Issue 05/2018

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news & views from the IEC

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(Photo: Claro Energy)

Going green

International Standards are a powerful tool in helping to build a sustainable future

Zoë Smart
Managing Editor e-tech

More and more governments and industry players recognize the importance of taking measures to safeguard the environment. But do International Standards have a role to play in the process?

The answer is a resounding yes! While often hidden from direct view, Standards underpin innovative technologies as well as the processes that are increasingly regarded as essential in enabling sustainable and environmentally responsible economic growth.

Renewable power generation capacity had a record year in 2017, with an estimated 178 GW added globally. While solar PV and wind have seen the most important uptake, technologies such as concentrating solar thermal power (CSP) are also seeing an increase in their global capacity. IEC Technical Committee (TC) 117 is paving the way for the technology's growth by working on a number of publications for the CSP industry.

Renewables often allow for smaller installations, such as roof-top solar panels or micro hydro. These, in turn, are perfect for the distribution of electricity by direct current (DC). In his article *Electricity for the 21st Century-for all*, IEC Ambassador Vimal Mahendru discusses the huge potential of DC and the importance of developing a complete set of global Standards in order to facilitate its adoption.

Vertical farms are an example of where DC could be applied. Still an industry in its infancy, vertical farming is making a case for food grown locally and year-round in existing infrastructure such as warehouses and skyscrapers. We take a look at this niche industry and the technology it uses.

But Standards are not only important in helping new environmentally-friendly technologies to establish themselves and thrive. With the increase in production, and the resulting disposal, of electrical and electronic devices, International Standards are playing an essential role in helping to guide manufacturers in meeting new legal requirements and even rethink the manufacturing process.

According to one report, e-waste is expected to reach 52,2 million tonnes by 2021. If not disposed of correctly, the toxic substances present in electrical and electronic devices present a real hazard to humans and the environment alike. At the same time, many of the rare earth metals used in these devices can be "mined" for reuse. International Standards can help ensure electrical and electronic products comply with regional and international regulations on e-waste.

The IEC Advisory Committee on Environmental Aspects (ACEA) chair Solange Blaszkowski, and leader of the new task force on the circular economy Kaisa-Reeta Koskinen, spoke to us about the concept of the circular economy, the importance of getting society as a whole on board, from manufacturers to consumers, and the role International Standards can play in bringing about this major shift.

The need to take concrete measures to safeguard the environment and rethink manufacturing and consumption models is becoming ever more urgent. International Standards have an important role to play in ensuring their success.

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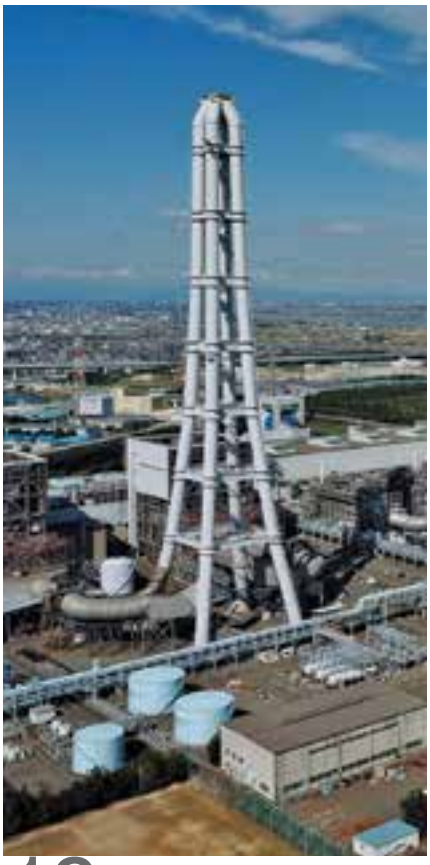

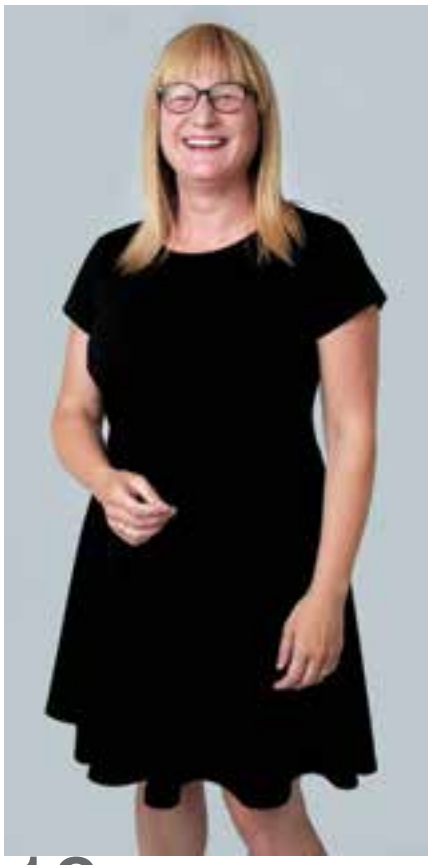

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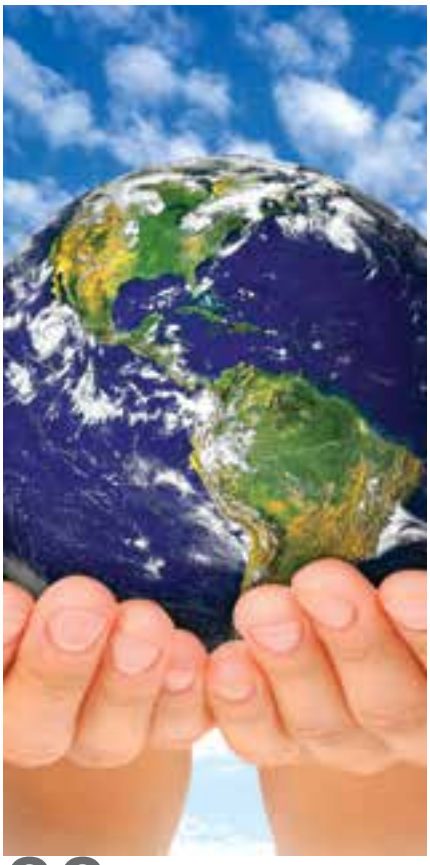
Stina Wallström, a past participant in the IEC YP Programme, has been elected President of Svensk Elstandard (SEK)



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Electricity for the 21st Century – for all

Power generation and distribution in direct current can bring electricity to the hundreds of millions of people denied access to the benefits of modern life

By Vimal Mahendru

Take a look around you. Is there anything we can do without electricity? Be it lighting, education, healthcare, productive work of almost any kind – everything requires electricity. And yet, today, there are around 1,1 billion people worldwide without any electricity access at all. Not providing electricity is the same as denying the fundamental right to be part of today's opportunities in an increasingly connected world. Direct current (DC) electricity could be the solution.

With direct current, power can be generated close to where it's consumed (Photo: Claro Energy)

Sustainable development

In 2015, more than 196 world leaders committed to 17 Sustainable Development Goals, commonly known as SDGs, to end extreme poverty, fight inequality and fix climate change. Of these 17 goals, number seven is about ensuring access to affordable, reliable, and clean energy for all by 2030. Twelve of the 17 SDGs are directly impacted by electricity or the absence of it. For this reason, SDG 7 is recognized as the key enabler for most of the other Sustainable Development Goals.

However, this is easier said than done! Connecting each and every hut, dwelling and home to a stable electric grid is expensive, time-consuming, mired with too many regulations, as well as the challenges of rough, remote terrain.

Given the urgency to enable electricity access, nations are seeking innovations which help reduce the time required to electrify rural areas in an affordable and sustainable manner.

The solution is direct current, or DC: electricity for the 21st Century! Today, in most countries electricity is produced in large power plants as alternating current – also known as AC. More often than not, these power plants operate on fossil fuels and add to global pollution, degrading the environment. These plants are located far from cities or areas of consumption and so electricity has to be brought in via long transmission lines.

Innovation for 21st Century electrical systems

In direct current, the electric charge (current) flows in one direction, from plus to minus. That is why you see the (+) and (-) symbols on all batteries. Electric charge in alternating current, on the other hand, changes direction periodically. Alternating current is better for transmission over long distances, while direct current is great over short distances.

Ironically, Thomas Edison discovered electricity as direct current, and in 1887, installed the first DC network in Manhattan, New York. However, due to

the nature of the technology, polluting and noisy power generators were installed right next to the homes of the wealthy who could afford electricity. Nicola Tesla invented the transformer which enabled moving the polluting power plants, which used fossil fuels, away from the cities, bringing electricity into the cities via transmission lines.

There are three main reasons why direct current is now considered the key innovation for 21st Century electrical systems:

1. Most consumption devices have electronic components these days, and all electronics simply run on DC. This is the reason why we get AC in our homes and offices, but use transformers, adapters or drivers to adapt electricity from AC to DC. Each time we make this conversion, adapters lose up to 20% electricity as heat energy. That is why your phone chargers or laptop adapters heat up.

2. From generating power at large utilities in the middle of open spaces, we are now generating power much closer to where it is used, on roof-tops via solar panels, as well as small wind turbines or micro hydro installations. This saves space and brings power generation close to power consumption, thereby reducing the need for power transmission lines across long distances.

3. The last and perhaps most significant reason is that politicians and administrators are under pressure to address climate change, increase energy efficiency and provide electricity to the millions who do not have it. Locally-produced renewable energy is the only answer to rapidly moving away from fossil fuel-based electricity to green electricity for all. This means that especially for rural areas not connected to the grid, small-scale direct current grids, or solar home systems are key to providing affordable and clean electricity to all.

DC is everywhere

Everything we love and like, is already using DC, we just don't realize it. DC is evidently the solution for the future, but how do we get there? When will it replace AC, if at all?

Adoption is rapid and as we speak there are in excess of 600 000 homes in India alone which are already powered by direct current. Bangladesh today has over five million DC-powered home energy systems, providing light, comfort and livelihood. The numbers are growing. As with many legacy systems, however, there is a huge amount of global investment and reliance on the existing AC infrastructure. These are long-term investments which are good for several decades to come. It may not be prudent to reduce these investments to junk, just because we want to change to DC.

You might ask if DC is only relevant in the context of supplying electricity to those homes which do not have it. The answer is the opposite: it is equally and perhaps more relevant in those areas where electricity may be in abundance.

> "Everything we love and like, is already using DC, we just don't realize it."

Direct current is impacting data centres. There are about 125 DC data centres worldwide. It is not hard to imagine why: all computers work on DC. In data centres, which are densely packed with computers, DC is more efficient and affordable. In fact, Facebook and Google are also now experimenting with DC in complete racks in their data centres. I recently visited a data centre in Texas, in the United States, which was generating power through solar panels on the parking lot and supplying it right there for direct use, achieving instantaneous savings!

It is the same with greenhouses, which are now beginning to generate electricity on the roof, and grow plants and flowers below. DC is consumed locally at the same greenhouse for light, heating, ventilation and irrigation. This reduces the total electricity consumed and avoids reliance on the electric grid. The savings add to the profits of the greenhouse.

Electric vehicles carry batteries which require DC for charging. You must have already noticed that LED is powered by DC and used in streetlights, traffic signals, roadside hoardings and airport lighting, among other uses. I am discovering new applications and uses of DC almost every day.

Building momentum

The question is how to create genuine momentum to trigger a universal movement toward DC?

The next step is to develop a complete set of global Standards so that DC can finally energize electricity-deprived homes and provide clean, affordable electricity. All applications which consume conventional electricity must begin to reap the benefits of clean, sustainable and affordable energy that can be used directly, without conversion losses, from the solar panel on your roof to the appliance in your kitchen.

