About Enterprise Singapore

Enterprise Singapore is the government agency championing enterprise development. We work with committed companies to build capabilities, innovate and internationalise.

We also support the growth of Singapore as a hub for global trading and start-ups, and build trust in Singapore's products and services through quality and standards.

Visit http://www.enterprisesg.gov.sg for more information.

About the Singapore Standardisation Programme

The Singapore Standards Council (SSC) collaborates with key stakeholders from the industry and government agencies to identify and develop new standards as well as review existing ones to enhance the competitiveness of enterprises and support national initiatives across safety, health, social issues and the environment.

Over 2,500 experts from the industry, government agencies, research institutes and institutes of higher learning participate in various Standards Committees (SCs), Technical Committees (TCs) and Working Groups (WGs) under the Singapore Standards Council. These experts identify and develop standards to support industry transformation, emerging areas and other national initiatives.

Singapore Standards (SS), Technical References (TR) and Workshop Agreements (WA) are in the form of specifications for materials, products, services and systems, codes of practice, requirements for interoperability, methods of test, management systems, guidelines, nomenclatures, etc.

TRs and WAs are provisional standards developed to address urgent industry demand and are issued for industry trials over a period of time. Comments received during this trial period are considered when a TR or WA is reviewed. TRs can become SS after the trial period, continue as TRs for further industry trials or be withdrawn. WAs, during its review may further its development as TRs or SSs, continue as WAs for further industry trials or be withdrawn.

To ensure adequate viewpoints are considered in the development and review of SSs and TRs, committees and working groups set up by the Standards Council consist of representatives from various key stakeholders which include industry associations, professional bodies, academia, government agencies and companies. SSs are also put up for public comment before publication.

SSC supports international, regional and bilateral engagements to facilitate market access and build capacity in areas of national interest.

Visit www.enterprisesg.gov.sg/standards for more information.

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Information about the Singapore Standardisation Programme: https://www.enterprisesg.gov.sg/quality-standards/standards

Enhancing the Chemical Industry's Competitiveness through Standards

Standards play an important role in developing Singapore into a world-class chemical hub.

Standards support the chemical industry in delivering consistent product quality, ensuring safety, enhancing productivity and supporting environmental protection. These advantages help to add brand value, build trust in Singapore products and services as well as facilitate trade, all of which boost our industry competitiveness and open up new market opportunities.

The Chemical Standards Committee (CSC) and the Environment and Resources Standards Committee (ERSC) are 2 of the 12 Standards Committees formed under the Singapore Standards Council.

The CSC spearheads the development and implementation of chemical standards to support the local chemical cluster and chemical-related supporting industries. The areas under the CSC's purview include bunkering, nanotechnology, surface coatings, chemical and processes as well as petroleum processes and products.

The ERSC focuses on the development, promotion and implementation of standards in areas relating to climate change mitigation and adaptation, circular economy, water management, sustainable energy, sustainable finance and clean technologies. These key areas could be further categorised under circularity of materials, energy, water and environmental management.

The standards under CSC and ERSC support the Energy and Chemical Industry Transformation Roadmap and other national initiatives on climate change, sustainability as well as the drive towards a zero-waste nation.

SDO@SCIC

SCIC SINGAPORE CHEMICAL INDUSTRY COUNCIL | Standards Development Organisation

In 2011, Enterprise Singapore appointed the Singapore Chemical Industry Council Limited (SCIC) as a Standards Development Organisation (SDO) to administer the standardisation work of the CSC. As of 1 Apr 2020, SDO@SCIC also manages the ERSC which focuses on spearheading the development and adoption of standards to address sustainable development.

The key functions of the SDO@SCIC are to coordinate standards development projects, encourage greater industry participation and promote adoption of standards. The SDO@SCIC aims to raise awareness of the benefits of standards among industries and education institutions alike.

National and International Standards Development

National standards are reviewed and developed to boost industry competitiveness and support regulatory frameworks. Singapore also participates in the development of international standards that are of importance to Singapore, including those pertaining to new technologies and emerging industries. National and international standardisation plays a vital role in preparing Singapore's industries for challenges and sustainable development.

Below are some examples of the wide range of standards under the purview of CSC and ERSC, subcategorised into their focus areas.

Safeguarding health and safety at workplaces

(i) Handling and usage of industrial gas cylinders at Workplace (Upcoming SS)

To support the growth of our local industries, alternative arrangements are needed to continue and expand our operations in view of the limited land space within Singapore.

This new standard aims to set out provisions for the safe handling, storage and in-process usage of gas cylinders at industrial workplaces regardless of whether it is situated at ground level, multi-level or underground. It also sets out the provisions for the transport of filled and spent gas cylinders between the gas manufacturers' site and their customer storage area.

