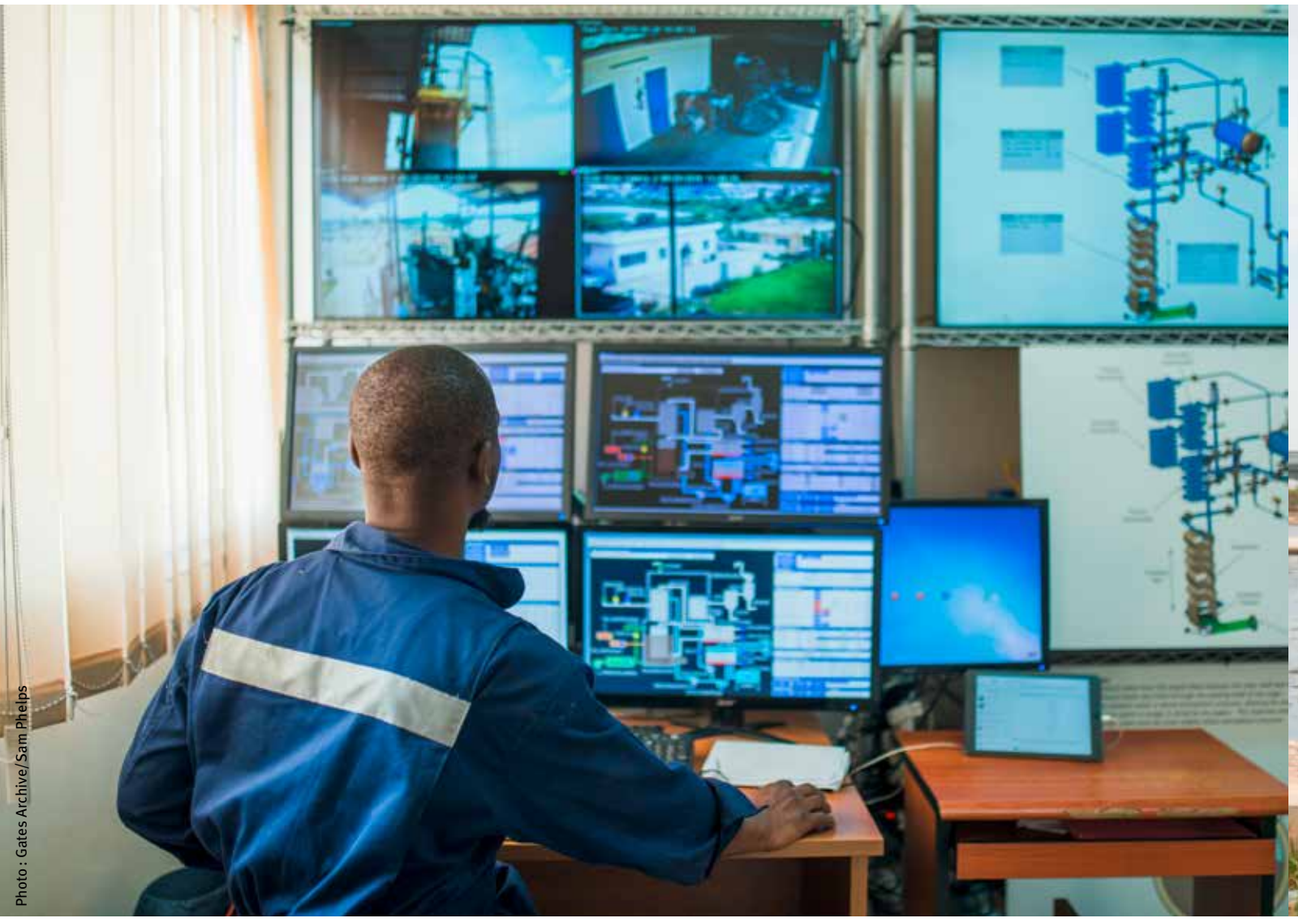


Photo : Gates Archive/Sam Phelps

A technician controls the automated system that operates the Janicki Omni Processor.