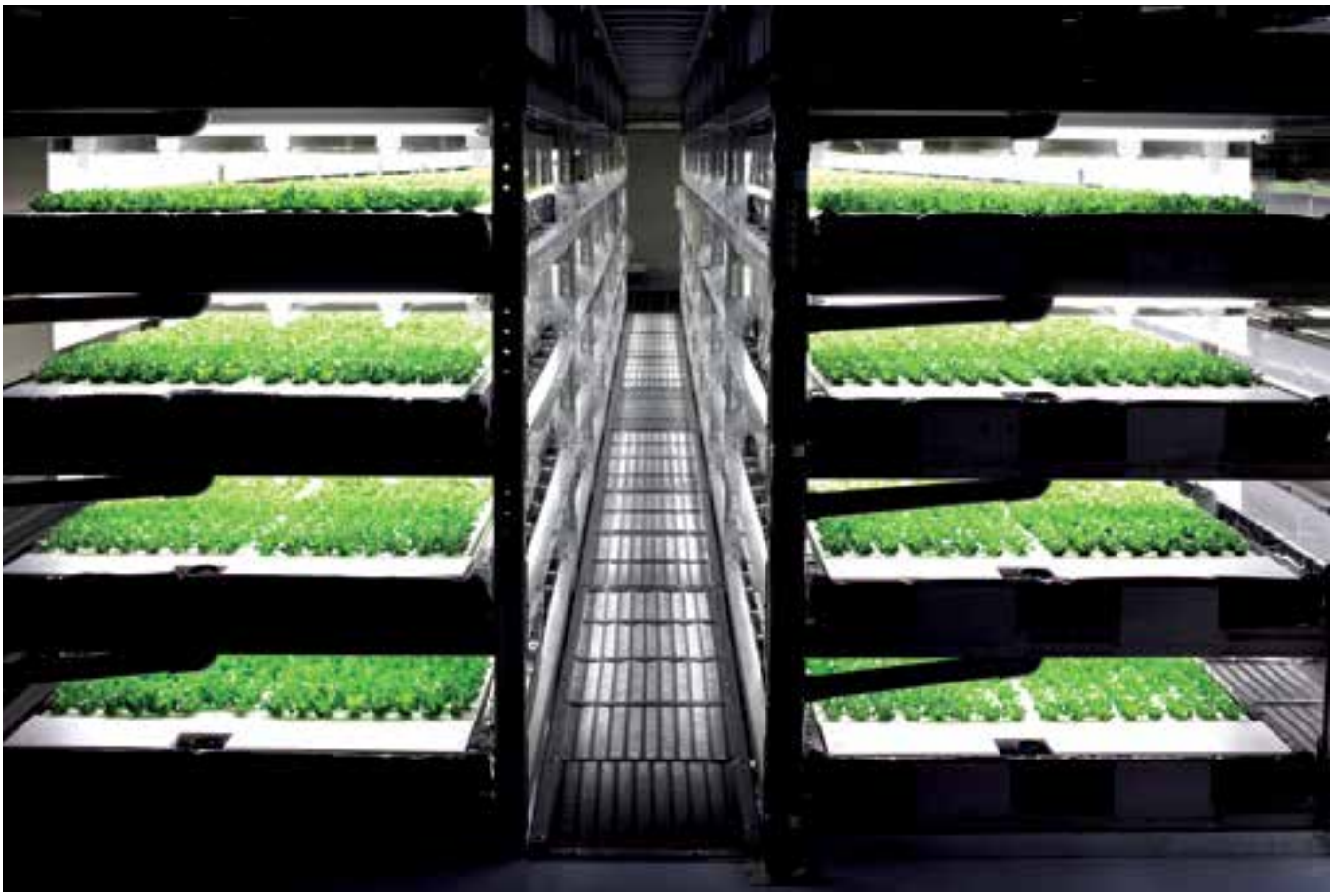
Growing high-tech salads

Advanced technology helps grow produce in cities

By Natalie Mouyal

LEDs provide the lighting plants need to grow. Sensors measure temperature and humidity levels. Robots harvest and package produce. This could represent the future for growing fruit and vegetables in a niche industry known as vertical farming.

Dilapidated warehouses and factories are being transformed into urban farms to grow salads and other leafy greens at a rate that surpasses traditional farming techniques. At one vertical farm in Japan, lettuce can be harvested within 40 days of seed being sown. And within two towers measuring 900 m^2 each (actual cultivation area of 10 800 m^2 and 14 400 m^2), the factory can produce 21 000 heads of lettuce each day.



Interior of a vertical farm growing salad (Photo: Spread)

Indoor farming is not a new concept, as greenhouses have long demonstrated. It has existed since Roman times and can be found in various parts of the world. Greenhouses are described in an historic Korean text on husbandry dating from the 15th Century and were popular in Europe during the 17th Century. In modern times they have enabled the Netherlands to become the world's second largest food exporter.

Vertical farming offers a new take on indoor farming. Popularized by the academic Dickson Despommier, its proponents believe that vertical farming can feed millions of people while reducing some of the negative aspects associated with current agricultural practices: carbon-emitting transportation, deforestation and an over-reliance on chemical fertilizers.

Vertical farming is defined as the production of food in vertically stacked layers within a building, such as a skyscraper or warehouse in a city, without using any natural light or soil. Produce is grown in a controlled environment where elements including light, humidity, and temperature are carefully monitored. The result provides urban dwellers with year-round access to fresh vegetables since they can be grown regardless of weather conditions, without the need for pesticides and have only a short distance to cover, from farm to plate.

Initially conceived by Despommier with his graduate students as a solution to the challenge of feeding the residents of New York City, vertical farming has since taken off around the world, most notably in the United States and Japan. According to the research company Statista, the vertical farming market is expected to be worth USD 6,4 billion by 2023.

High-tech farming

According to the UN Food and Agriculture Organization, food production worldwide will need to increase by 70% by 2050 to feed a projected global population of 9,1 billion. Vertical farming seeks to address the dual challenges of feeding a growing population that, increasingly, will live in urban centres.

By repurposing warehouses and skyscrapers, these "high-tech" greenhouses reuse existing infrastructure to maximize plant density and production. One vertical farm in the United States claims that it can achieve yields up to 350 times greater than from open fields but using just one percent of the water traditional techniques require.

In general, two methods for vertical farming are used: aeroponics and hydroponics. Both are water-based with plants either sprayed with water and nutrients (aeroponics) or grown in a nutrient-rich basin of water (hydroponics). Both exhibit a reliance on advanced technology to ensure that growing conditions are ideal for maximizing production.

So as to produce a harvest every month, vertical farms need to control the elements that affect plant growth. These include temperature, requisite nutrients, humidity, oxygen levels, airflow and water. The intensity and frequency of the LED lights can be adjusted according to the needs of the plant.

A network of sensors and cameras collects data with detailed information about the plants at specific points in their lifecycle as well as the environment in which they grow. This data is not only monitored but also analyzed to enable decisions to be taken that will improve plant health, growth and yield. Data sets sent to scientists in charge of the growing environment enable decisions to be made in real-time, whether they are onsite or at a remote location.

Automation can take care of tasks such as raising seedlings, replanting and harvesting. It can also be used to provide real-time adjustments to plant care. One factory plans to automate its analytical process with machine learning algorithms so that real-time quality control can take into account a diverse range of data sets.

While each of these farms will implement varying levels of technology, it can be expected that as these technologies become more widespread, their adoption will increase. The use of artificial intelligence and cloud computing is not yet extensive but is likely to become increasingly important to ensure production yields remain high.

Relying on IEC Standards

IEC Standards are essential to the technology used in vertical farms.

The Joint Technical Committee of IEC and ISO on information technology (ISO/IEC JTC 1) and several of its subcommittees (SCs) prepare International Standards that contribute towards artificial intelligence (AI). Given the rapid developments in AI across many industries, an SC on artificial intelligence, ISO/IEC JTC 1/SC 42, was set up in 2017 with the mandate of providing standardization in the area of AI as well as guidance to other committees developing AI applications.

AI depends on the gathering, analysis and sharing of great volumes of data which are exchanged between applications as well as with external service providers. ISO/IEC JTC 1/SC 41 develops International Standards for the internet of things (IoT), making connectivity possible, while ISO/IEC JTC 1/SC 38 addresses the standardization of cloud computing for the storage and retrieval of data.

International Standards for lamps, electric light and lighting solutions are developed by IEC Technical Committee (TC) 34 and its subcommittees. Standards for the design and use of semiconductors, including sensors, are developed by IEC TC 47.

In addition, several TCs prepare Standards in the area of industrial automation. These include IEC TC 65, which addresses process measurement, control and automation, IEC TC 17, which develops Standards for switchgear and controlgear and IEC TC 22, which standardizes power electronic systems and equipment. IEC TC 44 provides Standards for the safety of machinery. Conformity with the Standards developed by these TCs is provided by the IECEE, IEC System of Conformity Assessment Schemes for Electrotechnical Equipment and Components.

The water used by vertical farms relies on pumps with motors that are standardized by IEC TC 2. As vertical farms switch to renewable energy sources such as solar, wind and marine power, they will use Standards developed by IEC TC 82 for solar photovoltaic energy systems, IEC TC 88 for wind energy generation systems and IEC TC 114 for marine energy.

Growing pains

Despite the enthusiasm for vertical farming, its business model is not yet proven. The initial investment needed to launch a vertical farm and the electricity required to power the 24-hour lights, sensors and other technologies can be costly.

Depending on the source of the electricity used to run the equipment, it may not necessarily prove environmentally cleaner than traditional farming techniques. For this reason, a shift towards renewable energy sources could support the claim that these farms have a positive environmental impact.

At this stage, vertical farms are used primarily for growing crops that attract high market prices, such as herbs, medicinal plants and baby greens. They have not been used to grow the wheat, beans, corn or rice which feed much of the world. Its scale is not yet sufficient to meet food demands.

Vertical farming is still a nascent field. No large scale studies have yet been completed to allow a full comparison with traditional farming techniques. Despite this, it has generated much enthusiasm and, more recently, significant financial support, which may enable vertical farming to create a niche market for the supply of fresh produce to city dwellers.

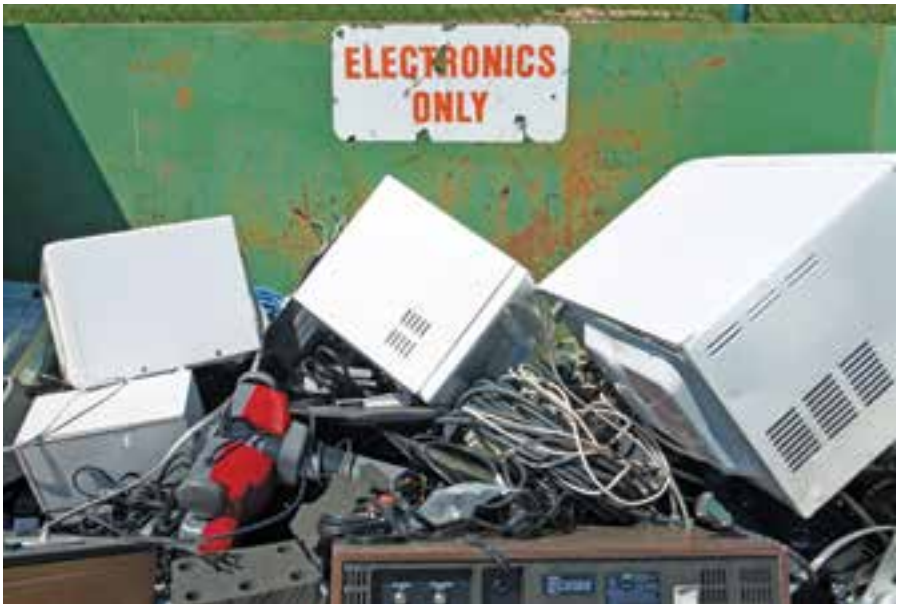
Inspecting produce (Photo: Spread)

Waste not, want not!

