SMART ENERGY

TECHNOLOGY FOCUS
Smart Cities to boost energy efficiency
Supporting technologies for photovoltaics
Stacking solar, setting standards

INDUSTRY SPOTLIGHT
Tackling energy efficiency from the start

CONFORMITY ASSESSMENT
IECRE issues first certificate for wind turbines

IEC WORLD
IEC-eCl@ss cooperation agreement
Smart Energy

Issue 08/2016 of e-tech focuses primarily on Smart Energy. A wide range of technologies will help cities optimize energy use for hundreds of smart city projects around the world. Smart grids, open data platforms and networked transport systems will help meet the challenges of environmental sustainability, population growth and urbanization. LVDC is bound to play a major role in speeding up electrification and enabling electricity access for all. Rapid development of new materials and production techniques in solar PV is pushing both the limits of technology and relevant industry standards. IEC work is key to the upgrade of the grids and to bring smartness to cities, buildings, homes, transportation and much more.

EDITORIAL
What makes energy smart?  3

TECHNOLOGY FOCUS
Smart cities to boost energy efficiency  4
Stacking solar, setting standards  7
Supporting technologies for photovoltaics  9
Moving from the core to the edge  12

INDUSTRY SPOTLIGHT
Tackling energy efficiency from the start  14

TECHNICAL COMMITTEE AFFAIRS
Standardization can help millions access electricity  17
IEC actively supports gender diversity  18

CONFORMITY ASSESSMENT
The technology that runs smart homes  22
Adopting smart technology  24
Smart equals sensors inside  26
Wind industry: Harmonized certification facilitates global market access  28

IEC FAMILY
Smart Energy  30
November 2016 nominations  31

IEC WORLD
Digital data exchange to be streamlined  33
Upcoming global events (December 2016-April 2017)  35

IN STORE
Covering countless safety requirements for SMPS  37

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Energy in itself is not smart. What makes it smart then? The numerous technological advances that allow companies and household to use energy more efficiently.

**Storing and monitoring**

The means to store surplus energy are still fairly limited nowadays but the development of industrial and domestic storage systems may soon change the way we generate, distribute and consume energy.

Storing surplus energy – especially from solar and wind power – in industrial-size batteries and releasing electricity whenever weather conditions keep generation at its lowest, will increase efficiency and at the same time may reduce green-house gas emissions by reducing reliance on fossil fuels, such as coal and gas.

On the domestic front, for those who have solar panels on their roof or possess an electric car, home batteries may provide a handy solution for the storage of excess electricity. This will reduce their electricity bill: they can use this backup power on sunless days or even sell it to their local utility.

**LVDC to play major role**

The use of low-voltage direct current (LVDC) is bound to play a major role, both in making energy smarter for cities, and in speeding up electrification and enabling electricity access for all throughout the world: almost everything, from electric vehicles, renewable energy technology, island irrigation systems, kitchen appliances, lighting and transport, smartphones and tablets, to systems with data and embedded electronics, such as the IoT, smart homes and smart cities, runs on LVDC.

Energy storage, LVDC, the intelligent use of renewable energy sources, new technological advances will help citizens, cities and countries, local and regional entities optimize energy use and meet the challenges of environmental sustainability, population growth, urbanization and electricity access for all.
Smart cities to boost energy efficiency
A wide range of technologies will help cities optimize energy use

Peter Feuilherade
In hundreds of smart city projects around the world, governments, municipalities and private stakeholders are investing in smart grids, open data platforms and networked transport systems to meet the challenges of environmental sustainability, population growth and urbanization.

Smart cities drivers
The continuing influx of people to cities, especially in Asia, Africa and Latin America, is predicted to add 2.5 billion people to the world’s urban population by 2050.

The primary drivers of smart cities are operational efficiency, cost reduction and environmental sustainability. Smart technologies have been most evident in sectors like energy, lighting, transport and water management.

Separate market studies in 2016 by consultancy firms Technavio and Frost & Sullivan estimate that the overall value of the global smart cities market will grow to between USD 1,400-1,500 billion in 2020. Asia-Pacific and Europe are expected to dominate the market because of government initiatives to accelerate smart city development.

IEC standards promote integration
Electricity and electronics are indispensable for the operation of the myriad interconnected services in smart cities and buildings.

Many IEC Technical Committees (TCs) and Subcommittees (SCs) coordinate on the development of International Standards for the broad range of electrotechnical systems, equipment and applications used to build and maintain smart cities and smart buildings, with an emphasis on safety and interoperability.

The IEC White Paper *Orchestrating infrastructure for sustainable Smart Cities* stresses that cities can only achieve economic, social and environmental sustainability by integrating their infrastructures and services to improve urban efficiencies.

There are hundreds of IEC International Standards that enable the integration of smart solutions for energy, buildings and homes, lighting and mobility.

Optimizing energy consumption
One of the key drivers for integrating systems and making buildings more intelligent is the energy savings that can be achieved.

A report published in October 2016 by the International Renewable Energy Agency (IRENA) noted that cities account for 65% of global energy use and 70% of man-made carbon emissions.
emissions. This makes optimizing energy consumption a fundamental objective of a smart city.

IRENA’s director-general Adnan Z. Amin believes that renewable sources can meet most of the energy needs of commercial and residential buildings in cities “either in a centralized way (i.e. delivering renewables sourced elsewhere to buildings via energy distribution networks) or in a decentralized way (i.e. through solar thermal collectors and solar PV panels located at the site where energy is needed)”.

Energy research analysts at Technavio have identified the top three trends driving the global energy-efficient building market as increased government support and investments, rising energy prices and reductions in emission levels of greenhouse gases.

The IEC Systems Committee on Smart Energy (SyC Smart Energy), aims to create one international platform for a comprehensive portfolio of efficient and easy-to-use standards that can be used by any project working on smart energy. The work of SyC Smart Energy includes wide consultation within the IEC community and a broader group of external stakeholders, in the areas of smart energy and smart grid, also including heat and gas.

IEC TC 8: Systems aspects for electrical energy supply, prepares and coordinates, in cooperation with other IEC TCs, the development of International Standards in these areas. IEC SC 8A prepares International Standards for the grid integration of large-capacity renewable energy sources.

IEC TC 57: Power systems management and associated information exchange, deals with communications between the equipment and systems in the electrical power industry, a central element of smart buildings, cities and grid projects.

International Standards developed by IEC TC 82: Solar photovoltaic (PV) energy systems and IEC TC 88: Wind turbines, (IEC 61400 series) are also central to smart energy.

In smart cities, both residential and commercial buildings are more efficient and use less energy. The consumption of energy is analyzed, data are collected and power production is optimized through different sources and distributed energy production.

Proper energy management requires accurate metering. Multi-function, communicating smart meters that measure energy exported and imported, demand and power quality, and management of load, local generation, customer information and other value-added functions, are essential when creating smart grids to coordinate supply and demand. IEC TC 13: Electrical energy measurement and control, develops International Standards for such meters, in liaison with other IEC TCs such as TC 8 and TC 57.

Another key component is the use of smart energy sensors with multiple functions to collect and share data for predictive analytics. These data can be used to detect and predict energy needs and provide valuable insights during times of peak demand. IEC SC 47E: Discrete semiconductor devices, prepares International Standards for components used in a variety of sensors.

IEC TC 82: Solar photovoltaic (PV) energy systems and IEC TC 88: Wind turbines, (IEC 61400 series) are also central to smart energy.

Internet of Things

The Internet of Things (IoT) is the network of interconnected objects or devices embedded with sensors and mobile devices which are able to generate data and communicate and share that data with one another. The spread of IoT-related technologies including low-cost sensors and high-speed networking will accelerate the adoption rate of smart city solutions over the next few years. IT research and analysis firm Gartner estimates that almost 10 billion connected devices will be in use in smart cities around the globe by 2020.

Microgrids

A new generation of low-carbon microgrids is changing the ways in which densely populated cities design and operate utility systems using the concept of locally generated and consumed energy. Microgrids allow predictive maintenance and are particularly promising for ensuring resilience in the energy demands of cities.

Microgrids

In the view of the Microgrid Media website.

“Coupled with rapid declines in the cost of emissions-free renewable energy technology such as wind and solar photovoltaic, recent drops in the cost of advanced stationary battery storage technology have altered the technological make-up of microgrids dramatically,” in the view of the Microgrid Media website.

Another significant factor behind the growth in renewable energy microgrids is the global drive to reduce carbon and greenhouse gas emissions. Transparency Market Research forecasts that by 2020 the microgrid market worldwide will be worth more than USD 35 billion.
A major feature of a smart city is the analysis and use of data collected by IoT devices and sensors to improve infrastructure, public utilities and services, as well as for predictive analytics. In Malaga and Madrid, for example, environmental sensors fitted to bicycles and post carts monitor air pollution, uploading data to a publicly-accessible web portal. And London is just one of many cities trying to alleviate urban traffic congestion by enabling drivers to quickly locate parking spaces and pay for them via smartphone apps, without having to carry cash.

Intelligent lighting, too, can serve as enabling technology for a range of IoT uses beyond illumination, as manufacturers embed video cameras, acoustic sensors and data communications capabilities into LED fixtures and bulbs.

The IEC White Paper entitled *Internet of Things: Wireless Sensor Networks* surveys the role of wireless sensor networks in the evolution of the IoT. It also highlights the need for standards to achieve interoperability among wireless sensor networks from different vendors and across varied applications, in order to unleash the full potential of the IoT.