(ii) Code of practice for the safe use of thermal foggers during pest management activities (SS 682:2022)

To safeguard operators during thermal fogger activities, a new standard was developed to provide guidance to the industry. This enables the minimisation and potential elimination of risk relating to fire incidents resulting in a safer working environment for both the service providers and their engaged customers.

This standard contains requirements for the safe handling of pesticides in terms of risk management of thermal fogging activities, proper equipment maintenance and storage, measures to prevent fire during thermal fogging and proper emergency planning and first aid procedures. Best practices to improve the effectiveness of thermal fogging are also included in the SS.

(iii) Code of practice for handling, storage and processing of combustible dust (SS 667:2020)

This standard provides a comprehensive procedure on the handling, storage and processing of combustible dust to prevent and mitigate fires and dust explosions in facilities handling such materials. It is designed to aid users in the assessment of dust fire and explosion hazards and the mitigation of those hazards through facility design, equipment/process control measures, elimination of ignition sources and minimisation of damage.

The code is applicable to industries (e.g. food processing, woodworking factories, pharmaceutical, petrochemical, specialty chemicals, additive manufacturing, and logistics), research institutions and institutes of higher learning (IHL) that manufacture, process, blend, convey, repackage, generate or handle combustible dusts or combustible particulate solids. This code is not applicable for warehousing of sealed containers of such materials when not associated with an operation that handles or generates combustible dust.

(iv) Technical Reference on Interior floor and Technical Reference on interior wood coatings (upcoming TRs)

In an effort to push for better indoor air quality for building occupants, the two Technical References (TRs) will be looking into defining the specifications for interior floor coatings and interior wood coatings applied to the building interior. These TRs will be including a list of minimum performance requirements for service and durability. It will also look into addressing both the chemical contents, (i.e., heavy metals and Volatile Organic Compound (VOC), allowed in the paint formula and the chemical emissions that could be emitted from such coatings when dried. This would in turn help to contribute towards the lowering of emissions of Total Volatile Organic Compound (TVOC) and formaldehyde, which can improve the indoor air quality and the general well-being of building occupants. These two TRs provide different sets of performance requirements to cater to users of solvent-borne, solvent-free or water-borne floor coatings.

(v) Code of practice for hazardous waste management (SS 603:2021)

The SS 603 was first published in 2004 as CP 100 and had completed its revision in 2021. The revision was carried out to provide better clarity on the hierarchy of waste management methods and principles. The key changes are rationalising the terms 'hazardous waste' and 'toxic industrial waste' to remove confusion; elaborate elements of audit protocol for hazardous waste generator, carrier or collector; specifying content requirements for waste container labels etc.

The SS 603 aids persons, organisations and industries involved in the generation, collection, transportation, storage, treatment and disposal of hazardous waste. The SS 603 sets provision on implementing appropriate, environmentally-sound and safe waste management practices.

This code sets out the procedures and practices for safe management of hazardous waste generated from industrial, institutional and other work activities. It also sets out the key requirements for the collection, transportation, storage, treatment and disposal of hazardous waste. This code briefly covers bio-hazardous and radioactive wastes and other specialised types of waste.

Enhancing productivity and trust

Following the successful publication of the world's first standard on bunker mass flow metering (TR 48/SS 648) to enhance transparency and overall productivity of the bunkering industry, Singapore now leads ISO/TC 28/SC 2/WG 13 Marine bunkering for the development of ISO standards based on the following national standards:

- Code of practice for bunker cargo delivery from oil terminal to bunker tanker using mass flow meter (SS 660: 2020)

  This standard cover bunker cargo custody transfer quantity measurement using mass flow meter and sampling requirements for oil terminal to bunker tanker interface. It will align the method of quantity measurement of bunker fuel in the entire bunker supply chain and further strengthen trust and confidence in the bunker supply chain.

- Meter verification using master mass flow meter (TR 80: 2020)

  This standard specifies requirements and procedures for meter verification using master mass flow meter to verify and check the stability and performance of a duty meter installed on bunker tankers or at oil terminals. It also details the criteria and metrological requirements for qualifying master meter and the maintenance of its long-term status.

The above ISO standards (ISO 6963 and ISO 6996) under development are envisioned to further enhance Singapore's position as the world's top bunkering port.

Digitalisation to enhance efficiency

To further build on the capabilities of the bunkering industry, a new Singapore standard on "Electronic documentation and processes for tracking fuel quantity and quality across bunker supply chain" is being developed.

This standard aims to establish a framework of the platform in which digital technology will be used to attest the authenticity and provenance of electronic documentation on bunker fuel quality and quantity at each custody transfer point in the bunker supply chain. Other key data and information of bunker transactions and inventory can also be recorded alongside these documents on the digital platform to facilitate traceability. This standard also covers the processes and requirements for systems interoperability, documentation, security of information, stakeholder accountability and accessibility to the custody transfer data and information generated along the physical bunker supply chains.