Getting the measure of rising e-waste volumes

By Adrian Pennington

As the amount of electronic and electrical equipment waste (e-waste) generated each year continues to increase, the work accomplished by the IEC becomes ever more essential in helping manufacturers meet legal requirements.



Electronic waste is on the increase

The *Global e-waste monitor*, a joint report published by the United Nations University, the International Telecommunication Union (ITU) and the International Solid Waste Association (ISWA) estimates that in 2017 total e-waste output reached 44,7 million tonnes (mt). Only 20% of this waste was recycled through appropriate channels. By 2021, according to that same report, e-waste volumes are expected to skyrocket to 52,2 mt.

E-waste refers to any refuse created by discarded electronic devices and components as well as substances involved in their manufacture or use. Toxic substances such as lead, mercury, cadmium and brominated flame retardants (used in circuit boards, for instance) are employed in manufacturing these devices and components. If they are not properly recycled when discarded, these toxic substances can seep into the environment and may contaminate land, water and the air. When not recycled through standardized procedures, e-waste is buried underground in a landfill or burnt in an incinerator. Both will cause environmental pollution.

Global and regional action

Countries around the world have recognized the need for global action by signing different international agreements designed to regulate e-waste. They include *The Basel Convention* which aims to control trans-boundary movements of hazardous waste and its disposal and the *Minamata Convention on Mercury*, which sets target dates for the phasing out of products which may contain mercury, such as batteries, switches and compact fluorescent lamps.

Many other agreements or declarations of intent have been drawn up at national level. Several are based on the principle of extended producer responsibility (EPR) which encourages producers to manage the waste generated by their products that are out on the market.

In 2001, Japan started to adopt a new legal framework aimed at providing safer and more effective waste management, following the three Rs principle: reduce, reuse and recycle. Five industry-specific laws were adopted based on EPR. They include a home appliance recycling law (HARL), which concerns products such as air conditioners, refrigerators, television sets and washing machines. In Japan, EPR is compatible with a shared responsibility approach in which everyone bears the burden of waste management: citizens, businesses, municipalities and the national government. For example under HARL, retailers collect end-of-life

products, consumers pay the expenses mandated for recycling and transport and producers recycle the collected products. For producers, take-back is mandatory.

The system has helped to forge a culture of recycling in manufacturing plants. Examples include mass recycling of the rare earth metals used in the nickel-metal batteries for the hybrid cars produced by a leading automotive manufacturer.

In 2017, China adopted a new EPR plan which set targets for the e-waste recycling rate to reach 50% by 2025. The plan requires producers to adhere to environmental protection standards throughout the life of their products, rather than just focus on the manufacturing process. It will initially concern electronics, automobiles, lead acid batteries and packing products.

The latest e-waste legislation of the European Union is its 2012 directive on *Waste Electrical and Electronic Equipment (WEEE)*. This was implemented by member states in 2014.

In developing countries, informal collection of e-waste is widespread. Backyard recycling, as it is sometimes called, can cause severe damage to the environment and human health. Crude techniques include open burning to extract metals, acid leaching for precious metals and unprotected melting of plastics. While a growing number of these countries are adopting e-waste legislation, the effectiveness of enforcement and even the type of e-waste collected and recycled varies considerably.

The need for International Standards

Meeting the requirements of International Standards is one of the ways to ensure electrical and electronic products comply with regional and international regulations on e-waste. The IEC is leading the way through the work of several IEC Technical Committees (TCs).

IEC TC 111 focuses on the overall environmental impact of electronic and electrical products throughout their whole life cycle: from raw material acquisition to the manufacture, distribution, use, maintenance, re-use and recycling of their component parts. One of its key publications is IEC 62430, a horizontal Standard which specifies the requirements for integrating environmental aspects into the design and development processes of electrical and electronic products. TC 111 is in close liaison with various IEC product-based TCs which deal autonomously with the environmental aspects relevant to their products. For instance, IEC TC 107: Process management for avionics, prepares Standards which mitigate the use of tin and lead in avionics.

IECQ, the IEC Quality Assessment System for Electronic Components, launched the hazardous substances process management (HSPM) scheme which provides third party certification for manufacturers who comply with the relevant national regulations in each country. The IEC's Advisory Committee on Environmental Aspects (ACEA), considers all the environmental protection aspects that relate to the detrimental effect of a product, group of products or a system using electrical technology, including electronics and telecommunications. It helps to coordinate IEC work on environmental issues to ensure consistency and avoid duplication in IEC International Standards. ACEA activities are focused on issues that relate to eco-design and more specifically to substance management, end of life treatment and environmental labelling.

Urban mining under the spotlight

Rare earth elements are used in the production of electronic goods for which there is a growing or continuous demand. These include mobile phones, LED television sets, electric vehicles (EVs) and oxygen sensors.

An increasing number of companies and initiatives view cities as a "mine" from which rare earth materials can be reclaimed. According to the urban mining philosophy, materials are only temporarily used in buildings, industrial facilities, mobile phones or computers. After they have served their purpose, they can be recycled and reused in other products. Scrap material can be recovered from existing utilities, infrastructure and landfills to create a market in secondary raw materials worth EUR 55 bn, according to UN estimates.

Reusing materials carries the added advantage of being less polluting, as conventional mining for rare earths often involves high levels of toxicity. For example, a scheme developed at the University of British Columbia, in Canada, centres on a method of physically crushing and grinding discarded LED bulbs to extract metals including rare earths. Researchers on the project state that "from the LED itself, we can recover copper and small amounts of rare earth metals including lutetium, cerium, europium and the technology metals gallium and indium". The researchers admit that "urban mining, even at its most efficient, can probably only meet about a quarter of the current demand for metals, but it can complement traditional mining and do the environment good at the same time". In the long run, their aim is to limit the exposure of communities to potentially toxic materials and reach the elusive target of zero waste.

House of the rising sun

Solar thermal electricity is gaining ground, especially in the developing world

By Catherine Bischofberger

IEC is paving the way for the growth of concentrating solar thermal power (CSP) capacity around the world by issuing a number of new publications in the field, while technical breakthroughs are making the technology more cost-effective.

Concentrating solar thermal power, also known as solar thermal electricity (STE), is on a strong growth trajectory, according to the *Renewables Global Status Report 2018*, published by REN21, an international non-profit association which is based at the United Nations Environment Programme (UNEP) in Paris. While Spain and the US have the largest installed capacity, according to the report, a new STE Plant came on line in South Africa in 2017 and facilities are being built in other countries around the world.

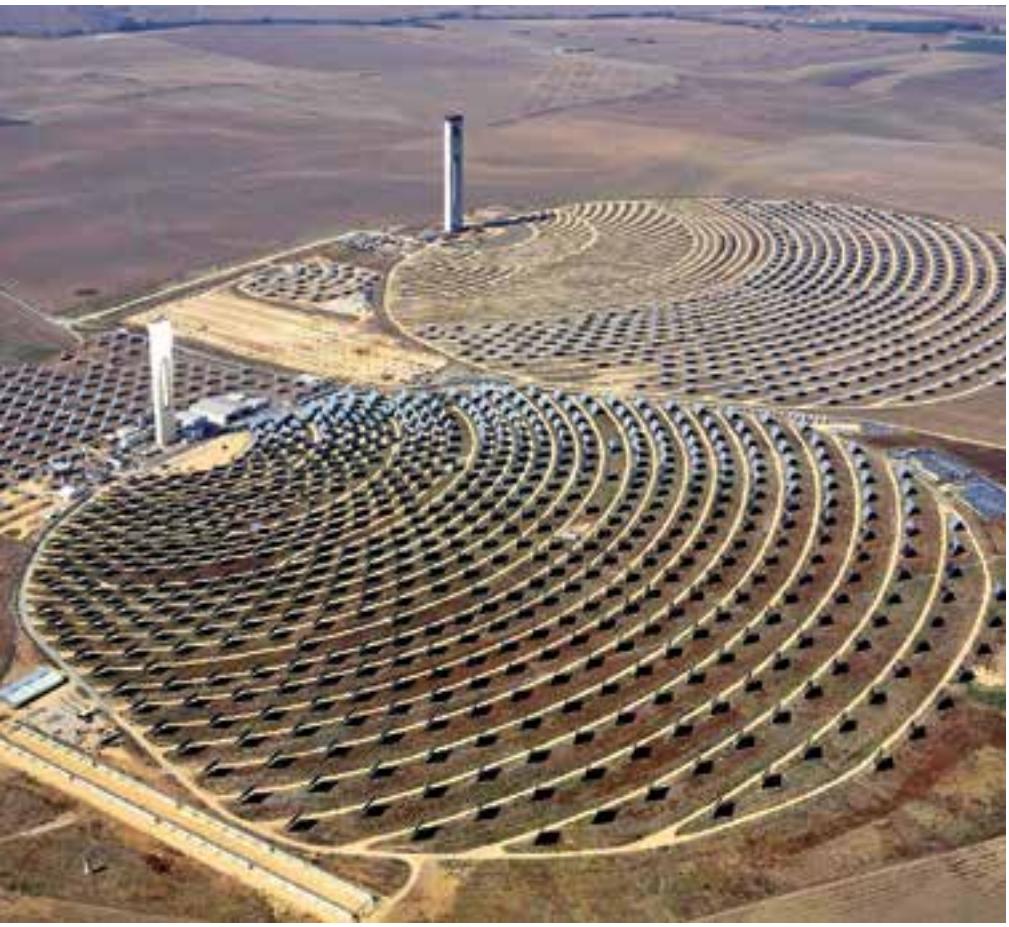
Mirror, mirror…

CSP technologies use reflective material such as mirrors to concentrate the sun's heat. That heat then drives steam or gas turbines to produce electricity. Most new STE plants incorporate some form of thermal energy storage (TES). This means that they can store heat during the day and convert it into electricity at night time. This is one of the important selling points for STE together with its high degree of production reliability. STE plants are built in sun-drenched areas, from Andalusia in the south of Spain to the edge of the Sahara desert in Morocco, guaranteeing predictable production levels and ensuring grid stability.

Four different CSP technologies are used in the various STE plants installed around the world:

- Parabolic trough – a mirror-based parabolic solar collector which reflects light so that it heats a tube containing a fluid to a high temperature. The heated liquid is then used in a heat exchanger to produce steam which then goes into a steam turbine driving an electric generator to produce power.
- Solar power tower – a series of flat movable mirrors called heliostats focus the sun's rays upon a collector tower with a receiver situated at its top. This device transfers the sun's heat to a fluid which produces steam and generates power in the same way as above.

This Japanese thermal power plant uses solar towers (Photo: Jihara19 at Wikimedia Commons)



The PS20 and PS10 Solar Power Plants in Andalusia, Spain (Photo: Wikimedia Commons)

- Linear Fresnel – flat mirror stripes concentrate the sunlight onto a receiver containing tubes located above them. These reflectors use the Fresnel lens effect (a concentrating mirror with a large aperture and short focal length). Fresnel is the name of the French physicist who invented that type of lens. Power is generated in the same way as above.

- Dish – the devices look similar to TV satellite dishes, but they are made of curved mirrors and lenses. Solar thermal energy is concentrated onto a single receiver point situated above the reflector dish. The dish can be connected either to a steam engine or to a Stirling engine. A Stirling engine operates by cyclic compression and expansion of air or gas at different temperatures leading to a conversion of heat energy to mechanical work which then drives a generator.

New IEC publications

While various fluids (water, synthetic oil…) have been used to produce steam, new installations are increasingly employing molten salts. The heated salts generate steam and are easy to store, decoupling energy collection from energy generation, which is crucial for TES.