As the IoT expands, so does the need for robust cybersecurity protection against malicious attacks on IoT-connected devices, applications and networks. This was demonstrated in October 2016 when hackers used software connected to tens of millions of commonly-used devices like webcams to launch a Distributed Denial of Service attack (DDoS) in the US which blocked some of the world’s most popular websites for several hours. The IEC is developing Standards and working on conformity assessment related to cybersecurity.

**Self-learning buildings**

A European consortium is developing ways to enable self-learning buildings to use wireless sensor technology and data mining methods to increase their energy efficiency over time by anticipating and meeting their occupants’ needs.

“In practice this will involve collecting various data, such as temperature, humidity, luminance, and occupancy via wireless sensors. The software then learns to optimize heating and ventilation so that user comfort is satisfied but energy consumption is minimized,” according to the University of Salford in the UK, which is taking part in the three-year Europe-wide project.

As self-learning buildings become more widespread, technologically advanced buildings will be able to communicate electronically with each other to ensure that energy consumption is balanced.

**The next generation**

The next generation of smart cities will benefit from innovative ways to integrate renewable energy and energy-efficient and intelligent building technologies.

Researchers at the University of California Los Angeles (UCLA) have developed transparent solar panels that can be mounted on the windows of buildings in order to capture more sunlight than traditional roof-mounted panels.

Another innovation is a small, ultralight wind turbine built into a building or other urban structure. These are already in use or undergoing trials around the world, from the Eiffel Tower to Bahrain’s World Trade Centre and the Pearl River Tower in Guangzhou, China.

The falling costs of sensors, controllers and gateways will see the IoT gain further traction in the smart buildings market, especially among owners of small and medium-sized buildings.

In these and many associated areas, the work of the IEC on standardization and conformity assessment as a fundamental principle in the development of future smart city technology is set to play a central role.
Stacking solar, setting standards
Solar photovoltaic installations on the cusp of significant performance boost

David Appleyard
Rapid development of new materials and production techniques in solar photovoltaics (PV) is pushing both the limits of technology and relevant industry standards. With a swathe of new PV cell types emerging, the solar sector is set for a revolution. International Standards developed by IEC Technical Committee (TC) 82 and the IECEE certification scheme for PV help support this expansion.

Multitrack approach to better PV performance at lower cost...
New materials, new processes and new ideas continue to break records for solar photovoltaic technology cost and performance. In many places across the world, solar is already cost-competitive and the advances continue apace. In November, for instance, Germany’s Fraunhofer Institute for Solar Energy System (ISE) working with Austrian company EV Group announced that it had achieved a record 30.2% conversion efficiency with a multi-layered solar cell. Perhaps though, the biggest breakthroughs are yet to come. A host of novel materials are set to emerge in the coming years that are widely anticipated to transform solar into the lowest-cost energy option on a dollar per kWh basis.

Principal ways in which researchers are addressing PV costs are the use of cheaper materials and achieving higher conversion efficiencies. Through different chemistries, the art of stacking...
Currently the solar market is dominated by crystalline silicon technology. A relatively expensive material, alternatives have already been successfully launched. Lower-cost, though typically lower-efficiency, thin-film technologies such as cadmium telluride (CdTe) and copper indium gallium selenide (CIGS) are commercially mature. For example, in October, one of Jordan’s largest solar installations, the 52.5 MW Shams Ma’an plant featuring CdTe modules from First Solar Inc., was commissioned.

However, as the theoretical limits of conversion efficiency come closer for crystalline silicon and other cell chemistries, the next generation of PV technologies are looking at stacking cells in order to more effectively absorb a wider range of the electromagnetic spectrum. Fraunhofer’s 30%+ efficiency cell is just such an arrangement, effectively a hybrid between a conventional crystalline silicon cell with three-semi-transparent thin-film solar layers above, including commercially emerging materials gallium-indium-phosphide (GaInP), gallium-arsenide (GaAs) cells.

...and better tuning
By ‘tuning’ each of the cells to a specific range of receptive wavelengths, the overall range of the stacked cell is significantly improved, allowing more of the spectrum to be utilized.

Indeed, there are a host of novel photovoltaic materials and technologies under development. Some of the more promising that are suitable for this kind of stacking approach include perovskites, quantum dot and organic PV.

But, to achieve commercial success, prospective new semiconductor materials require both attractive conversion efficiencies and low-cost primary materials. Such materials must also be reproducible at an industrial scale while maintaining performance and multi-decade longevity.
Large-scale low-cost manufacturing

Certainly, many of the new materials being explored today offer opportunities through the use of lower-cost primary materials, but there are also advances anticipated in large-scale, and therefore low-cost, manufacturing. Tom Aernouts, R&D team leader at the Belgian research and innovation hub imec, explains: “Mostly those technologies are thin-film technologies, so less materials and also mostly quite low-cost materials and also advantages in processing. Most are looking to solution processing with the idea of going to roll-to-roll processing in the future, but this will probably take some time before it really will be a commercial product.

“Nevertheless, solution processing potentially can make the processing low-cost with high throughputs at low temperatures. These are some of the claims that these technologies make and some of them have even shown that it is possible, and therefore can be at a competitive level – if the efficiency and stability become also competitive with silicon PV, which is still dominating the market.”

Tyler Ogden, Research Analyst at US-based market intelligence firm Lux Research Inc. highlights one emerging prospect: “One of the hottest topics – in terms of emerging technologies in the solar world – is perovskites in regards to their skyrocketing efficiency gains. They are currently at a record efficiency above 20%, which has caught up pretty rapidly to where the record efficiency for more mature thin-film technology such as CdTe currently are.”

“One of the major concerns is wanting to try to maintain a high efficiency in the production of modules, going from cell to module. But also insuring that these cells and modules are produced for commercial installation, meet reliability and durability standards set by crystalline silicon.”

Scaling up is the challenge

This is a point echoed by Aernouts, who says: “For such a young technology, which has only been out there for a few years, the challenge will be to see if it can be up-scaled, if you can make modules out of that.”

He adds: “We think technologically it’s possible, especially with the fact that [perovskite] cells have already shown that efficiency can go up to 22% and potentially even higher. The potential is definitely there, the scalability is thought to be also possible.”

Most start-ups using perovskite technology are in the process of demonstrating that the technology has the potential to meet the same standards as the industry incumbents. UK-based Oxford Photovoltaics, for example, is currently one of the more advanced players in the perovskite sector as, following an GBP 8.7 million (USD 10.4 million) funding round, it is now establishing a demonstration production line in Germany in order to showcase their technology in tandem with standard crystalline silicon technology.

This is a trend picked up by Ogden: “A lot of the research is based around pairing perovskite technology with existing silicon or even thin-films. After demonstrating core efficiency of perovskites alone, it has turned to looking at how we can integrate perovskites with industry incumbent technology.

“They’re aiming to pair up the technology and lead to a module achieving greater than 22% upwards to 25% or even higher and breaking the [theoretical] limit for silicon.”

Though positive about the promise of perovskites, Aernouts does sound a note of caution: “Lifetime is the next key issue. The stability is still to be improved. There are signs of improvement, but the initial stability was pretty poor on perovskite devices because of high sensitivity to the humidity, which really can deteriorate the quality of the active layer.”
IEC Standards and Certification are central to solar development

Inevitably, where key considerations concern the performance and longevity of an electrical product, industry standards are a key requirement. IEC already has a number of appropriate instruments in place. A Technical Specification (TS) setting out general guidelines and recommendations for the design and installation of ground-mounted photovoltaic plants is under development by IEC TC 82: Solar photovoltaic energy systems.

For example, IEC 61215:2016 lays down requirements for the design qualification and type approval of terrestrial photovoltaic modules suitable for long-term operation and apply to all crystalline silicon terrestrial flat plate modules.

Ogden emphasizes the importance of standards evolution: “These start-ups, they are holding their technology to the same standards as thin-films are held to under the IECEE certification scheme for PV – in terms of things like damp heat testing, UV exposure, temperature cycling. They’re aiming to meet the same type of standards that thin-film technologies like CIGS and CdTe have met in the past and led them to reach maturation.”

IECEE is the IEC System for Conformity Assessment Schemes for Electrotechnical Equipment and Components, it covers 23 categories of electrical and electronic equipment and testing services.

Ogden adds: “There is interest among developers of perovskites, for instance, or really any new or novel material, to develop new standards that better align with these emerging materials that don’t quite correspond with what we see currently in the industry.”

This is a point also noted by Aernouts: “If you look into the stacking aspect, I think that silicon and silicon standards are dominating. If you want to give a warranty on a stacked product, the perovskite part probably has to be able to withstand the same standards and testing also.”

However, he also emphasizes the challenge in developing new standards for emerging photovoltaic technologies: “Understanding the exact type of measurements that you need on the perovskite and on thin-film PV in general, the best way of measuring these devices and how much lifetime you can guarantee from this kind of accelerated lifetime testing, is not fully clear. That’s a crucial point to investigate and come to reasonably good standards, which might deviate quite a lot from conventional ones used for silicon PV.”