Photo : Gates Archive/Sam Phelps

Waste is transported to the Omni Processor for treatment.

It's a winner!

In many ways, the concept of an FSTU is a win-win, with the means to provide sanitation for areas that lack sewers connected to sewage treatment plants. There are also environmental benefits; as well as eliminating water pollution caused by untreated faecal sludge, FSTUs will also reduce climate change impacts. This is because untreated sewage ferments and then releases methane, which is a very powerful greenhouse gas – thirty times more powerful than carbon dioxide. "Instead of methane emissions produced from the natural anaerobic digestion of faecal sludge, direct treatment and conversion to carbon dioxide would have less impact on climate change. Also, since the carbon dioxide emissions would primarily be from consumed food, they are part of the ongoing carbon cycle and not a release of carbon previously locked in fossil fuels," explains Kim.

"We believe that an FSTU is better from a pathogen perspective, better from an environmental perspective, and when compared with letting the faecal material digest uncontrolled, it is also better from a greenhouse gas perspective," emphasizes Kim.

But such solutions must be economically viable too, or manufacturers and potential users will not embrace them. So ISO 31800 will also provide a foundation for economic sustainability by providing the frameworks for testing and certification in addition to specifications for efficient, effective and economic operability. These factors, in turn, will give confidence to the buyers, operators and users of FSTUs. "From our perspective, sustainability has many different aspects. But for this standard to be far-reaching, it really must support viable businesses," concludes Kim. And based on the experiences in Dakar, ISO 31800 has a strong potential to succeed. ■

ISO 31800 will also provide a foundation for economic sustainability by providing the frameworks for testing and certification.

The Omni Processor by Sedron Technologies

Janicki Industries from the state of Washington, USA, was the first company to meet the challenge of developing an operational FSTU or "omniprocessor", a term coined by engineers at the Bill & Melinda Gates Foundation. "The Gates Foundation approached us to ask if we were interested in developing the concept of an FSTU," explains Justin Brown, an engineer with the company. "What started as a team within Janicki Industries dedicated to working on this challenge, ultimately developed into a spin-off company, Sedron Technologies, to focus on the Omni Processor among other waste and water treatment technologies," he adds.

How it works

In simple terms, the Omni Processor is a self-contained and self-sufficient system. Initially, after the sludge is fed into the unit, the machine dries the sludge, recovering and purifying the water. The next stage then burns the sludge under highly controlled conditions to minimize emissions, odour and noise. Meanwhile, the heat from burning the dried sludge serves to create high-temperature and pressure steam, which is used by a steam engine to drive a generator. The electricity created is not only used to run the processor, but any excess electricity can be used for other roles. Additionally, the heat from the engine's exhaust steam is recovered to dry the incoming sludge. The exhaust gases from the sludge combustion are controlled to meet emissions requirements.

With financial support from the Gates Foundation, Sedron Technologies built the first system in 2015 to process the faecal material of up to 100 000 people, which is now operational in Dakar, Senegal. The company has recently completed a second larger system, capable of serving over 250 000 people.

From tech to standards

Being deeply involved in the project, Brown was asked to join project committee ISO/PC 318 to contribute to IWA 28. "After IWA 28, I joined the ISO/PC 318 US Technical Advisory Group (TAG) and have served as one of the US TAG delegates to develop ISO 31800," he explains.

As an engineer, Brown is well versed in using specifications. However, he had not worked with ISO standards development before. So how did he find it? "I think standards at their best help with ensuring quality in product development and ultimately in driving costs down through standardization of parts and componentry. Their goal is to drive industries forward responsibly and this is usually exactly what they do," describes Brown.

So what challenges has the working group faced? "I think a challenge we have had to grapple with is how to develop this standard in a way that guarantees safe treatment of faecal sludge and ensures high-quality products are delivered without accidentally creating so many requirements that the cost of the units becomes inconsistent with the realities of where they're needed most," he explains. That's why the valuable experience gained with Sedron's Omni Processor in Dakar, along with expertise of many others, is influencing the development of ISO 31800.