According to SolarPACES, the international network of researchers and industry experts for the development of CSP and solar chemistry technology under the umbrella of the International Energy Agency (IEA), the most widespread CSP technology used in STE plants around the world, is parabolic trough, followed by solar tower. The number of linear Fresnel plants is increasing but remains low in comparison. In the network's global listing, there are only two dish/engine projects.

IEC Technical Committee (TC) 117: Solar thermal electric plants, is currently preparing the IEC 62862 series of Standards which will specify the different requirements for these various STE technologies. The TC has recently issued its first publications. You can find more information about some of these publications in the article *Solar thermal first*, published in the January 2018 issue of *e-tech*.

Zoom forward

A large amount of research and development work is focusing on technology which can lower the costs of STE and make it more efficient. Its drawback is that it is more expensive to generate than electricity produced by other forms of renewable energy sources, such as solar photovoltaic (PV) systems. Research projects include an US lab's high-temperature falling particle receiver, in which sand-like ceramic particles are heated as they fall through a beam of highly concentrated sunlight focused by an array of mirrors. The falling-particle receiver can process heat at significantly higher temperatures than existing CSP technologies (up to 1000 °C and higher), which can increase power cycle efficiencies and reduce costs. Like molten salt, the particles can be stored conveniently.

Alternative salts are also being considered, for instance chloride. The chemical compound can reach higher temperatures than the sodium/potassium nitrate used today. IEC TC 117 is monitoring these technology breakthroughs closely as standardization is expected to play an essential role in achieving greater competitiveness for STE.

From a line to a circle: a new shape for the economy

Using Standards to help develop a circular economy

By Natalie Mouyal

A new mobile phone is released and millions of consumers purchase it even though they already own a working phone. A television set breaks down and is replaced by a new one, rather than being repaired. Based on a linear economic model, products are made, used and discarded.

Yet, in the long term, this economic model is unsustainable. The population of the world is expected to reach 9 billion by 2050, exacerbating the demand for scarce resources. Landfills are filling up rapidly, with municipal waste generation expected to reach 2,2 billion tonnes by 2025, compared with 1,3 billion tonnes in 2012, according to the World Bank.

A new economic model is emerging that re-evaluates our current approach to production and consumption. It calls for a paradigm shift across society in which products, components and materials are viewed as regenerative and restorative. An increasingly popular topic, the notion of a circular economy is gaining traction not only among environmentalists and academics but also within governmental and business sectors.

The IEC is examining the requirements for the circular economy. Exploratory studies are underway in the Advisory Committee on environmental aspects (ACEA), which provides guidance to the Standardization Management Board (SMB) on issues related to the environment, as well as in IEC Technical Committee (TC) 111, which develops horizontal Standards related to environmental issues.

e-tech spoke with ACEA chair Solange Blaszkowski and with Kaisa-Reeta Koskinen, who leads the new ACEA task force on the circular economy, to gain a better understanding of this topic.

Defining a circular economy

According to Blaszkowski, the concept of a circular economy is a reconsideration of how resources are managed and how waste is perceived. It affects the entire lifecycle of a product, from initial design

and the materials employed to the use of the product, its repair, reuse and the transformation of its parts into a new product.

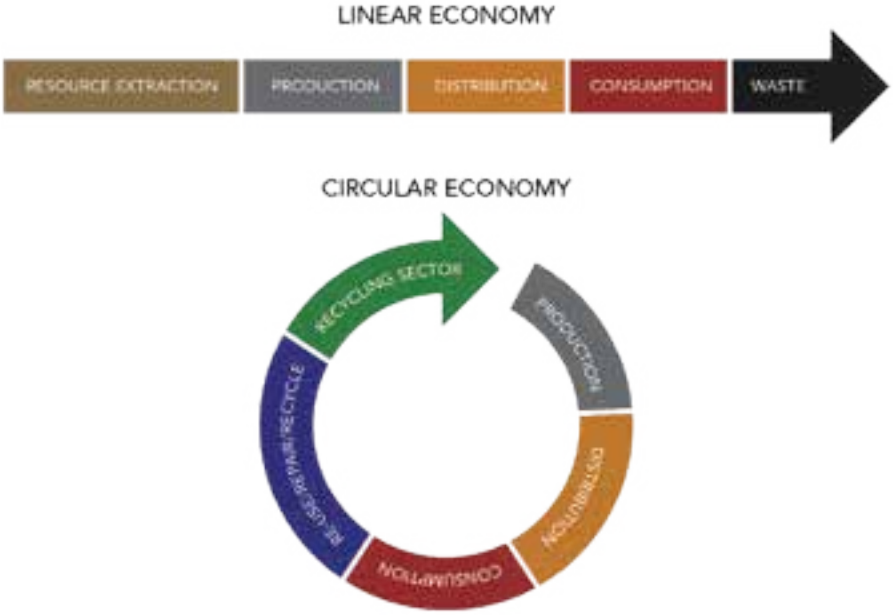
> "We are talking about a system change."

The Ellen MacArthur Foundation, a leading advocate of the circular economy, describes it as:

…a systemic approach to the design of processes, products/services and

Solange Blaszkowski, Chair of ACEA

Kaisa-Reeta Koskinen



(Image: metrovancouver.org)

business models, enabling sustainable economic growth by managing resources more effectively as a result of making the flow of materials more circular and reducing and ultimately eliminating waste.

A circular economy is based on the effective functioning of existing (circular) mechanisms such as extending product lifetime, reuse, repair, refurbishment, remanufacture and recycling.

Koskinen gives the example of a mobile phone that is no longer needed. Instead of being discarded, it can be sold or given to a family member for their use. Should the phone break down, it can be repaired rather than replaced. Likewise, it can be upgraded to extend its functionality – for example by increasing its storage capacity. Eventually it can be resold or disassembled for the extraction of its parts, some of which will include secondary raw materials that can be recycled and used for other products.

However, the recycling of materials is viewed as a last option since only some of the materials are able to be recovered while others, especially those present in only small amounts, are lost. As Koskinen comments, "it is very easily misunderstood that a circular economy is about recycling. Giving another life to your mobile phone has more value than putting it in a recycling bin where only some materials can be recycled".

Treating waste is currently viewed as a (negative) cost. In a circular economy, however, waste is instead viewed as an asset with inherent value. It is a resource that can be put to new use. Blaszkowski provides the examples of a digital imaging and printing company and a healthcare provider in the Netherlands which both include "asset recovery" as part of their business model. They strive to keep their devices in operation for as long as possible and, when devices must be replaced, the useful parts in the original devices are g iven a second life in, for example, new devices or are reused as spare parts f or other devices. To adopt this approach, these companies focus on ensuring that their products are robust and easy to repair rapidly – for example by screwing in parts rather than gluing them together. The term material efficiency is often invoked when discussing the concept of a circular economy. However, according to Blaszkowski, "this term, often used in Europe, is generally misunderstood since only the properties of the materials themselves are considered". Instead, she notes, "we should think of material efficiency as the conservation of materials". It is about making products more durable, resource-efficient and recyclable.

The circular economy should not be viewed as merely a means of maintaining consumption at current levels. It is different from resource efficiency which calls for the use of fewer resources to achieve the same outcome, but does not challenge the current linear economic model. Instead, Blaszkowski observes, "we need to change the mind-set of manufacturers and users and the whole system around it as well as the economies that support these systems".

Implications for manufacturers

Creating a circular economy will affect all participants in the product value chain: manufacturers and their business models, consumers and their behaviour and the waste management industry.

For manufacturers, the circular economy impacts products from the moment of their initial design. As Blaszkowski says, "you can have a product with a long life that is not repairable for e.g. safety reasons, or a product that lasts less, but is easily repairable. Trade-offs must be made based on product application".

She lists a few examples that need to be considered, such as what type of materials – whether raw or secondary – to use, whether components can be reused, extending product usability by allowing upgrades to new technologies, improving the durability of the product and the ease with which it can be repaired as well as making it easy to retrieve certain materials when recycled.

Many hurdles exist with current business models. "Business models should stipulate making products that are as robust as possible, easy to refurbish or remanufacture or use components that can be retrieved and reused in new or reused products", says Blaszkowski.

Manufacturers may also be reluctant to reuse components or materials if quality is not assured. Some take-back schemes for unwanted products generally involve only those that have been produced by the original manufacturer since this

affords the best traceability in terms of the quality of the materials used. And, because the recycling process varies between countries, the results will not be consistent.

> "We need to change the mindset of manufacturers and users."

Standards can be an important tool in promoting a circular economy. They can provide tools to measure aspects such as the durability or upgradeability of a product, the ease with which it can be repaired or recycled and ensure the quality of recycled materials. "Standards are needed for the entire supply chain", Blaszkowski comments.

Changing the consumer mind-set

Consumers will need to change current behaviours such as the continuous acquisition of the latest product models. New habits will need to be adopted such as the repair or upgrade of existing products, the use of second-hand goods and the adoption of product lease models. New services will need to be developed such as shops that can repair or refurbish products.

As Koskinen observes, "it will require a change from society as a whole and not only, for example, the economy". These changes will need to take place simultaneously across society. She remarks, "there is no point in manufacturers making products that can be repaired if consumers do not get them repaired, or if repair shops do not exist or the repairs are very expensive". Blaszkowski adds that there is little point in having manufacturers design products that are easy to recycle if a system is not in place to recycle the materials or able to guarantee the quality of its recyclates.

Education will be essential. As Blaszkowski comments, "it is always a question of education and the effort made to educate manufacturers and consumers to get them to learn new ways of thinking".

"We need to talk to TCs"

The IEC is currently at the preliminary stage of determining what actions can be taken to support a circular economy and material efficiency.

The ACEA task force on the circular economy is surveying TCs in order to gain a better understanding of which TCs are affected by material efficiency and the circular economy, how they are affected and what type of support they may require. The results and recommendations will be discussed at the next ACEA meeting taking place alongside the IEC General Meeting in Busan, Korea.

Based on the results of the survey, ACEA may decide to include the topics of the circular economy and material efficiency in the next edition of the IEC Guide 109, which is used to provide TCs with environmental considerations to take into account when developing electrotechnical product Standards. Alternatively, ACEA may decide to publish a new guide dedicated to the circular economy. As Blaszkowski says, "we need to talk to TCs to understand what actions could be important".

IEC TC 111 is preparing a study which provides an overview of the current status of the circular economy around the world with a specific focus on regulation and standardization. It will provide recommendations on what activities TC 111 should undertake in the near future.

Both ACEA and IEC TC 111 are collaborating with ISO TC 207 which handles environmental issues and has established an ad hoc group on the circular economy. Possible joint activities under discussion could include the development of basic concepts and terminology related to the circular economy.

Implementing a circular economy will require the involvement of many groups and it is likely to take time to educate all segments of society. As Koskinen recognizes, "it is a big change. We are talking about a system change".

From IEC Young Professional to President of the IEC National Committee of Sweden

An interview with Stina Wallström

By Natalie Mouyal

Last April, Stina Wallström was elected President of Svensk Elstandard (SEK), the IEC National Committee of Sweden. In this position, Wallström is responsible for guiding the national committee and leading its involvement in international fora.

Standardization has been a leitmotiv throughout Wallström's career. She first realized the importance of standards when completing her graduate studies in chemical engineering and has been engaged in standardization work ever since. Her initial foray into the IEC began with her participation in the Young Professional Programme (YPP) in 2013.

In an interview with *e-tech*, Wallström tells us more about her current work in standardization and encourages the next generation of leaders to become involved.

Tell us about your background

I graduated with a PhD in polymer technology from the Royal Institute of Technology (KTH) with a thesis entitled *Biofilms on silicone rubber materials for outdoor high voltage insulation*. The work was financed by, and undertaken in close cooperation with, ABB Corporate Research.