Supporting technologies for photovoltaics

Barrier layer assemblies and printed electronics bound to play major role, especially in flexible PV

Dr Alan Hodgson,
Chair IEC TC 119: Printed Electronics,
Member IEC SMB SG 10: Wearable Smart Devices

There are a number of technologies supporting the development and further implementation of photovoltaic (PV) devices. International Standards developed by several IEC Technical Committees (TCs) and Subcommittees (SCs) in the barrier layer assemblies and printed electronics domains underpin this implementation.

Barrier layer assemblies

Traditional silicon-based photovoltaics needs some physical protection from...
Multiple products needed for multilayer barrier

Multilayer barrier requires several types of products that also dictate the standardization regime. There are prefabricated barrier films that are sold with a self-adhesive layer to protect sensitive products. There are also barrier adhesives that allow assemblies to be constructed without providing a conduit for water and oxygen into the device.

There are two major electrotechnical product groups that have a need for barrier layers and it is useful to compare and contrast them from this perspective. The first is Organic Light Emitting Diode (OLED) for both display and lighting, the second is photovoltaics. OLED materials used for display in items such as smartphones and televisions and in emerging lighting modules exhibit a high sensitivity to atmospheric oxygen and water. However, they are in general used in a comparatively benign environment and in general are expected to have product lifetimes measured in small numbers of years.

Photovoltaics is a rather different proposition in terms of barrier performance expectations.

The emerging thin-film technologies are rather less sensitive to water and oxygen than the materials used in OLED devices. However, these products need to survive in an outdoor environment for a service life of at least 20 years. As a result the overall performance requirements for barrier layer assemblies may actually be more similar than at first sight.

As a consequence the testing of barrier layer performance is a critical part of the assessment of the potential lifetime of OLED display and lighting and photovoltaics. And this illustrates the need for standardization in this area.

Standardization of barrier layer performance

Barrier layers are not used exclusively for electrotechnology. Indeed the main use of barrier layers is in plastic films incorporated into packaging to exclude moisture and oxygen from food products. Consequently the International Standards for the testing of these products have evolved not within the IEC but within ISO TC 61: Plastics. ISO TC 61/SC 11: Products, has two working groups (WGs) covering barrier layer technology. The first, WG 3: Plastics films and sheeting, is...
defining test methods for barrier layer assemblies. The second, WG 5: Polymeric adhesives, is starting a similar task for barrier layer adhesives.

However, the interest in this work is not confined to ISO. For example, the Organic Electronics Association (OE-A) is an active supporter of International Standards for flexible electronics and has established a WG entitled Encapsulation. Their goal is to further facilitate the International Standards development process by conducting round robin testing of adhesive and barrier layer materials. They have also organized workshops in this area.

There is also understandable interest in this work through the IEC TC structure. For example IEC TC 110: Electronic display devices, and IEC TC 82: Solar photovoltaic energy systems, have interest as barrier layer technology is important in these applications. In addition, WG 6 of IEC TC 47: Semiconductor devices, has commenced work on a test method for barrier layer performance for flexible and stretchable semiconductor devices.

Barrier layer performance is also of importance in the field of printed electronics. As a result IEC TC 119: Printed Electronics, has resolved to start a liaison relationship with ISO TC 61/SC 11 to contribute to the work on barrier layer performance.

Printed Electronics

As photovoltaics moves into the area of flexible substrates, the use of printing techniques to manufacture electronics assemblies becomes an attractive prospect. This is because these techniques allow industry to fabricate devices and structures over a wide area. And printing processes are also amenable to roll-to-roll processing, as described in e-tech August 2016.

TC 119 is working on Standards for the terminology, materials, processes and equipment that will facilitate the industrialization of printed electronics. Printing could be a significant benefit to photovoltaics as it moves into new thin-film technology. For example, printing technology has the potential of significantly reducing the cost of CIGS (copper indium gallium selenide) photovoltaics over the alternative sputtering process. It can increase materials utilisation whilst facilitating high speed roll-to-roll deposition. As an example companies are aiming to develop a production-scale CIGS ink to accelerate the adoption of this technology.

Printing will also allow photovoltaics to be incorporated into other electronics systems into the future. The use of photovoltaics for energy harvesting at low light levels is currently attracting significant attention. The ability to replace the thick and rigid coin cell batteries with a combination of printed photovoltaics and energy storage could facilitate a number of applications.

Wearable devices, as described in e-tech January 2016 is one area where this could become important and where standardization is needed.

IEC SMB Strategy Group (SG) 10: Wearable Smart Devices, has resulted in an SMB decision to create a new TC in this area, and working with other Technical Committees, IEC TC 119 will be contributing to this. As an example of this contribution IEC TC 119 has published IEC TR 62899-250:2016, a technical report on the material technologies required in printed electronics for wearable smart devices. Further work is now being initiated on standards documents covering materials for flexible wearable smart devices, such as stretchable substrates and inks.

PV technology potential move into wearables

As PV technology moves into flexible form factors, new technologies such as barrier layers and printed electronics become a priority. International Standards are developed to support this from a number of directions. There is the potential for these new photovoltaics to move into wearable electronics too and structures within the IEC are growing to accommodate this.
TECHNOLOGY FOCUS

Moving from the core to the edge
Scaling to support the Internet of Things’ trillions of sensors and billions of systems

Janice Blondeau
The IEC has initiated a White Paper dedicated to Vertical Edge Intelligence in cooperation with Fraunhofer Institute’s FOKUS NGNI

Trillions of sensors and billions of systems
According to International Data Corporation (IDC), to enable and realize the true value of the Internet of Things, edge intelligence, which shifts processing for data intensive and processing applications away from the core to the edge of the network, continues to expand. Les Santiago, research director, Wireless and IoT Semiconductors at IDC, says, “A radical transformation is underway from the cloud to the edge of every major system. In an effort to address the opportunity, both edge and cloud infrastructure need to continue to scale and support trillions of sensors and billions of systems.”

The growth of edge intelligence
As processors, microcontrollers, and connectivity are embedded into a plethora of new devices, edge intelligence in smart appliances, wearables, industrial machines, automotive driver assistance systems, smart buildings, and the like continues to increase.

This means that several IT and Operational Technology (OT) industries are moving closer towards the edge of the network so that aspects such as real time networks, security capabilities to ensure cybersecurity, self-learning solutions and personalized/customized connectivity can be addressed.

New IEC White Paper initiated
Members of the IEC Market Strategy Board (MSB) have initiated a project

Edge intelligence shifts processing for data intensive and processing applications to the edge of the network, away from the core
to produce a White Paper on Vertical Edge Intelligence. The project experts were recruited from the IEC, Huawei, Mitsubishi, SAP, Johnson Controls International and Fraunhofer FOKUS NGNI, the Fraunhofer Institute for Open Communications Systems – Software-based Networks (Germany).

The goal of the project is to explore market potential and vertical use-case requirements, analyze gaps and produce recommendations for adopting Vertical Edge Intelligence technologies.

The kick-off meeting took place on 21 and 22 November at FOKUS. The next meeting will be hosted in Shenzhen, China, on 24 and 25 January and will include new experts from the IEC. The resulting White Paper will be published by the IEC in October 2017.

The IEC Market Strategy Board
The Market Strategy Board was set up by the IEC to identify the principal technology trends and market needs in the IEC fields of activity. The MSB helps maximize market input and establishes priorities for IEC technical and conformity assessment work, enhancing the response of the Commission to the needs of innovative and fast-moving markets. Its members comprise Chief Technology Officers of major international corporations.

FOKUS, the Fraunhofer Institute for Open Communications Systems
Fraunhofer FOKUS researches digital transformation and its impact on society, economics and technology. Since 1988 it supports commercial enterprises and public administration in the shaping and implementation of the digital transformation.

For this purpose, Fraunhofer FOKUS offers research services ranging from requirements analysis to consulting, feasibility studies, technology development right up to prototypes and pilots in the following business segments: Digital Public Services, Future Applications and Media, Quality Engineering, Smart Mobility, Software Based Networks, Networked Security, Visual Computing and Analytics.

With 424 employees in Berlin and an annual budget of approximately EUR 30 million, Fraunhofer FOKUS is the largest ICT institute of the Fraunhofer Society. Over 70% of its budget is generated through projects from industry and the public domain.

Every year the IEC MSB publishes a series of White Papers that ensure that IEC work helps solve global issues in electrotechnology.
Tackling energy efficiency from the start

Better energy efficiency is central to our future energy supply and to sustain growth

Morand Fachot

Energy efficiency represents the biggest source of untapped energy in the world and, by helping slowing down final energy consumption, one of the main contributors in the reduction of noxious gases emissions. Improved electrical energy efficiency is made possible by standardization work performed by many IEC Technical Committees (TCs) and starts with electricity generation, distribution and storage.

Covering all areas

Energy intensity, the measure of energy consumption per unit of gross domestic product (GDP), can be an imperfect indicator of energy efficiency in general. In recent years, despite relatively low energy prices, energy intensity has improved greatly, contributing significantly to a slowdown in energy-related emissions of greenhouse gases (GHG), CO₂ in particular.

“Increasing mandatory energy efficiency regulation, which now covers 30% of global final energy use, played a key role in moderating the effect of low energy prices on energy use,” according to an International Energy Agency (IEA) report. The report indicates that some 1.5 billion tonnes (GtCO₂) of GHG were not released in 2015 and 13 GtCO₂ cumulatively since 2000, thanks to energy efficiency (EE).

Electrical energy efficiency (EEE), which is central to overall energy efficiency, ranges from electricity generation, improved electricity distribution and storage infrastructure, to the introduction of more energy efficient equipment and systems in industry, buildings, transport and consumer goods.

Generation first...

EEE starts with energy generation, the conversion of primary energy (from hydropower, fossil fuels, nuclear, renewables, such as wind, solar, marine or geothermal sources) into electricity.

Hydropower was the first source of electricity, it represents now some 15% of electricity production in OECD countries, which is 75% more than the share of electricity generated by other renewable sources. Modern hydro turbines can convert 90% of all available energy into electricity.

IEC TC 4, established in 1913, develops International Standards for hydraulic turbines. TC 4 develops and maintains publications that assess the “hydraulic performance of hydraulic turbines, storage pumps and pump-turbines.”

Hydropower installations are robust and reliable but they need rehabilitation after 30 to 50 years of operation. TC 4 works on a new edition of a Standard that deals with the various options to increase power and efficiency in rehabilitation projects.

Burning fossil fuels – coal or oil – in thermal power plants is the second oldest form of generating electricity. The share of electricity generated from fossil fuels was 67% in 2014, according to the IEA. A significant amount of primary energy is wasted in the conversion of fossil fuels into electricity in thermal plants (up to 60-65%). One way of reducing waste is to recover waste heat generated in cogeneration Combined Heat Power (CHP) installations to use in industry or for urban heating systems.

Thermal power plants use steam turbines to convert heat and steam into power. International Standards for steam turbines, which are used also
in nuclear power plants, geothermal installations, solar thermal electric and CHP plants, are developed by IEC TC 5.

IEC TC 2: Rotating machinery, develops International Standards for rotating electrical machines, including motors, used, for instance in “generators driven by steam turbines or combustion gas turbines”. This work includes aspects aimed at improving the EE of motors.

Renewable sources are set to play a central role in EEE efforts, by reducing the share of fossil fuels. All IEC TCs involved in renewable sources installations work on developing new more EE systems and in improving the EE of existing ones. These TCs include:

IEC TC 82: Solar photovoltaic energy systems, which develops also International Standards for various measurements and performance parameters of PV devices.

IEC TC 88: Wind energy generation systems. TC 88 prepares, for instance, International Standards “for power performance measurements of electricity-producing wind turbines”. In wind power generation, drivetrain, voltage optimization, use of high voltage direct current (HVDC – IEC TC 115) and advanced control systems (IEC TC 57) contribute to better EEE.

IEC TC 114: Marine energy – Wave, tidal and other water current converters, is a recent IEC TC, but the potential of harnessing marine energy is very promising. Much of the work of this TC focuses on power performance assessment of these converters.

IEC TC 117: Solar thermal electric plants, also covers a fairly recent area, which is fast expanding and showing a significant potential.

...followed by distribution

Electricity distribution is also an area where EE is addressed by developing new technologies and systems or improving existing ones.

Electrical energy produced by power plants in medium (MV 20 000 V) or low (LV 1 000 V) voltage is elevated to HV (up to 400 kV) by a step-up substation before being transmitted across long distances by high-tension power lines. A step-down station converts HV to MV to transport it to feed MV or LV transformers for use by households, factories, commercial buildings, etc. The efficiency of large transformers in step-up and step-down substations is very high and can reach 99%. The efficiency of MV and LV transformers may range between 90% and 98%.

IEC TC 14 develops International Standards for power transformers.

Losses in cables are higher than in transformers, but EE is improving there as well. IEC TC 20 develops
and maintains International standards for electric cables and incorporates improved efficiency and durability in its maintenance procedure. Ultra high voltage (UHV) distribution of both DC and alternating current (AC) is seen as allowing the EE transmission of power generated by renewable energy sources in sites far away from the main load centres, e.g. in offshore wind farms, large hydropower plants or large solar installations in deserts with acceptably low transmission losses. International Standards for HV and UHV transmission systems for DC and AC are being developed by IEC TC 115 and IEC TC 122, respectively.

Storing electricity for later use
Energy storage is an important component of EE projects. It helps reduce transmission losses and help balance power from intermittent RE sources. By allowing electricity to be stored for later use, it can eliminate the need for the expensive (and polluting) use of generators and idling power plants. It is also an essential ingredient in so-called microgrids and off-grid rural electrification. International Standards for electricity storage systems are developed by:

IEC TC 4: Hydraulic turbines: Hydropower, in addition to generating electricity, makes up some 90% of installed storage capacity worldwide, in the form of pumped storage hydro (PSH) installations. In PSH, water is pumped in a reservoir uphill when electricity is cheap and plentiful (excess electricity from wind or solar power installations) and released downhill to generate electricity, when needed. It is highly efficient (80% or more). IEC TC 4, prepares also International Standards for “storage pumps and pump-turbines”.

IEC TC 21: Secondary cells and batteries, prepares International Standards for all types of batteries used in energy storage, including stationary (lead-acid, lithium-ion and NiCad/NiMH) batteries and flow batteries.


Into the future...
In many countries, electricity grids were designed based on technology that was modern more than 100 years ago. Standardization work by several IEC TCs makes it possible to update these legacy systems in order to transform them in “Smart Grids”. This is essential to reduce distribution losses and identify energy efficiency opportunities. This means updating the ageing infrastructure to allow the integration of intermittent renewable energy sources, ensure the security of supply and increase in energy use.

[ ] “For instance, a small service-based country with a mild climate would have a lower intensity than a large industry-based country in a cold climate, even if energy was used more efficiently in the latter country.” (IEA)
Standardization can help millions access electricity
IEC approves Systems Committee for LVDC

Antoinette Price
It has been a busy year for Systems Evaluation Group (SEG) 4: Low Voltage Direct Current (LVDC) Applications, Distribution and Safety for use in Developed and Developing Economies. During the IEC 2016 General Meeting (GM) in Frankfurt, SEG 4 Convenor, Vimal Mahendru, presented a final report to the Standardization Management Board (SMB). The SMB voted in favour of the proposal to set up a Systems Committee (SyC) for LVDC and LVDC for electricity access.

The importance of LVDC
The work of SEG 4 is very important, given that everything from electric vehicles, renewable energy technology, island irrigation systems, kitchen appliances, lighting and transport, smart phones and tablets, to systems with data and embedded electronics, such as the IoT, smart homes and smart cities, runs on LVDC.

Electricity requires a systems approach
One in five people does not have access to electricity. “LVDC bridges the distance between the solar photovoltaic (PV) generation and the consumption devices in the home. This happens without conversion losses and expensive, cumbersome grids. LVDC networks are quick to erect, energy efficient and cost effective, enabling speedy electrification of homes and villages”, says Mahendru.

If more people are to have access to electricity, a lot more needs to be done. A number of IEC technical committees (TCs) have direct current (DC) provisions in their current scope of work, including: IEC TC 8: Systems aspects for electrical energy supply, IEC TC 64: Protection against electric shocks, and IEC TC 82: Solar photovoltaic energy systems, to name a few. Additionally, SEG 6: Systems Evaluation Group – Non-conventional Distribution Networks/Microgrids, contributes to this work.

IEC needs a systems approach to LVDC standardization, because no single TC covers everything. Around 30 will need to upgrade existing Standards to include LVDC Standards. At the same time, several TCs need to come together, along with domain experts and new actors operating in the area of electricity access so that completely new publications may be developed which enable deploying LVDC for electricity access.

“Actually you have to see LVDC as a transversal topic, touching overwhelmingly everything that uses electricity. As a result, almost all TCs are likely to be required to eventually update their Standards. Hey, this is truly disruptive! Then you have to see LVDC for electricity access as a vertical, a specific use case. However, LVDC for electricity access is perhaps the most profoundly impactful work that the IEC community would be taking up in a long time. It is all about inclusive development, about bringing electricity and ensuing opportunity to all in our shared world”, says Mahendru.

From SEG to SyC
The newly proposed Systems Committee structure would comprise two Coordination Advisory Groups (CAGs) and one Working Group (WG).
- CAG 1 will review markets for Standards and use cases. It will
provide recommendations on industry needs for standardization, highlight areas for future cooperation with external stakeholders and promote IEC LVDC work and Standards.

- CAG 2 will be responsible for internal coordination and implementation of the work carried out by the different TCs and subcommittees. Both CAGs will participate in defining a strategic business plan for the new SyC.
- WG 1 is expected to work on the LVDC publications for electricity access.

SEG 4 intends to keep the momentum going during the transition process, with a number of events expected to take place between now and May 2017. In particular, it will hold a webinar in February, which will be open to all stakeholders from within, or outside the traditional IEC community. The webinar will allow participants to see how IEC is leading this work with the different stakeholders (governments, funding agencies, insurers etc.).

From 22-24 May, the first IEC International Conference on LVDC for Electricity Access will be held in Kenya. This is going to be a unique, one-of-a-kind event to bring together all stakeholders to specifically discuss how to leverage LVDC to enable rapid electrification.

Additionally, as an IEC Ambassador, Mahendru will also promote the IEC and its LVDC work at international events, such as India Smart Grid Week 2017, where he will be one of the guest speakers.

Solar lamps provide off-grid lighting (Photo: Solar for Africa Blog/John Keane)

Many everyday items, like laptop and smart phones run on LVDC

IEC actively supports gender diversity
Embracing the female perspective in standardization

Antoinette Price

Gender equality is essential for achieving peace, defending rights, fostering economic growth, and promoting global well-being. In standardization, it is important to include female insights for everyone’s benefit.