Stina Wallström

After my dissertation, I started working as a project leader at a sister organization to SEK, the Swedish Standards Institute (SIS), with the responsibility of leading ISO projects for the Swedish secretariat.

I was then recruited by the Swedish Engineering Industries as Deputy Director for international trade and standardization. In this position, I was responsible for promoting the views of over 4 000 Swedish engineering companies on issues related to trade agreements as well as legislation about standardization, product safety and market surveillance. I also represented the European Technology Industry (Orgalime) in several groups and committees, including the CEN Technical Board.

Now, I work as Director for regulatory affairs at IKEA Range and Supply, the part of IKEA responsible for designing, producing and distributing all products sold globally. For a global company like IKEA, standards are of uttermost importance and discussions of standards and standardization are an integral part of my daily work.

I am very proud of being elected President of SEK.

> "In a world where protectionism and nationalism are on the rise, standardization, with its values of openness and consensus, is a beacon of light."

How did your studies in chemical engineering lead you to your current role in standardization?

I first came into contact with standards when developing new test methods within the framework of my PhD studies. I soon discovered how useful state-of-the-art

standards could be as a solid ground on which new innovations could be built. As you can see from my background, standardization has since been a "red thread" throughout my career.

Tell us more about your role at the SEK

As President of SEK I manage and provide leadership to the Chief Executive Officer (CEO). I am accountable to the Board and act as liaison between the Board and the management of the company, through the CEO.

How did the Young Professionals Programme (YPP) boost your involvement in standardization work at the international level?

Aside from being a wonderful experience where new friendships and contacts were formed with other YPs from all over the world, I learned a lot about the IEC. This information is of great importance to me in my role as SEK chair.

Why would you encourage potential YPs to participate in the programme?

When I participated in the programme, my already high expectations were surpassed. The programme is well thought out and wide-ranging. When you complete the programme, you have, as expected, a firm knowledge about the world and functioning of the IEC. But over and above that, you also get ample opportunities to form a network of peers from all over the world to whom you can turn to for advice and new business opportunities. The IEC also makes sure that you get to meet and interact with experienced and influential experts within the IEC system to further broaden your professional network.

What recommendations would you give to current YPs to encourage their involvement in standardization work?

In a world where protectionism and nationalism are on the rise, standardization, with its values of openness and consensus, is a beacon of light. It is easier than you may think to have a global influence via the standardization community. Through strategic participation in standardization work, you can foster global harmonization and create new business opportunities while meeting and exchanging experiences with some of the best experts in the world within your field.

What are some of the big challenges, if any, currently facing standards developing organizations (SDOs)?

Nationalism and protectionism are a threat to the world as well as to the SDOs. We do see worrying tendencies to develop national standards rather than turning to IEC and other global standards organizations.

The short-sighted focus on profitability adopted by many modern businesses may also be a threat. Standards, although strategically highly important, rarely give profit in time for the next quarterly report. We need to convince companies to keep investing in standardization, providing the money and expertise needed to ensure market relevant and scientifically sound standards.

Rapid digital development is also a challenge, but not a threat. I am sure we will be able to use it to our advantage and find new and innovative ways to deliver our standards with the speed and accessibility modern engineers expect.

> "Through strategic participation in standardization work, you can foster global harmonization."

How are IEC Standards applied in your work at IKEA (i.e. automation, augmented reality applications, etc)?

Of course we always look to International Standards when we develop new and cool technology solutions such as the innovative system for smart lighting that recently hit our stores. However, let's not forget the "old and boring" Standards. The importance of global harmonization of Standards, for example electrical safety and consumer protection, cannot be underestimated for a company like IKEA.

What are some of the challenges – if any – that you have faced as a woman in technology? How would you encourage young female leaders in technology?

Although I am very aware that gender equality is far from a reality in this day and age, I personally have experienced very few problems. I attribute this to the supportive managers, male and female, that I have had the privilege to work for during my career.

My advice to young female leaders in technology would be to surround yourself with people that encourage and inspire you. That will give you the confidence you need to tackle the few remaining dinosaurs that still haven't understood that your gender does not define your skills.

How tech savvy leaders stay ahead of the game

Standards addressing latest technologies give business strategies a competitive edge

By Antoinette Price

Rapid advances in technology are changing how we live and work and along with this, the expectations of people and businesses.

Business operations are often complex, involving data-rich systems which provide diverse services. With new technology comes different terminology, definitions, ways of doing things, opportunities for innovation and new threats to business viability.

The great challenge for the leadership and management of public, private and not-for-profit organizations is to stay up to date with this evolution, in order to survive and maintain a competitive advantage.

The importance of standards

For decades standards have contributed to the organization of businesses and how they operate. In particular, the International Standards produced by the IEC and ISO Joint Technical Committee for information technology (ISO/IEC JTC 1). The broad scope of JTC 1 work covered by its subcommittees (SCs) includes among others artificial intelligence (AI), biometrics, internet of things (IoT), information technology security techniques and IT service management and governance.

Given that IT has penetrated most industries in the modern global economy, Standards benefit all these sectors. They address the specification, design, development, integration and interoperability of systems, services, tools and applications.

JTC 1/SC 40: IT Service Management and IT Governance, was established in 2013 to bring the governance, service management and business process of outsourcing activities together in one subcommittee.

> "Some people believe it's better to wait for technologies to mature or for people to agree on terminology and definitions, but businesses can't wait."

Interview with Chair of SC 40

e-tech caught up with Jan Begg, Chair of JTC 1/SC 40, to discuss the latest developments and challenges in the field.

What does SC 40 do?

Unlike other JTC 1 subcommittees, which deal with particular types of technology or applications of a technology, whether programming languages or the technology

Jan Begg, Chair of ISO/IEC JTC 1/SC 40 IT Service Management and IT Governance

that goes into IoT, SC 40 is more business focused and provides a link with corporate governance. In other words it looks at how these technology areas or opportunities are managed within an organization, and then for people with responsibilities at governance level (board or executive managers) and how they think about their governance responsibilities when it comes to technology.

The SC 40 foundation Standard ISO/IEC 38500, *Governance of IT for the organization*, is a principle-based guidance document; the six principles can be applied to any technology or service which is enabled by technology.

"New technology often brings with it different terminology, definitions, ways of

doing things, opportunities for innovation or new threats to the business viability. Just keeping up-to-date can be challenging for our market – the leadership and management of our public, private and not-for-profit organizations", says Begg.

SC 40 experts must think about how their Standards can be used in this new context or if there is a gap where new Standards need to be developed.

"We've found over the years that we need to show people how to apply the principles, so in 2015 we published an implementation guide ISO/IEC TS 38501 and in 2017 ISO/IEC 38505-1 for the Governance of data – Part 1: Application of ISO/IEC 38500 to the governance of data and this year Part 2: Implications of ISO/IEC 38505-1 for data management (ISO/IEC TR 38505-2), which includes case studies."

What is the impact of new technologies, such as AI, IoT, algorithms and cyber security?

Increasingly, businesses are applying new technologies. In the case of healthcare, many organizations may use AI combined with some type of robotics to support their work, for example to supplement what a human can do. This may include AI for decision making or combined with robotics to assist in operating on a patient or helping a frail person recover from an operation.

Begg explains that strategically speaking, one organization might decide not to use AI because it is worried about automated decision making, ethics and possible risks. This sort of strategic decision could be made from applying the SC 40 foundational governance Standard. However, another board might decide it needs a strategy that utilizes IoT, AI and is cognizant of cyber security risks, to give it the advantage over another organization and develop new ways of doing things. This could result in a deliberate request to management to come up with plans for a new business process or how to use new technologies to achieve something better than their competitors. Again this is a direct application of the SC 40 foundation governance Standard and could involve another of the ISO/IEC 30105 series of Standards relating to IT-enabled business process outsourcing.

"The way managers and leaders of organizations, such as the governing body or board, think about this using our Standards is to say what is it in our organization that we do, how do we do it, and what do we need to be aware of when we are making our decisions?"

Organization leaders don't have to know what the new technology is or know a great detail about it, but for a business to develop a new strategy or understand its risk profile, whoever is advising it needs to know how that new technology might be applied in its industry or might be applied by one of its service suppliers.

"Even if they don't chose to use a specific technology through our service management Standards it's about understanding that you've bought a service from somebody else, such as the outsourcing of your helpdesk or payments. This external service provider might be using AI and you might not even be aware of it. Part of our guidance is around saying, what other questions do you need to ask and what other things do you need to be aware of?"

With so many interdependent technologies how important is it for SC 40 to liaise with other groups?

Over the last couple of years businesses have had to deal with big data and the analysis of it has become practical, whether it is done internally or outsourced. In order for people to better understand how to apply ISO/IEC 38500 Standard to that, SC 40 produced a new Standard ISO/IEC 38505-1, which went through the types of terminology in data and analysis. It also showed a connection between the foundation Standard 38500 and the six principles, and how to apply them when thinking about data. In addition, a Technical Report 38505-2 was produced which included real case studies from organizations.

"This makes it a lot more practical for people, so for AI, the new ISO/IEC 38507 project that has recently been approved will cover how we apply our 38500 governance of IT to AI. We will need to work with JTC 1/SC 42 AI experts to understand AI technology and how this affects the way businesses operate and how we produce a new guidance document to help people get ahead of that and start thinking about it. It's very exciting and a great way to show collaboration within JTC 1."

SC 40 already liaises with a number of JTC 1 subcommittees and ISO technical committees, which cover IT security techniques, software and systems engineering, cloud computing, blockchain and governance of organizations. It is also actively involved with the Joint Technical Coordination Group (JTCG) set up by ISO/Technical Management Board, in which it shares its experience on writing ISO Management System Standard (MSS) standards. Soon a practical guide on the application of another foundation Standard that is an MSS, ISO/IEC 20000 on service management will be published.

"Some people believe it's better to wait for technologies to mature or for people to agree on terminology and definitions, but businesses can't wait. They're in an evolving market and need guidance sooner rather than later, because by the time we've defined it all, someone may have put them out of business."

Protecting the planet

IEC TC 111 prepares crucial Standards to help industry meet environmental targets

By Catherine Bischofberger

IEC Technical Committee (TC) 111 prepares horizontal International Standards which are key in helping to ensure electrical and electronic products are designed with the environment in mind. They are essential tools in the fight against e-waste, while aiding manufacturers to meet legislative requirements on toxic substances control.

It is easy to only pay lip service to the protection and preservation of the environment. In this day and age, it is often more about marketing one's eco-friendly credentials than truly making a difference. But behind the scenes, a number of engineers, scientists and legislators are working hard to reduce environmental pollution in all sorts of areas. They include various members of IEC TC 111: Environmental standard-ization forelectrical and electronic products and systems.

Paving the way for recycling and urban mining

Since its creation in 2004, the TC has published a number of crucial International Standards relating to the environment. It is preparing for a future where recycling in a circular economy could well become the norm, while the recovery of rare earth metals – a process known as urban mining – may become widespread.

Before they can even begin to think of recycling the various materials they use in their goods, suppliers need to know and report the substances in their products so as to conform to the various pieces of legislation that exist across the globe. A key publication is IEC 62474 which establishes the requirements for reporting the substances and materials included in electronic and electrical products. It also facilitates the transfer and processing of this data by defining a common data format which applies to exchanges in the supply chain. The Standard comes with a validated open database, which includes a list of substances, substance groups and common material classes. "We have worked on an updated version of the Standard which is to be issued before the end of the year. The database now comprises lists of substances from industries which are not in the electrical sector", the Chair of IEC TC 111, Christophe Garnier, explains.