Participants in the SyC AAL plenary meeting in Frankfurt, Germany, that took place during the IEC General Meeting
**Importance of the female viewpoint**

A pertinent example is the crash test dummy. Swedish traffic researchers at Chalmers University of Technology in Gothenburg, were able to demonstrate that women weren’t properly protected against whiplash injuries caused by rear-end collisions, because all the crash test dummies used were based on a male driver’s relative weight and anatomy. As a result, they have created the world’s first female crash test dummy to help manufacturers make vehicles that protect women, as well as men, from such injuries.

**Improving the status quo**

It is well-known that societies have not encouraged women to pursue careers in science, technology and engineering. While there are no complete global statistics, a report by the US Congressional Joint Economic Committee shows that only 14% of engineers are women. This holds true for the IEC technical community, however the Central Office has a large share of women and parity, including at the head of the Affiliate Country Programme, Young Professionals (YP) and Marketing and Communications.

The IEC is also a participant in the International Gender Champions initiative, in which it undertakes to impact the work culture and integrate gender equality in the sphere of influence of the IEC around the world, by:

- Reaching out to all IEC Members to increase their awareness regarding the importance of participation of women in technical committees and to consider gender balance when sending participants to the IEC YP Programme.
- “Training” IEC CO Technical Officers to encourage technical committees to adopt a more gender balanced approach in all relevant Standards.

**Leading by example**

Another great example of where IEC has enhanced the gender balance is the IEC Systems Committee for Active Assisted Living (SyC AAL), which has a predominantly female management, and 24% of female experts, who complement the work of its male experts. The development of Active Assisted Living is driven by the demographic evolution of aging populations and an increasing desire for convenience, comfort as well as active and independent living. This Committee prepares the many Standards that are needed to increase the interoperability of devices from different manufacturers.

**What is AAL and why is it important?**

Our world is becoming smarter. Intelligent technology, including AAL devices, systems or services, is being incorporated in cities, infrastructure, buildings and homes, to improve the quality of life of AAL users. While benefitting all who use it, AAL technology particularly helps people living with a range of disabilities. It enables them to remain at home independently for longer, as well as facilitate access to transport and other places outside the home. Find out more about the technology in the October 2016 e-tech article Smart Cities for golden years.

**Female participation from the Chair...**

Established in 2015, the IEC SyC AAL is chaired by Ulrike Haltrich and comprises two coordination advisory groups (CAGs) and four working groups (WGs).

Haltrich has worked for 20 years at Sony on diverse standardization projects.

She is also involved in IEC Technical Committee (TC) 100: Audio, video and multimedia systems and equipment, and eventually co-chaired its project for Ambient Assisted Living related to audio, video and multimedia systems and equipment and in 2015, became the technical secretary of its Technical Area 16: Active Assisted Living, Accessibility and User Interfaces.

“...AAL users of products, services and systems may require a bit of help at home from time to time or a lot of support throughout the day. We have to consider many aspects, which can be specific to countries or regions.”

Connected medical kit allows people to monitor their health at home (Photo: www.clinicloud.com)
For example, legal implications, data protection, privacy and security, and we absolutely must ensure that everything is safe and performs well for all users wherever they are in the world."

...to the working groups
With a background in electrical engineering, Tania Donovska has been involved with IEC standardization activities for over 10 years, covering IT, energy efficiency, electromagnetic compatibility and electrical engineering. Donovska is Secretary of the Canadian mirror committee for IEC SyC AAL.

“It’s encouraging to see the talent and commitment around the table. I believe that female champions on committees have a lot to contribute – technical expertise, a unique approach to collaboration and consensus building, and the ability to go beyond cultural differences.”

Dr Iris Straszewski is Convenor of IEC SyC AAL/WG 2: Architecture and interoperability, which works on defining AAL reference architecture based on user needs.

“In order for all the products and systems to run smoothly, the technology must be interoperable at different levels and between different domains. Our work is based on principles of interoperability integrity, security and privacy, simplicity, low operation costs and short time to market.”

Straszewski is also responsible for national committees and working groups on AAL for the German Commission for Electrical, Electronic and Information Technologies (DKE).

Janina Laurila-Dürsch is an information technology and electrical engineer, specializing in the transmission of messages. She has worked as a project and standardization manager at DKE since 2011. She leads the project to establish AAL terminology (PT 60050-871).

Taehwa Han, Research Professor at Yonsei University, Seoul, Korea, and head of the AAL delegation for the Korean Agency for Technology and Standards (KATS) since 2015, is actively engaged in developing use cases which would be suited to Korean society.

“The work we are doing in AAL is very exciting. In our use cases, we see how innovative technology product and system solutions can greatly improve healthcare and how we provide it. AAL will help to ensure products and services are safe and especially in this field, that private data remains protected.”

Also participating are Guo Li Zhen of the China Household Electric Appliance Research Institute (CHEARI) and Si-hwa Bae, PhD and Professor in the Department of Architecture at Gachon University, Seoul, Korea.

Covering product safety assessment and testing
Pamela Gwynn brings over 27 years’ experience in product safety related to medical electrical devices and personal health and hygiene appliances. She is Co-Convenor of IEC SyC AAL WG 3: AAL Quality and Conformity Assessment, which deals with quality, conformance and interoperability issues related to AAL products, systems, components and services.

“It is paramount to ensure testing and certification are done so that the levels of safety, reliability, and performance are in compliance with relevant IEC International Standards.”

Gwynn also has testing and certification experience as a Lead and Technical Assessor for the IEC System of Conformity Assessment Schemes for Electrotechnical Equipment and Components (IECEE) CB Scheme in the medical category through her work for IEC TC 62: Electrical equipment in medical practice.

Seeing things from the consumer viewpoint
Patricia Cunniffe represents consumers in the area of standardization at national and international levels. She has 20 years of experience of electrical safety standards in New Zealand and IEC. She is a member of the consumer panel for New Zealand Health Information Service, and a trustee of the Whanganui Regional Primary Health Organization. She runs an ergonomics consultancy specializing in workplace assessment and modification, for hospitals, health providers and other clients.

“I have been and still am the sole female on these committees, representing the consumer’s viewpoint…It’s a real pleasure to be involved with the IEC SyC AAL where the end user of AAL products and systems, rather than the technology, is the focus, and gender diversity is the norm.”

Sharon Duff is a community developer and health promotion practitioner at the Whanganui Regional Health Network in New Zealand. She works on the project for defining AAL terminology and on conformity assessment frameworks and privacy issues.

“I support end users and other actors in the areas of health literacy, ensuring product information and manuals meet health literacy guidelines. I also cover ICT expertise assessment of actors.
providing education and training required by end users and also health professionals for interacting with technology."

**Understanding and addressing accessibility**

Catherine Grant has a PhD Cantab, and is a multimedia and accessibility consultant. She works on projects related to standardization, broadcasting, video content analysis, sensor networks and surveillance. She is involved in a number of IEC and ISO technical committees and is Convenor of IEC TC 100/TA 16: Active Assisted Living, accessibility and user interfaces.

“My standardization work was first in the masculine world of industrial automation with few women at international events I attended. However committees such as ISO/IEC JTC1/SC 29 for audio, picture, multimedia and hypermedia information coding involve more women, but IEC SyC AAL is the first committee I have served on where there is a more balanced membership.”

**Working for the well-being of aging and disabled populations**

Yan Ling works at CHEARI, on standardization research and management of household electric (including smart) appliances, national policies and regulations related to special populations. With over 10 years working on standardization, she joined the group in 2015 and contributes to all four SyC AAL working groups.

“Our work is inspiring because it is committed to improving the quality of life for old people, children and other special needs groups through standardization.”

**Looking ahead**

Women continue to join the group. Jeanette Johem from the IEC Swedish National Committee (SEK) was welcomed at the SyC AAL plenary, during the recent IEC GM in Frankfurt.

Joanna Goodwin, a Technical Officer for IEC TC 1: Terminology, and terminology coordinator at IEC, took up as Secretary of the SyC AAL in October. Goodwin has worked in international standardization for 30 years, covering standards production management, electronic publishing, technical editing, process reengineering, business process analysis, automation and management, and lead auditing.

“I have found that women are able to show leadership in the SyC AAL. In Japan, the fields that women can work in actively are increasing. Many of my work colleagues are women (approx. 40%), not only for the SyC AAL but standardization as a whole.”
We are all familiar with remote controls. We use them to change TV channels, select our favourite music and protect ourselves with sophisticated security systems. Still, more appliances and systems in our homes work by using automated electronic controls.

From lighting to heating water

We can also programme these automated controls to adjust equipment according to changes in the surroundings. Motors open and shut blinds, windows and vents to control temperature. They also operate fans, dampers, valves and pumps, so that water or air can flow for heating and cooling systems. These can be pre-set to certain temperatures and triggered by timers or sensors. Some systems function remotely, such as lighting, which turns on and off through motion detection.

Today more household appliances are connected and an integral part of the Internet of Things (IoT) and can be controlled from anywhere using smart devices.

Making sure the controls work properly

If well designed, this technology not only helps occupants with disabilities to carry out daily activities, it can also save energy. However, if the controls don’t function correctly, smart homes may not be as safe, secure or efficient.

The IECEE, the IEC System of Conformity Assessment Schemes for Electrotechnical Equipment and Components, tests and certifies electrical and electronic equipment.
Its CB Scheme provides the assurance that tested and certified electrical equipment – and its components – meets the strictest levels of safety and performance in compliance with the relevant IEC International Standards.

In this case, IEC Technical Committee (TC) 72 produces International Standards which ensure the safe and reliable operation of automatic electronic controls for household appliances. A number of Standards from its IEC 60730 series is used for testing and certification. These cover, among others, requirements for burner control systems, thermal protectors for certain parts of fluorescent lamps, timers and time switches, pressure sensing valves, electrically-operated water valves, temperature sensing control, motor starting relays, door locks and energy regulators.

This series also applies to automatic electronic controls for equipment that may be used by the public, such as equipment intended for use in shops, offices, hospitals, farms and commercial and industrial applications.

**Tackling cybersecurity**

Every day, we hear about cyberattacks, which are carried out through different connected devices. The IEC takes cybersecurity very seriously. In addition to a number of TCs which focus on publishing International Standards specifically on this topic, the IEC Conformity Assessment Board (CAB) Working Group (WG) 17 investigates the market need and timeframe for CA services (global certification schemes) for products, services, personnel and integrated systems in the area of cybersecurity.

IECEE WG 3: Cybersecurity Task Force, is working on an approach for CA in relation to the IEC 62443 series of Standards for Industrial Automation and Control Systems.
(IACS) security, produced by IEC TC 65, which deals with industrial automation. This includes descriptions of testing tools and test protocols. It also requires coordinating with IEC TC 65, to ensure its International Standards contain elements for cybersecurity in relation to industrial automation, to evaluate the need for personnel certification for cybersecurity and the need for a system level certification for cybersecurity of an industrial application.

Additionally, IEC CAB WG 17 communicates to other industry sectors the generic cybersecurity approach taken by IECEE WG 3 and how this may apply to these other sectors.

Adopting smart technology
Networking and communication essential to the oil and gas sector

Claire Marchand

With the steady increase in energy demand from developing, emerging and developed countries, the recent drop in oil prices as well as national or regional regulations to drastically reduce carbon dioxide emissions, the oil and gas sector needs to explore new avenues to expand productivity and at the same time cut down costs. One way to achieve this is to embrace smart technologies.
Tackling 21st century challenges

Traditionally the oil and gas sector, while modernizing and upgrading its operations and installations, has often kept away from the smart trend of the last decade. Different units within a same company tend to work in silo, rarely communicating with one another. However, despite this apparent lack of communication, the sector has thrived and been profitable for many years. But to face the energy challenges of the 21st century, the oil and gas sector has to become smart(er).

How to make oil and gas smart?

By installing sensors and controllers in pipes and wellheads, companies will be able to capture, classify and filter data in the field as well as control processes and perform quality checks. Transmitting this data to onshore and offshore facilities in real time will allow companies to monitor the wells’ conditions and operations, detect problems when they arise and make real-time decisions to schedule interventions. This will prevent damage occurring in equipment and reduce the risks of failure and potential accidents.

Transmitting data from wellheads to offshore and onshore facilities in real time helps detect potential problems and make real-time decisions to schedule interventions.

Safe and secure

Smart oil and gas operations provide better security and safety, help prevent disaster and minimize shutdown risks, maximize production, and increase profitability while reducing operating costs.

Of course the systems that need to be put in place are more complex than is implied by the simple installation of a number of sensors and controllers to connect data and people. The entire workflow and communications process between the wells and pipes on one side and the facilities on the other has to be fully automated and optimized so as to set up simulation models that will in turn lead to risk mitigation and safer operations.

A well-designed smart oil/gas field network should also take into account potential cyber threats and build the necessary protections to ensure that the network is as secure as it is smart.

Designed and built for Ex areas...

As is the case with larger pieces of equipment used in explosive (Ex) atmospheres, any device that is part of a smart operation – from the tiniest of sensors to controllers, central processing units (CPUs) and remote
CONFORMITY ASSESSMENT

terminal units (RTUs) – has to be designed and built in compliance with the very strict requirements set out in standards and specifications, most notably in IEC International Standards developed by IEC Technical Committee (TC) 31: Equipment for explosive atmospheres.

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

...tested and certified by IECEx
IECEx, the IEC System for Certification to Standards Relating to Equipment for Use in Explosive Atmospheres, is the only truly international Conformity Assessment (CA) System to provide testing and certification for all items of Ex equipment and installations as well as certifying the skills and competence of individuals working in hazardous areas.

The System addresses the inspection (location and other), installation, maintenance and repair of equipment and systems and assesses the competence of personnel working in this highly specialized area.

IECEx has been endorsed by the United Nations (UN) through the UN Economic Commission for Europe (UNECE) as THE certification system for the assessment of conformity in Ex areas.

IECEx operates the following Schemes:
- IECEx Certified Equipment Scheme
- IECEx Certified Service Facilities Scheme
- IECEx Scheme for Certification of Personnel Competence (for Explosive Atmospheres)

The System also has the IECEx Conformity Mark Licensing System which provides on-the-spot evidence that products bearing the Conformity Mark are covered by an IECEx Certificate of Conformity.

For more information: www.iecex.com

Smart equals sensors inside
Smart technology relies heavily on high-quality sensors

Claire Marchand
Smartness has become a way of life. Today most of our activities are – at least in part – smart. Whether you work, drive, sleep, enjoy an idle moment, it is most likely that smartness is part of it. We also keep our energy consumption in check with smart appliances and meters. Even our pets now have their own smart devices and apps, allowing us to track their every movement. All this smartness has one common denominator: electronic components and in particular sensors.

Collision avoidance systems, like all advanced driver assistance systems, rely heavily on sensors (Photo: Ford Motor Company)
Ubiquitous sensors: from phones, tablets...
Remove the sensors inside and your phone or tablet won’t be that smart anymore. The proximity sensor that determines how close the device is to your face or the accelerometer and gyroscope that detect its rotation and movement and allow the switch between landscape and portrait modes are only two of the numerous sensors that equip these devices today.

...to cars...
Advanced driver-assistance systems (ADAS) in cars also rely heavily on sensors. Adaptive cruise and light control, blind spot detection, collision avoidance systems, GPS navigation or intelligent speed adaption would not exist without highly sophisticated sensors.

...health and almost everything
The same goes for thousands of other devices and systems in smart homes, from intelligent household appliances to cameras and sleep pattern monitoring. Wearables not only help you track your workout routine but also have drastically changed the doctor-patient relationship by allowing individuals to monitor some of their vitals at home and share them with their physician.

Need for safe and reliable components
Sensors and sensor systems are a key underpinning technology for a wide range of applications. They can be used to improve quality control and productivity in manufacturing processes by monitoring variables such as temperature, pressure, flow and composition. They help ensure the environment is clean and healthy by monitoring the levels of toxic chemicals and gases emitted in the air, both locally and – via satellites – globally. They monitor area and regional compliance with environmental standards. They enhance health, safety and security in the home and workplace through their use in air-conditioning systems, fire and smoke detection and surveillance equipment. They play a major role in medical devices, transportation, entertainment equipment and everyday consumer products.

Technological innovations have brought a new generation of sensors, such as microelectromechanical systems (MEMS) and nanoelectromechanical systems (NEMS). These are smaller, smarter and can be integrated into fixed and portable devices.

Wearables can take the form of skin tattoos that can read and analyze the levels of sodium, glucose and even alcohol in someone’s system (Photo: iDownloadBlog)
But whatever the size of the sensor, the device has to be accurate and reliable. Whatever it measures, the measurement has to be extremely precise. A defective sensor can have serious consequences, putting human lives in jeopardy.

**Safety in the electronic component supply chain**

Sensor manufacturers and suppliers all over the world have a powerful tool at their disposal, enabling their products to meet the strictest requirements: IECQ testing and certification. IECQ is the IEC Quality Assessment System for Electronic Components.

As the worldwide approval and certification system covering the supply of electronic components, assemblies and associated materials and processes, IECQ tests and certifies components using quality assessment specifications based on IEC International Standards.

In addition, there are a multitude of related materials and processes that are covered by the IECQ Schemes. IECQ certificates are used worldwide as a tool to monitor and control the manufacturing supply chain, thus helping to reduce costs and time to market, and eliminating the need for multiple re-assessments of suppliers.

IECQ operates industry specific Certification Schemes:
- IECQ AP (Approved Process)
  - IECQ AP-CAP (Counterfeit Avoidance Programme)
- IECQ AC (Approved Component)
  - IECQ AC-AQP (Automotive Qualification Programme)
  - IECQ Scheme for LED Lighting
  - IECQ AC-TC (Technology Certification)
- IECQ Avionics
  - IECQ HSPM (Hazardous Substances Process Management)
  - IECQ ITL (Independent Testing Laboratory)

For more information: www.iecq.org

Wind industry: Harmonized certification facilitates global market access

IECRE issues first wind turbine certificate

**Antoinette Price**

**Developed with the participation of industry players, including equipment manufacturers, power producers, insurance companies, test laboratories and certifying bodies, IECRE, the IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications, streamlines a complex process and benefits not only the wind, but other renewable energy industries such as solar and marine.**

**The benefits of certification**

“The IECRE System for certifying wind turbines harmonizes the process and makes it less costly, so that one certificate is valid for multiple markets. It’s what the whole wind community has been waiting for. Based on mutual recognition, all stakeholders will have confidence and trust that devices are built to International Standards and perform as promised”, said Kerry McManama, Executive Secretary of the IECRE System.