Other major publications are the IEC 62321 family of Standards, which defines standardized methods for determining the levels of potentially toxic substances in electrical and electronic products, by using various methods of measurement. "This important family of Standards is prepared by Working Group (WG) 3. These publications cover ways of measuring several different substances. One of these is spectrometry, for instance.

Christophe Garnier, Chair of IEC TC 111

While WG 3 includes experts from different fields, we are looking for more test lab scientists to become involved", Garnier says.

Eco-friendly design and joint work with ISO

The environmentally-conscious design of products has been a hot topic for many years. For instance, it is viewed as one of the ways of significantly reducing pollution by limiting the use of non-recyclable materials.

Yet another important Standard issued by IEC TC 111 is IEC 62430 which provides guidelines for minimizing the adverse environmental impact of devices throughout their lifecycle. The publication defines environmentally-conscious design for all electrical and electronic products, for instance which materials are used, the quantity of energy consumed to make them, as well as their rate of recyclability. "We have formed a Joint Working Group with ISO, JWG ECD 62959, to prepare a global Standard which will deal with the environmentally-conscious design of all products, not only electrical and electronic devices. This new Standard will be published in a couple of years and should draw from IEC 62430 and the work of ISO/TC 207. It will bear the logos of both the IEC and ISO", Garnier reveals.

IEC TC 111 includes 25 participating member countries and 12 with observer status. "The most active countries are mainly based in the northern hemisphere. I would like to encourage all our members to take part in a proactive manner. Everyone can contribute – we must get more feedback from a higher number of developing nations as well, especially on environmental issues, as their input will be crucial as we move forward".

The TC is holding its plenary meeting during the IEC General Meeting (GM) in Busan at the end of October. "We will present a study on the main initiatives launched around the world based on regenerative economic models. The outcome of this report will be discussed during the plenary and a recommendation for a future Standard relating to the circular economy will be made".

The TC is studying different environmental labels

Another group is studying the different environmental labels around the world. "We are looking at the feasibility of harmonizing the criteria used in various recycling labels, for instance", Garnier explains. The work of IEC TC 111 might take place behind the scenes but it is more relevant than ever, as concerns about the environment reach new highs across the globe.

Managing hazardous substances

IECQ helps manufacturers and suppliers with their hazardous substance management processes

By Claire Marchand

Take a moment to think about the number of electronic devices you've acquired in your lifetime. Can you remember all the computers, tablets, phones, game consoles, cameras that passed through your hands at some point? Not to mention the electric toothbrushes, microwave ovens, hair dryers that you discarded because newer, smarter, more powerful models were launched and you thought you absolutely had to upgrade! Do you ever stop to think that all these devices that you enjoyed for a while only to be replaced by the next generation are your (small) contribution to the ever growing pile of electronic waste (e-waste)?

Repairing electronic devices helps extend their life cycle

Growing demand for electronics = growing e-waste

In the past few decades, the demand for electrical and electronic devices and equipment of all kinds has skyrocketed, and so has the worldwide generation of e-waste.

The problem with discarding huge amounts of gadgetry lays not only with the metals and plastics they're made of that are dropped in landfills but also with the number of hazardous substances they contain, among them cadmium, lead and mercury. That in turn may have dire consequences for human health and for the environment.

What you can do as an individual

Getting rid of e-waste is most certainly a complete utopia. There are ways however to reduce the amount of e-waste.

As an individual there are some steps you can take. You alone may not make a difference but millions of individuals around the world might. Weigh the pros and cons of acquiring that extra gadget. Try finding multi-function devices. Prolong the life of your devices: protect them from shocks, don't overcharge them. Buy eco-friendly electronics. Don't throw away your devices when you get a new one but offer them to charities and social programmes. Have them repaired when possible, rather than discard them. And recycle electronics and batteries (many countries have recycling programmes in place).

Legislation in place

To address the issue of e-waste in general and hazardous substances in particular, many countries and regional bodies have put relevant legislation in place.

The European Union (EU) has two directives on restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS) and on waste electrical and electronic equipment (WEEE). WEEE came into effect in February 2003 and RohS in July 2006.

Both directives have been revised since: RoHS in July 2011 and WEEE in July 2012. In view of a revision of RoHS, the EU Commission adopted, in January 2017, a legislative proposal to introduce adjustments in the scope of the directive.

Another EU directive on the registration, evaluation, authorization and restriction of chemicals (REACH), came into force in June 2007. It deals with chemicals and their safe use, so as to improve the protection of human health and the environment through better and earlier identification of the intrinsic properties of chemical substances.

EU countries are not the only ones to have drastically limited the use of hazardous substances. Many industrial countries around the world, including Australia, China, Norway, South Korea, Switzerland, Thailand and the United States, have followed suit and established their own legislation.

Programmes also exist that allow manufacturers and suppliers of the electronic components used in all modern devices to ensure that their products have extremely limited amounts of hazardous substances or are hazardous substance-free.

One in particular, set up by IECQ, the IEC Quality Assessment System for Electronic Components, has the perfect solution for manufacturers and suppliers who want to produce and distribute hazardous substance-free (HSF) electronic components: the IECQ hazardous substance process management (HSPM) scheme.

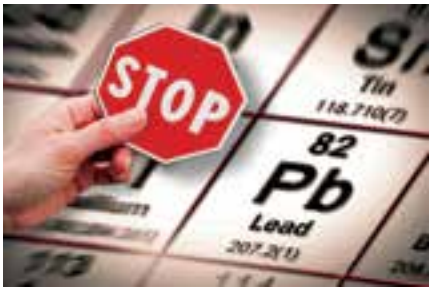
A truly global solution

IECQ HSPM is a technically based management systems approach to implementing and maintaining hazardous substance-free products and production processes. IECQ HSPM was developed in response to component manufacturers' need to give suppliers the means of demonstrating, through third-party assessment, that their electrical and electronic components and assemblies meet specific hazardous substance-free local, national and international requirements. Many companies today are working to attain IECQ HSPM Certification to IECQ QC 080000, *IEC Quality Assessment System for Electronic Components (IECQ System) – Hazardous Substance Process Management (HSPM) System Requirements*. The fourth edition, published in May 2017, clarifies how organizations can use IECQ QC 080000 to manage their hazardous substances other than through the outright removal of restricted substances and avoiding their use in products.

There are numerous advantages to using the 4th edition of IECQ QC 080000. Among them:

- adaptation to global increasing hazardous substances legislation. For example, additional controlled substances, change control, product recall, as specified by the REACH regulation, the information communication within the supply chain, and notification to the European Chemical Agency (ECHA) about substances of very high concern (SVHC)
- enhancement of documented information requirements in response to the applicable statutory and regulatory obligations. For example, requirements in the re-casted RoHS such as compliance assessment, preparation of technical file, preparation of self-declaration, use of markings, etc. can now be managed through IECQ QC 080000.

The new edition also aligns with ISO 9001:2015, *Quality management systems – Requirements*, and has adopted ISO Annex SL defining the new high-level structure for all ISO management systems standards.



Lead is one hazardous substance that is dangerous to humans and the enivronment alike

The processes used to identify, control, quantify, and report the HS content in electrotechnical products, or their components, must be defined and understood in sufficient detail to assure all relevant interested parties of the HSF status of a product. The processes must be appropriately documented and conducted in a controlled and consistent manner to:

- facilitate verification of compliance to applicable customer requirements and regulations
- allow efficient and effective compliance checks
- facilitate the consistent deployment across organizations and their supply chain
- allow harmonization of compliance and enforcement methods.

The whole process helps reduce technical barriers for product trading worldwide.

IECQ QC 80000 is available on the IEC webstore in English, French, Korean, Russian, simplified Chinese and traditional Chinese.

For more information: www.iecq.org

IECRE expands third-party verification of tidal energy devices

Crucial step increases confidence in marine industry

By Antoinette Price

IECRE, the IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications, has established a new mechanism, which will allow applications from renewable energy test laboratories (RETLs) that cover the power performance assessment of electricity producing tidal energy converters within IEC Technical Specification (TS) 62600-200.

The TS gives requirements for site and test conditions, measurement procedures and their exploitation to obtain the power curves.

The growth of renewable energy globally, including the emerging marine RE sector, is dependent on the development of international standards and the verification of compliance to these. Third-party verification to consensus-based standards reduces marine energy equipment and project risk and improves their safety, performance and reliability, which increases confidence in the marketplace.

"The recently published Operational Document (OD) and the associated Rules of Procedure enabling 3rd-party testing to the 62600-200 Technical Specification under the IECRE System is a milestone and it will increase confidence in the marine industry which is critical in order to grow the sector. It's going to allow the issuance of third party, transportable renewable energy test reports (RETRs), which verify the power curve and other parameters of tidal energy converters", said Jonathan Colby, IECRE, Marine Energy OMC Chair.

Great potential

According to a report by the World Energy Council, 0,5 GW of commercial marine energy generation capacity is in operation and another 1,7 GW under construction, with 99% of this accounted for by tidal range. The report also notes that in the best scenario, the global market for wave and tidal deployment could reach GBP 40 billion per year by 2050.

While ocean energy has the potential to increase in the long term, most projects are still in the demonstration phase and face challenges, such as high costs, harsh environments and the need to protect the immediate nature and wildlife.

The power of water

There are plenty of success stories. The world's largest operating tidal stream turbine in Scotland produced more than three gigawatt hours (GWh) of renewable electricity in less than 12 months. Over the last year, the turbine supplied the equivalent annual electricity demand for around 830 UK households. At times, the energy provided to the Orkney Islands, with a population of around 22 000, was more than 25 percent of its electricity demand.

A number of tidal stream technologies are being trialled in different countries (Photo: Siemens, UK)

The first French tidal turbine to produce energy, which has been fed to some of the residents on the island of Ushant, established the power curves of the tidal turbine prototype according to IEC TS 62600-200.

Other pilot projects are being developed and tested around the world in North America, UK and Europe, some Asian and African countries and Australia.

Find out more

Interested parties are encouraged to contact their member body or IECRE for further information.

Providing safety solutions for hazardous areas

International acceptance of IECEx continues to grow

By Prof Dr Thorsten Arnhold, IECEx Chair

I recently attended an international conference in Barcelona. The event was about safety solutions and, among other topics, it also dealt with hazardous areas. For me, as the IECEx Chair, there were many interesting conversations with end users, solution providers and certification bodies. It was very positive to see that the international acceptance and reputation of our System is continuously growing.

Counting the number of test reports, certificates, certification bodies and test labs in our annual statistics is one thing. It is definitely better to get a positive feedback directly from our customers! Events such as the one in Barcelona provide the best opportunities to learn how to improve the IECEx System further, as the following example shows.

The benefits of selecting Ex equipment covered by an IECEx certificate are obvious in terms of providing independent verification of a manufacturer's claim of compliance with IEC International Standards, and this also includes on-going monitoring of the manufacturing process.

As regards the latter, we reassure the end user that the products manufactured today and tomorrow are in line with the samples that passed the original testing and assessment.

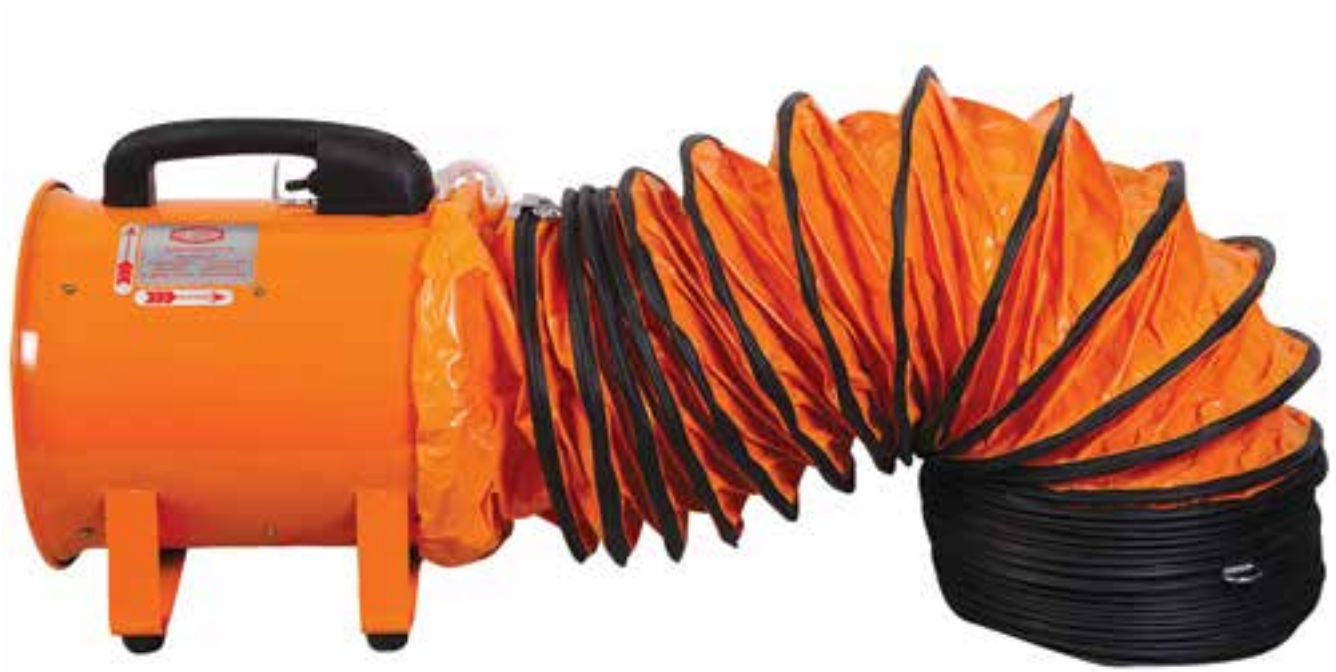
IECEx Chair Thorsten Arnhold

I have the impression that more and more operators in the process industry and even manufacturers appreciate that IECEx is now able to certify both electrical and non-electrical equipment and – by means of the brand new Technical Specification IEC TS 60079-46, *Explosive atmospheres – Part 46: Equipment assemblies* – a combination of both. The market need for this is expressed by the fact that already about 20 certification bodies (ExCBs) have a scope extension to cover ISO 80079-36 and ISO 80079-37, as well as the TS mentioned above.

Due to the fact that assemblies in the majority of applications consist of a combination of electrical and non-electrical aspects of explosion protection, the IECEx Executive decided that a scope extension for IEC TS 60079-46 has to be made in conjunction with a scope extension for ISO 80079-36 and ISO 80079-37. After seven months in operation, more than 70 certificates of conformity have already been published on the basis of these Standards. This is definitely a positive development, but there are some special issues to be solved such as the surveillance of the quality management system, which was an issue raised by our customers.

While for specific products such as luminaires, motors etc. the process to achieve and maintain IECEx certification seems rather straightforward, when it comes to more complex products and assemblies involving a combination of both electrical and non-electrical parts, the need to ensure that adequate surveillance over the manufacturing of key or critical parts and assemblies is paramount in ensuring on-going compliance with Standards is maintained.

In many cases such manufacturing and production usually occurs at different locations and often by different companies with their own quality management systems and procedures.



Portable ventilator fans are suitable for ventilating hot or fume laden workplaces, such as workshops, some warehouses, garages and more (Photo: www.powerstarelectricals.co.uk)

The IECEx certified equipment scheme provides this assurance of on-going compliance for both relatively straightforward and complex products and assemblies, and acknowledges that there is no "one-size fits all" approach to the monitoring and control of the production of parts and assemblies. It also has the ability to cater for differing manufacturing arrangements and structures, while still ensuring that the universal system for assessing and auditing manufacturing processes is maintained.

So, for instance, if there are value chains where it is possible to clearly distinguish between general operations and operational steps critical for the explosion protection concept, the focus of the quality assurance (QA) assessment is fixed on the latter one. The ExCBs are requested to create a 'tailor-made concept' for the QA assessment working closely with the customer.

During our series of working group meetings in June, which took place in Weimar, Germany, we took many decisions about the new non-electric elements of our System. So we decided to add these special aspects in all our relevant units of competence that are defined in the OD 504. We think it is not enough just to focus on the design, production and certification of non–electric products for hazardous areas. It is also of high importance to cover the special requirements of inspection and tests, maintenance and repair, etc.

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Keeping spills and explosions at bay

IECEx-certified equipment is one sure way to mitigate risks in Ex areas

By Claire Marchand

Every year sees its share of oil spills, gas leaks or industrial explosions that could have dire consequences for human beings as well as for the environment. They can be caused by the wrong or faulty equipment, poor maintenance and/or by poor operating procedures or mistakes.

These incidents are often associated with certain so-called explosive (Ex) environments, such as the oil and gas or chemical industries, mines, and many others that don't necessarily come to mind as Ex locations: chemical plants, food processing facilities, sugar refineries, grain silos, and others.

In the past…

The explosion that destroyed the North Sea Piper Alpha oil and gas offshore platform in July 1988 resulted in the death of 167 workers and damage in excess of USD 1 500 million at the time.

The explosion of the Deepwater Horizon drilling platform in the Gulf of Mexico in April 2010 killed 11 workers, caused major environmental damage that required a huge clean-up operation costing billions of dollars.

Thousands have also died in explosion-related mining accidents across the world over the years, the worst recent one killed over 300 miners in Soma, Turkey, in 2014.

All ends well at times

Fortunately not all incidents end in such a disastrous way. Especially in the oil and gas sector, the production process is complex, from drilling, refining and storing to transporting. Spills can happen when a pipeline breaks, when storage tanks leak or when a simple piece of equipment is defective.

This happened in 2015, when a malfunctioning valve at a Prospect Energy oil processing facility released 6 500 gallons (more than 24 600 litres) of crude oil on the ground in Colorado. The spill was rapidly contained, using barriers of compacted soil to limit the spread. Clean-up involved using backhoes to collect the contaminated soil that was then taken to a certified waste disposal site. The US Environmental Agency (EPA) later confirmed that the incident had no short- or long-term consequences on the environment, thanks to the rapid intervention of Prospect Energy staff and the local authorities.

Leaks in oil and gas pipelines can contaminate soils for years

Ex-proof equipment

Factories and plants operating in hazardous areas can rely on equipment – in particular electrical equipment – that is designed to contain explosions within the device and that doesn't produce sparks with enough energy to trigger an explosion.

Designed and built for Ex areas

All pieces of equipment and devices used in explosive (Ex) atmospheres, whether large or small, electrical or non-electrical, have to be designed and built in compliance with the very strict requirements set out in Standards and specifications, most notably in the IEC 60079 or ISO/IEC 80079 series of International Standards developed by IEC Technical Committee (TC) 31: Equipment for explosive atmospheres, and its Subcommittee (SC) 31M: Non-electrical equipment and protective systems for explosive atmospheres.

Testing and certification are a must

Designing and building devices operating in Ex areas in compliance with IEC International Standards is not enough on its own. To ensure that any piece of equipment meets the required criteria, it also has to be tested and certified. Products associated with a certificate of conformity satisfy the criteria for safe usage in hazardous environments.

To make sure that the equipment purchased meets the very strict requirements specified in IEC 60079 and ISO/IEC 80079, as well as those put in place by national or regional regulations and legislation, the Ex industry can rely on IECEx, the IEC System for Certification to Standards Relating to Equipment for Use in Explosive Atmospheres, for testing and certification.

An IECEx certificate provides clear proof of compliance with International Standards, an important assurance for anyone responsible for the safety of those working in such areas.

IECEx is the only truly international Conformity Assessment (CA) System that provides testing and certification for all Ex equipment and installations.

Repairing, not replacing

Because Ex equipment has a much higher capital cost than the same equipment used elsewhere, repairing it is often more cost-effective than replacing it. And again the IEC, through TC 31, has developed an International Standard, IEC 60079-19, which gives instructions, principally of a technical nature, on the repair, overhaul, reclamation and modification of equipment designed for use in explosive atmospheres. This ensures that unique Ex safety features are not compromised during the repair or overhaul process. The system includes on-site audits prior to issuing the IECEx certificate and periodic audit reports.

The IECEx Certified Service Facilities Scheme also covers other Ex related services including installation and inspection of Ex equipment and installations.

High level of safety for Ex workforce

Ensuring that all equipment is designed, built or repaired in compliance with IEC International Standards is essential but may not be sufficient. What if those operating the equipment do not possess the very specific qualifications required to work in Ex environments?

To cover all safety aspects in Ex environments and to complement the Certified Equipment Scheme, IECEx has developed the IECEx Certification of Personnel Competence Scheme for assessing and certifying individuals working in potentially hazardous areas.

The IECEx CoPC (Certificate of Personnel Competence) provides independent proof that the certificate holder has the required qualifications and experience for working on electrical equipment located in hazardous areas and can implement IEC International Standards covering explosive atmospheres.

For the CoPC, competence is defined as "the ability to apply knowledge" rather than simply assessing knowledge. In this sense, the assessment of persons includes assessing their ability to perform certain Ex-related tasks.

Increased level of security

Manufacturers who rely on IECEx for the testing and certifying of their equipment, who have their staff go through the steps necessary to obtain a certificate of personnel competence, have that additional level of security that makes a real difference. They know that they operate in the best possible conditions and minimize the risks inherent to Ex sector.

More information: www.iecex.com

A common language for IoT

IEC and ISO publish a ground-breaking International Standard relating to the Internet of Things

By Catherine Bischofberger

The Internet of Things (IoT) is fast becoming the Internet of everything: the technology is impacting a huge number of sectors, from the transmission and distribution of electricity to the devices we use in our cities and homes. A new all-encompassing joint publication by IEC and ISO establishes a reference architecture for IoT, using a common vocabulary, reusable designs and industry best practices.

Wearable electronic patches, autonomous cars and smart grids may not seem to have much in common but they all show how IoT is beginning to change our lives. It involves the integration of smart physical entities – or "things" – with IT systems through networks, using electronic devices such as sensors and actuators to collect information and act upon these physical entities.

According to some forecasts, IoT will connect 50 billion devices worldwide by 2020. IEC has long recognized that this dynamic and wide-reaching technology area requires International Standards to provide the appropriate safety specifications, and contribute towards the interoperability of various electronic devices and systems.

Generic and all-encompassing Standard

The IEC and ISO Joint Technical Committee, ISO/IEC JTC 1, prepares International Standards for information and communication technologies related to business and consumer applications. In 2016, JTC 1 created Subcommittee (SC) 41 to produce Standards for the Internet of Things.

Since its creation, SC 41 has published several Standards, most recently on underwater acoustic sensor networks. One of its greatest achievements to date, however, is the publishing of ISO/IEC 30141, *Internet of things – Reference architecture*. The 84-page document establishes an all-encompassing framework for IoT, which serves as a basis from which to develop context-specific IoT architectures and actual systems.

"We worked on this document for many years. This project was lead by three co-editors: Jie Shen from China, Wei Wei from Germany and Östen Franberg from Sweden. More than 50 people were directly involved. We received a lot of help from the Industrial Internet Consortium as well", explains JTC1/SC 41 Chair François Coallier. "One of the challenges we faced is that the market for IoT is growing and evolving rapidly, thanks to ever more powerful computer systems and the lowering of sensor prices and other devices, but the technology is still immature in many respects. We had to keep track of all these developments and reach a global consensus before publishing," he adds.