IECRE certificates are valued in many of the world’s largest wind power markets, including China, Germany and other European countries, the United States, and elsewhere.

**Simplifying a complex process**

Previously, wind turbines had to be certified in each country by private certification bodies, according to different criteria. This was more costly, time-consuming and required repeat testing. It also took much longer to get
product to market. Additionally, the IECRE System provides a common language for a very technical product, which gives greater clarity to standards developers, product manufacturers, authorities and users, as to what is being certified. The IECRE also enables broader industry stakeholder participation in defining the certification process, which guarantees the certificates will meet the needs of the broader industry.

The first certificate was issued to Vestas, a wind power solutions company, which designs, manufactures, installs, and services wind turbines around the world. Anders Vedel, Vestas Chief Technology Officer commented, “What is unique about the IECRE System is that end-users, mainly our customers, together with equipment manufacturers and other stakeholders have substantially contributed to defining the new standards against which wind turbines are evaluated. Vestas began work in 2012 with other stakeholder to create such a System, so we are especially pleased that the first certificate has been issued for a Vestas turbine”.

From the Certification Body testing lab perspective, DNV GL as one of the first approved Renewable Energy Certification Bodies (RECBs), was instrumental in the development of the IECRE and the Certification Body that issued the first IECRE Certificate to Vestas.

About IECRE

IECRE has been created in recognition that the ever-increasing demand for electricity and the need to reduce the share of fossil fuels in power generation have led to rapid development and growth of the renewable energy (RE) sector.

The System aims to facilitate international trade in equipment and services for use in RE in the Solar PV Energy, Wind Energy and Marine Energy sectors, while maintaining the required level of safety. Each of these sectors will be able to operate IECRE Schemes that cover products, services and personnel, to provide testing, inspection and certification.

Currently IECRE focuses on these three energy sectors; however, the door remains open for consideration of other technologies such as concentrated solar power (CSP), geothermal energy and fuel cells.
Smart Energy
A global path towards Energy Efficiency and sustainable development

Ricardo Luis Nava Garibay, IEC 2015 Young Professional Leader

Ricardo Luis Nava Garibay provides insights into a Mexican programme that aims to increase energy efficiency with consumers and the need to encourage the take-up of renewable energy (RE) sources.

The challenge of the 21st century
The relatively recent demographic and economic growth of the world’s population started 200+ years ago and nowadays represents an immense challenge – especially in many developing countries – in terms of energy generation, transmission, distribution and management. Not to mention all the large investments in public transport infrastructure to fulfil the travel needs of an increasingly urban population.

There is also plenty of room to talk about sustainable food production, distribution and waste management, as well as ecological problems related to pollution, resource use, over-population, inadequate infrastructure and hygiene problems.

Cities are key
It is demonstrated that cities around the world hold the key to a smart and sustainable future for many reasons. One of the most important is that cities nowadays produce at least 70% of the world’s CO₂ emissions and they house around 50% of the world’s population. This last number will rise to 80% by 2050. Cities also play a dominant role in global consumption, production and pollution (Sukhdev, 2009).

It may seem that the milestones are still far away from our reach, so how can we help shape a smart and sustainable future from a standardization and conformity assessment standpoint?

The answer to this question comes in two parts:
- Energy efficiency
- Renewable energies

Energy efficiency – a perspective from Mexico
Each year, around 30% of the world’s electricity is wasted in net losses, heat losses, inadequate infrastructure, non-efficient (or old) residential, commercial and industrial equipment and other factors. Smart Grid is part of the solution to efficient energy management but a strong cooperation of different stakeholders such as government, manufacturers and population is also required to drive positive changes.

Energy-saving product exchange
Five years ago, in Mexico there was a national programme called “Cambia tu refri viejo por uno nuevo” (Change your old fridge for a new one) when 1.7 million refrigerators and 200 000 air conditioners were exchanged. This gave the most vulnerable, and not so vulnerable, Mexican population the opportunity to take advantage of governmental support to replace their old fridges and air conditioners for new, more energy-efficient ones. This programme was coordinated by several stakeholders – government, through its Energy Secretariat, the National Commission for Energy Efficiency Use, CFE – Utility and FIDE; the Environment Secretariat; and the Treasury Department; manufacturers, distributors and the public.

Which products participated in this programme? Only the ones that complied with International Standards such as the IEC 60335 series on safety for household and similar electrical appliances and the NOM for Energy Efficiency were included in this programme.
More recently, 42 million incandescent bulbs in residential buildings were replaced by energy-efficient lamps. It’s worth mentioning that electricity in Mexico is subsidized for consumers using under 250 kWh/month. This is a clear example of how, at a national level, standards help shape and drive a positive change towards energy efficiency in collaboration with other stakeholders.

There are also many other electric devices such as lamps, lighting towers, screens, vehicles, transportation and heavy duty machinery that nowadays are much more efficient than those of previous years. It is a demonstrated solid business case that the investment in new, energy-efficient equipment gives both consumers and industries a fast ROI and more than 50% of energy bill savings in a 10-year period exercise, using the new devices.

**The need for smartness**
Being efficient is not enough to secure sustainability. We need to realize that most of our energy is still obtained from burning fossil fuels such as coal, oil, gas and shale gas. The residues of our civilization are mainly greenhouse gases which certainly heat up our planet and contribute to the alteration of the water and carbon cycle – commonly known as climate change. Being efficient is an on-going evolution of technology and how we use it to optimize our energy consumption habits, but being smart is also to rely on energy from natural and renewable sources which do not impact negatively on the earth’s delicate balance.

**Renewable energies**
There are many examples of countries which have adopted governance policies to foster large investments in renewable energies, such as Germany. Actually, only a few months ago during a series of sunny days and abundant winds, more than 70% (during a short period of time) of the electricity generated within the country came from existing photovoltaic and wind power infrastructures. It is also true that during these days the national grid was overloaded so additional measures had to be executed to secure the grid’s correct operation and the safety of the population.

**The role of standardization**
Standardization and conformity assessment provide four of the biggest assets for successful international trading: reliability, compatibility, quality and safety. These elements are vital to manufacturers of solar modules and inverters for they represent one of the fastest growing markets in the electrotechnical field. If there were no standards like IEC 61730, IEC 60904, IEC 62257, IEC 62446 or IEC 61727, the global compatibility, performance and safety of these devices would be virtually impossible to achieve in a safe, sustainable way.

It is the combination of Smart Grid, for energy management, and the use of renewable energies that will drive a sustainable urban transformation and make our energy consumption much more efficient. Also, the Internet of Things is a major actor that will involve even more the final consumers into this race for a sustainable future using smart energy.
member of IEC TC 25/Working Group (WG) 1 for the revision of IEC 60027-1 and IEC 60027-3. Krystek participates as an expert in other organizations, such the National Metrology Institute of Germany (PTB) and the International Bureau of Weights and Measures (BIPM).

Michael Krystek has been nominated Chair of IEC TC 25 for the period of 2016-06-01 to 2021-05-31.

James Phillips
With a BSc in electrical engineering, James Phillips founded Brainfiller, a company providing training programmes for a wide range of electrical power system engineering topics. He took up as Chair of IEC TC 78: Live working, in June this year. Since 2014, he has worked in the TC on testing for protective clothing and hand protective equipment. Phillips is a senior member of the Institute of Electrical and Electronics Engineering (IEEE) and a technical expert for the American National Standards Institute (ANSI) through which he got involved in IEC TC 78. He has also published over 70 articles on electrical safety.

James Phillips has been nominated Chair of IEC TC 78 from 2016-06-01 to 2021-05-31.

Alexander Kern
Alexander Kern is an electrical engineer with a PhD, and since 1996, has been a professor for high voltage engineering and fundamentals of electrical engineering at Aachen University of Applied Sciences, Germany. He took up as Chair of IEC TC 81: Lightning protection, in December, and has worked on risk management, thunderstorm warning systems and lighting protection systems in the TC since 1998. He is also active in standardization for lightning protection at both European and German levels. Additionally Kern has around 100 publications on lightning research, protection, electromagnetic compatibility (EMC) and HV simulations.

Alexander Kern has been nominated Chair of IEC TC 81 from 2016-12-01 to 2022-11-30.

Jonathan Colby
Jonathan Colby began his role as Chair of IEC TC 114: Marine Energy – Wave, tidal and other water current converters, in November. He is Director of Technology Performance at Verdant Power, where he worked as a hydrodynamic engineer prior to his current role. He has helped create Technical Specifications and a Conformity Assessment Scheme in support of IEC TC 114 and the IECRE, the IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications. Colby has published over 20 articles and regularly presents at conferences related to marine energy.

Jonathan Colby has been nominated Chair of IEC TC 114 from 2016-11-01 to 2022-10-31.

Peter Kennerley
Peter Kennerley took up as Chair of IEC TC 18: Electrical installations of ships and of mobile and fixed offshore units, in December. He is an electrical engineer working as lead specialist at Southampton Global Technology Centre UK, on electrical and control system design appraisal for commercial and naval ships. For over 25 years, he has worked with Standards produced by this TC, with particular emphasis on the IEC 60092 series covering marine/offshore. Kennerley also has IECEx training for electrical installations in hazardous areas, selection, installation, inspection and maintenance.