Trustworthiness is key

One of the aims of this generic and horizontal document which can apply to numerous areas – smart manufacturing, grids, buildings, cities, agriculture, intelligent transport systems, e-health etc. – is to assist stakeholders in creating a vertical-specific architecture ensuring that IoT-based applications are resilient, safe, and easy to use and access. Another prerequisite is to protect people's privacy by ensuring their data cannot be hacked or stolen. "The right balance has to be struck between these different requirements. It is crucial for users to feel they can trust IoT systems. Trustworthiness was one of the key concepts that guided our work in this document."

The Standard establishes a conceptual model with a common vocabulary for the systems and devices involved. This leads to four different architecture views derived from current reference models which provide common definitions of the processes relating to IoT. Trustworthiness is explained and is based on safety, security, privacy, resilience and reliability which are all defined separately.

SC 41 is working on two other projects with trustworthiness as a guiding principle. These are ISO/IEC 30149, *Internet of Things (IoT) – Trustworthiness framework and ISO/IEC 30147, Internet of Things (IoT) – Methodology for implementing and maintaining trustworthiness of IoT systems and services*.

"We have left some points out of the new Standard which will be added in the revision work which has already started", Coallier says. It is imperative to continuously update this crucial document to keep up with the rapidly changing technological landscape, but at least manufacturers, suppliers and users of IoT can now speak a common language.

From solar PV to wearables – digital printing technologies are booming

Interview with Alan Hodgson, Chair, Technical Committee 119: Printed electronics

By Antoinette Price

Alan Hodgson participated in several sessions during the *Printing for Fabrication* conference organized by the Society for Imaging Science and Technology (IS&T) in Dresden, Germany, in September.

Since printing brings together the printed electronics, wearables and display communities, such events allow participants from a broad industrial, academic and engineering background the chance to discuss and develop better solutions for healthcare and clothing. IEC has already produced International Standards relevant to these areas, which include inkjet printing measurement, substrates for wearables and surface roughness.

E-tech caught up with Hodgson to learn about the topics discussed and the useful feedback he received on future areas for standardization.

Why is this event important for IEC?

"The conference *Printing for Fabrication* explores the potential applications of digital printing technologies in areas for which IEC carries out standardization activities, such as photovoltaics and lighting devices.

Electronics can be printed onto flexible layers making them ideal for smart wearables (Photo: Sensoria Inc.)

For instance, using the new thin-film technologies, photovoltaics electronic assemblies can be produced on flexible substrates, allowing new design freedoms. This means printing techniques for manufacturing electronics assemblies becomes an attractive prospect, because these techniques allow industry to fabricate diverse devices and structures and because printing processes are also amenable to roll-to-roll processing, in which electronic devices are created on a roll of flexible plastic or metal foil. Printing will also allow photovoltaics to be incorporated into other electronics systems, such as photovoltaics for energy harvesting at low light levels. The conference also looked at the potential for using printing to fabricate electronic components that will be integrated with other electrotechnical components to produce a physical manufactured product, such as electronic displays and printable materials for organic light-emitting diode (OLED) luminants.

Moreover, printed electronics have a role to play in the manufacture of future wearable electronic devices. Electronics can be printed onto textile flexible and/or stretchable substrates, thus becoming flexible displays that can be integrated into garments. These could then be incorporated into wearable devices that could fit into everyday life in a variety of implementations.

Several IEC Technical Committees (TCs) publish International Standards for printed electronics and digital printing technologies, which will help develop and hasten many products to market, such as wearables for healthcare and clothing and more."

What topics were discussed?

The conference dealt with the use of printing for the fabrication of components, such as sensors and microelectromechanical systems (MEMS) devices.

"On the topic of sensors, it was about the ability to combine the printing on both electronics and sensor elements, plus all the different materials and production processes that can be deployed for sensor fabrication. For MEMS devices, discussions covered the use of printing techniques related to certain aspects of the electrical connections between the multi-layered assemblies. There was also a strong component of inkjet printing technology. The delegates working in that area have become interested in the work of IEC TC 119, in particular, the IEC 62899-302-1 and 2 International Standards which cover the imaging based measurement of jetting speed and droplet volume for inkjet equipment, respectively."

With the printed electronics, wearables and display community in attendance, it is the ideal opportunity to explore the technical issues around the fabrication of textile electronics and sensor assemblies and examine where these devices fit into the IEC interest areas, including smart cities, industry 4.0 and active assisted living (AAL).

"In terms of technical issues, we concentrated on those areas not already covered by IEC TC 119 and IEC TC 124 for wearable electronic devices and technologies. Broadly speaking these are sustainability, 3D printing, electrostatics, barrier layers and surface roughness. For smart cities, it is the issue of 'citizen as a sensor' through wearable electronics. In other words, citizens become mobile sensor platforms, feeding actionable data back into the infrastructure of the Smart Cities of the future. Since the meeting was held in Germany, there was a big focus on industry 4.0 and where textile electronics fit into the factory of the future. In relation to AAL, increasingly sensors and printed electronics are being integrated into smart wearable devices to facilitate the healthcare and well-being of ageing populations."

Showcasing IEC work

During the conference, a session was devoted to International Standards and intellectual property.

Hodgson presented his paper entitled *International Standards Enabling Printed Electronics for Wearables*, which introduces the standardization effort taking place to support the industrialization of wearable electronic devices and where printing for fabrication technologies will fit into these. It covers market sectors for wearable electronic devices and examines where printed electronics and other technologies will contribute, concentrating in particular on textile electronics and sensor fabrication. It also explains the concept of e-textiles in this space and explains how interested parties can participate and the benefits thereof.

IEC TC 119 expert Kei Hyodo presented the *Overview of Standardization Activities for Inkjet Additive Manufacturing (within IEC TC 119 Printed Electronics)*. The paper explains that until recently, inkjet printing technologies have been mainly applied to conventional graphics printing and as such didn't require standardized evaluation methods. However, the advent of additive manufacturing and expansion of printed electronics, in particular has brought about an industry-wide need for standard evaluation methods of this type of printing, which IEC TC 119 is addressing.

What are some of the challenges?

There is still much work to do and new areas that need to be addressed.

"In terms of the future areas requiring standardization, we discussed the topic of sustainability and the congruence of this approach through the UN Sustainable Development Goal 12, which aims to ensure responsible consumption and production. The integration of printed electronics into 3D printed structures was raised and specific issues around electrostatics, data privacy and terminology were also mentioned. As this was a technical audience, it also proved to be a good opportunity to explore some of the more complex areas for future work such as flexible barrier layers, functional textiles and the effects from surface roughness and structure."

The results of this feedback will be included in a review of the IEC TC 119 strategic business plan, during the IEC General Meeting in Busan, Korea in October.

Future events

The conference was very positive because it allowed IEC participants to specifically target pertinent disciplines with a message about the importance of IEC Standards, and discuss what work is in the pipeline.

Hodgson plans to discuss data security and privacy issues of mobile devices during the upcoming IS&T *Colour and Imaging* conference in Vancouver, Canada. This is an area of common interest between IEC TC 124 and the IEC and ISO Joint Technical Committee for information technology, (ISO/IEC JTC1), which covers many topics including biometrics and IT security.

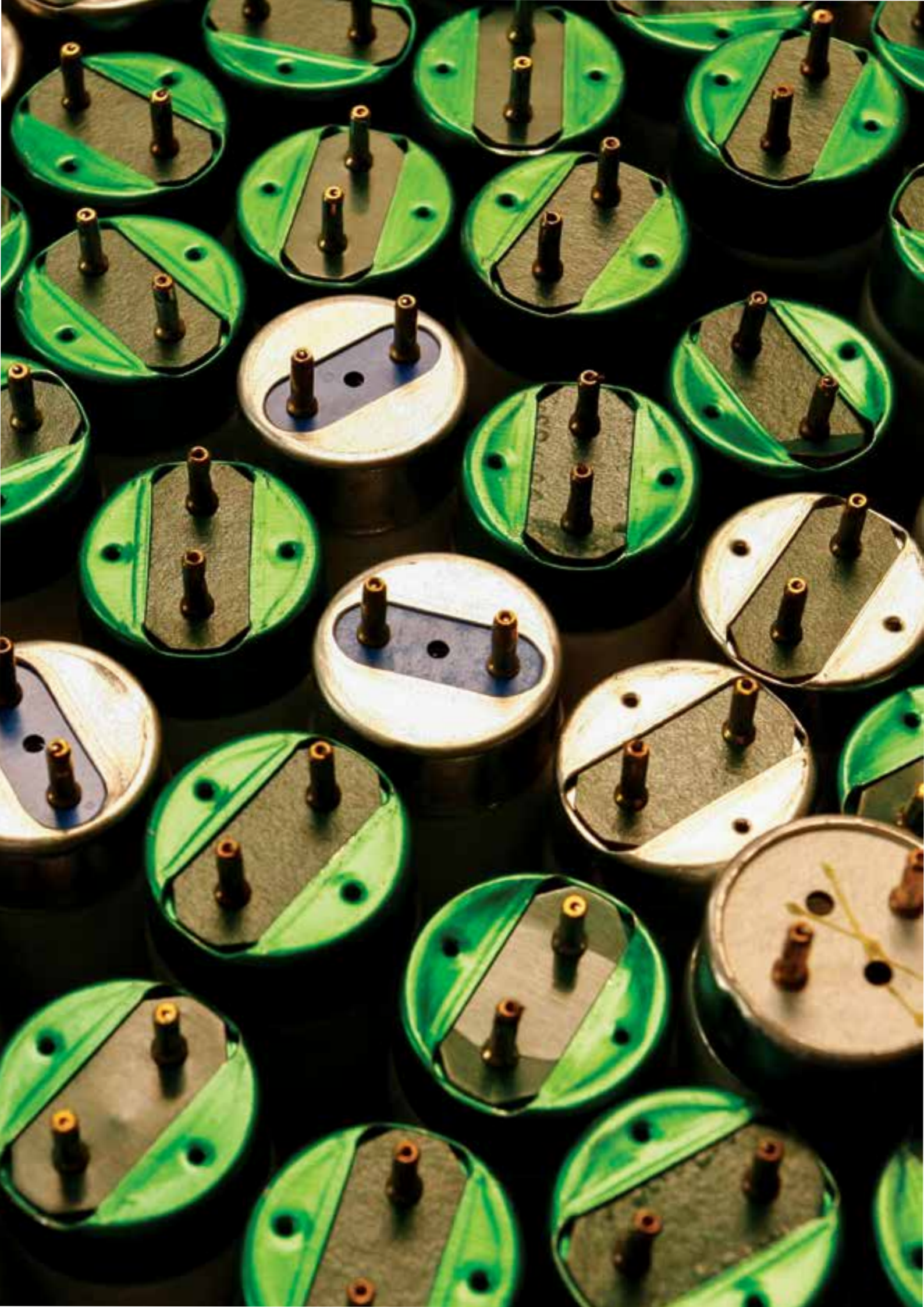
"From a TC 124 perspective it is the personal medical and well-being data that will flow from the wearable into the mobile device. The *Colour and Imaging* conference is more concerned with the acquisition of biometric and identity data. As these all come together, there is the issue of consumer trust in mobile platform security, cyber and physical. This is what I plan to explore at this conference and I believe International Standards could make a significant contribution."

A safer cyber world and GM 2018 highlights

Today we use more and more connected devices, such as medical wearables to monitor health, smartphones to make payments, purchases and manage smart homes, while the automation of manufacturing, transport and critical infrastructure advances. These technologies only work if the data gathered remains private and users of automated systems remain safe. In the next issue, we look at how IEC Standards contribute towards maintaining cyber security in different situations. We also include highlights from the GM in Busan, Korea.

IEC Family has moved...

All IEC Family articles can now be found on the IEC blog: blog.iec.ch/category/iec-family



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