Peter Kennerley has been nominated Chair of IEC TC 18 from 2016-12-01 to 2022-11-30.
Digital data exchange to be streamlined
International Cooperation Agreement signed between the IEC and eCl@ss e. V.

Janice Blondeau
The harmonization of standards in electrical engineering and electronics means a breakthrough for digital data exchange.

Speaking the same digital language
In industry, a great deal of time and effort can be wasted in the transposition of measuring equipment data from one form to another. For example, the technical data of an instrument may exist at the manufacturer’s facility as two separate data sets for paper and electronic presentation, while end-users require much the same data for works standards, engineering data bases or commercial data bases. In many cases, the data cannot be automatically re-used because each application has its own particular data storage format.

IEC eCl@ss Cooperation Agreement
To streamline the exchange of data in an industrial and manufacturing setting, the IEC has recently signed a Cooperation Agreement with eCl@ss e. V. – essentially to reduce overlap and misunderstandings across several data dictionaries containing product classes and product properties.

The agreement aims to facilitate the automatic transfer of shared content between the IEC Common Data Dictionaries (CDD) and eCl@ss dictionaries. This means that classifications and product descriptions will conform to both current IEC International Standards and eCl@ss properties. End-users will benefit through mapping and long-term harmonization of content overlap, with reduced misunderstandings in interpretation and in the use of product properties.

Based on IEC Standards
The cooperation between the IEC and eCl@ss e. V. centres on the requirements of international and digital information exchange based on globally implemented Standards of the IEC. In the framework of the project “d-m@p,” experts from the IEC and eCl@ss e. V. are developing a mapping system that makes product data characteristics and attributes reciprocally readable.

Under this Cooperation Agreement, the content for mapping belongs to IEC 61987, Industrial-process measurement and control – Data structures and elements in process equipment catalogues; IEC 61360, Standard data element types with associated classification scheme for electric components; and eCl@ss Segment 27: Electric engineering, automation, process control engineering. For the benefit of eCl@ss and IEC CDD users, common content shall be identified and easily accessible in a harmonized form.

Advancing digitization
Markus Reigl, head of the central department of technical regulation and standardization at Siemens AG, explains: “Market-leading companies have recognized that normatively structured product data, unambiguously classified and accompanied by a comprehensive description of characteristics, is the lever by which to advance digitization in highly diverse applications in such areas as B2B, Industry 4.0, and smart buildings.”

The product will be published by IEC as a ‘Value Added Product’ and by eCl@ss as a ‘mapping table’ and it will be available on the IEC Webstore and on the eCl@ss download portal.
About eCl@ss

eCl@ss is the most successful cross-industry product data standard for the classification and unambiguous description of products and services. eCl@ss is an ISO/IEC-compliant industrial standard to be applied nationally and internationally. With over 40 000 groups and more than 17 000 characteristics, the eCl@ss standard provides companies with a means of product data communication that is internationally recognized and free of media discontinuity.

Normatively structured product data, unambiguously classified and accompanied by a comprehensive description of characteristics, advances digitization in such areas as B2B, Industry 4.0, and smart buildings.
Upcoming global events (December 2016-April 2017)

On the agenda: displays, energy storage, Smart Grids, metering and IECEx

Claire Marchand
The IEC regularly supports key global and regional industry events, which can present the IEC endorsement on their website and materials.

23rd International Display Workshops / Asia Display 2016
Fukuoka, Japan, 7-9 December 2016
On the agenda: thirteen workshops in specialized fields playing important roles in information display activities. Topics include: oxide semiconductor TFT, AR/VR and hyper reality, lighting and quantum dot technologies, printed electronics, automotive displays and more.

More information on the event’s website

Energy Storage 2017
Paris, France, 8-9 February 2017
Key industry stakeholders will discuss energy storage market challenges and latest developments. On the agenda: insights on business cases, regulatory environment, financial aspects and technology advancements.

IEC participants benefit from a 15% reduction using the promo code EESe7MA15.

More information on the event’s website

India Smart Grid Week 2017
New Dehli, India, 07-10 March 2017
India’s electric utilities, policy makers, regulators, investors and world Smart Grid/Smart City experts will discuss technology trends, cybersecurity, standards and interoperability of equipment and data & security.

IEC participants benefit from a 20% reduction using the promo code IEC20.

More information on the event’s website
systems, EV charging infrastructure, renewable energy, smart microgrids for transport and more.

IEC participants benefit from a 10% discount.

More information on the event’s website

Metering India 2017 – towards smart and sustainable utilities
New Delhi, India, 6-7 April 2017
Call for papers – Final submission date: 31 Dec 2016

Utilities, consultants, businesses, regulators and manufacturers will look at how ICT can make Indian power utilities more sustainable. On the agenda: metering, communication technologies, demand-side management, IT infra, sustainable business processes and more.

More information on the event’s website

2017 IECEx International Conference
Shanghai, People’s Republic of China, 11-12 April 2017

On the agenda: an overview of IECEx and its three Schemes and the IECEx RTP programme; an update on IEC International Standards for Ex atmospheres; a practical approach to Ex installations; area classification’s importance in the design of new plants and changes to existing plants and infrastructure; intrinsic safety; end-user feedback; the conclusions of a UNECE Global Study into regulations for the Ex field; and more.

More information in the conference programme

The 2017 IECEx International Conference will take place in Shanghai, China, on 11-12 April 2017
Covering countless safety requirements for SMPS

The second edition of a Standard will improve the safety of a myriad of systems

Morand Fachot
Low-voltage switch mode power supplies (SMPS) can be found in innumerable applications in IT equipment, vehicles, battery chargers, etc. A second edition of IEC 61204-7, an International Standard addressing safety requirements for SMPS was recently published. This Standard is also available as an Extended version (EXV).

SMPS everywhere...
An SMPS is an electronic circuit that converts power using switching devices that are turned on and off at high frequencies. It has storage components such as inductors or capacitors to supply power when the switching device is in its non-conduction state, according to the IT Education Site Techopedia.

An SMPS transfers power from a DC or AC source (often mains power), to DC loads. It is highly efficient and is widely used in a variety of electronic equipment, including computers and other sensitive equipment requiring stable and efficient power supply.

The IEC 61204 series of Standards covers various aspects of SMPS, such as performance characteristics, electromagnetic compatibility (EMC), supplies and performance and safety requirements for “products that include power electronic converters, with a rated system voltage not exceeding 1 000 V AC or 1 500 V DC.”

Safety is paramount
IEC 61204-7:2016 concerns safety requirements. This second edition of the Standard cancels and replaces the first edition published in 2006, and constitutes a complete technical revision. It has been prepared by IEC SC 22E: Stabilized power supplies, a Subcommittee of IEC Technical Committee (TC) 22: Power electronic systems and equipment.

This edition includes the following significant technical changes with respect to the previous edition:
• modification of the title by deleting the wording “DC output” and adding “switch mode”.

This Standard specifies requirements to reduce risks of fire, electric shock, thermal, energy and mechanical hazards, except functional safety as defined in the IEC 61508 series of Standards on functional safety.

The objectives of this Standard, which has the status of a product Standard, are to establish a common terminology...
and basis for the safety requirements of products that contain power electronic converters across several IEC TCs.

**Coverage**

IEC 61204-7 lists the various types of hazards, as well as aspects (like functional safety as defined in IEC 61508) and equipment that are not covered, such as motor-generator sets, step-down converters, other types of SMPS and certain types of transformers covered by other IEC Standards.

It also gives details of additional requirements that may be necessary for SMPS intended for certain specific uses. These are listed as “SMPS intended for operation in special environments (for example, extremes of temperature, excessive dust, moisture or vibration (e.g. earthquake zones), flammable gases, and corrosive or explosive atmospheres); SMPS intended to be used in vehicles, on board ships or aircraft, or in tropical countries; and SMPS intended for use where ingress of water is possible.”

This Standard specifies the various provisions necessary to protect against different types of hazards (electric shock, energy hazards, fire and thermal hazards, mechanical hazards, etc.). It also gives details about wiring connections, enclosures and specifies test requirements.

**Standard available as Value Added Product**

This Standard is available as an Extended version (EXV), which includes the provisions of the general rules dealt with in IEC 62477-1.

This inclusion allows users to check immediately relevant additions without the need to search for them in IEC 62477-1.

An Extended version is not an official IEC Standard. Only the current versions of the related Standards are to be considered the official documents.

Given the very wide range of equipment and applications using SMPS this second version of IEC 61204-7, with its status of product Standard, and its Extended version in particular, will prove essential for all manufacturers who use SMPS in their products or applications.

Personal computer power supply units (PSUs) use SMPS

Mobile phone chargers use SMPS
IEC General Meeting – Frankfurt, Germany

Issue 09/2016 of *e-tech* will summarize much of the 2016 IEC General Meeting (GM) proceedings in Frankfurt, Germany. It will cover the President’s address to Council and the IEC activity report presented by IEC General Secretary and CEO Frans Vreeswijk. Further reports will include management meetings such as Standardization Management Board (SMB), and Conformity Assessment Board (CAB) as well as an outline of the Council Open Session on *Shaping the Future of Standardization*. The Affiliate Forum, the Young Professionals and Industrializing Country workshops will also be featured. Not to forget several cooperation agreements: the Frankfurt agreement between the IEC and CENELEC as well as two MoUs between the IEC and GSO and SARSO respectively. And last but not least, a photo gallery will provide highlights of the event.