This standard aims to increase industry competitiveness and achieve higher efficiency, inter-operability, traceability, security and accountability, thereby facilitating fair trade and enhancing trust and confidence in the Singapore bunker industry.

Reducing emission to combat climate change

To meet the 2020 0.5% sulphur limit regulation in International Maritime Organization's MARPOL VI, Singapore is LNG-bunker ready with TR 56 : 2020 Technical Reference for LNG bunkering:

- Part 1: General Introduction
- Part 2: Requirements for custody transfer
- Part 3: Procedures and safety distances
- Part 4: Competency requirements for personnel

The TR 56 : 2020 mandated by MPA which aims at helping our industries transit to sustainable fuels usage in bunkering. It covers LNG delivery from LNG bunkering facilities to receiving ships through four modes of transfer (truck-to-ship, shore-to-ship, ship-to-ship and cassette bunkering). It is used to guide the implementation of operational protocols by licensed LNG bunkering suppliers thereby helping the industry gain operational experience in LNG bunkering.

With the bunkering industry moving towards a low carbon economy, one of the short-term measures for alternative fuels includes the application of biofuels in marine fuels. The new Workshop Agreement (WA 2 Specification for marine biofuel was published in 2022 to be used complementary with ISO 8217 Specifications of marine fuels. Other alternative fuels e.g. methanol, ammonia and hydrogen are being explored as the Singapore's bunkering industry aims to move towards a carbon neutral economy in the next decade. These efforts aim to establish Port of Singapore as a multi-fuel bunkering hub.

Supporting new growth and emerging areas

(i) Nanotechnology

Graphene flakes have been vastly used in numerous applications such as batteries, aerospace, sports equipment's and fabrics. Commercially available graphene flakes used for research and manufacturing have shown to have a wide variation in its characteristics thus hindering the positive outcomes of R&D and commercialisation of graphene-based products. With the development of Singapore Standard SS 643 : 2019 which covers the assessment and characterisation of graphene flakes, local manufacturers and graphene users can be assured that the graphene produced or used is of the right characteristics. This will ensure the consistency of graphene characteristics and help to address the gap between producers and customers.

Despite nanotechnology's potential applications in manufacturing, biomedical science and renewable energy arenas, the lack of local understanding of the risks associated with the use and exposure of nanomaterials and the lack of workplace safety standards to mitigate the associated risks remains a significant challenge for Singapore to push this forward. There is a growing international regulatory activity in the UK, EU and US on workplace safety of nanomaterials and common understanding that workplace safety measures have to be in place to ensure the safety of the workers and consumers who may be exposed to nanomaterials.

With the publication of TR 73 : 2020 Handling of engineered nanomaterials in workplaces, it will help to increase safety in the workplaces and potentially reducing long term occupational health problems. This set of Technical References, consisting of 3 parts, provides guidance on occupational health and safety measures relating to the handling of engineered nanomaterials. Part 1: Health and safety practices in occupational settings relevant to nanotechnologies, Part 2: Overview of available frameworks for the development of occupational exposure limits and bands for nano-objects and their aggregates and agglomerates (NOAAs), Part 3: Occupational and environmental monitoring of engineered nanomaterials.

With the ever increasing national and global importance of nanotechnology applications, the National TC on Nanotechnology, mirroring ISO/TC 229 Nanotechnologies, continuously monitors, supports and develops the various standards in the following areas:

- Terminology and nomenclature
- Measurement and characterisation
- Health, safety and the environment
- Materials specification
- Products and applications

(ii) Fine Bubble Technology

Fine bubble technology (FBT) is an exciting and innovative technology that has demonstrated revolutionary changes to industry sectors such as urban agri-food industry, water treatment applications and environment cleaning in Singapore. This technology originates from Japan and it capitalises on the unique behaviour of air-in-water fine bubbles ranging from a few micrometers to nanometers, that is observed to radically different from that of normal bubbles in water.

ISO/TC 281 Fine Bubble Technology was established from 2013 to champion and promote industry adoption of fine bubble technology, and also serves as a platform to contribute to the sustainability of this technology. Towards this end, Singapore participates actively in the ISO/TC 281 committee which develops international standards on fine bubble technology in order to foster industry applications.

Singapore had held its first Fine Bubble Symposium in 2017 to provide an avenue for knowledge sharing by experts of FBT in applications, measurements and principles related to FBT. On 30 Aug 2022, Singapore Chemical Industry Council (SCIC) in collaboration with Fine Bubble Industries of Japan (FBIA), had co-organised the 2nd FBT Symposium in Singapore which serves to promote and encourage adoption of FBT applications in water treatment, agro and aqua farming.

With an increase in FBT applications, this will pave the way for Standards to facilitate further growth and productivity of industries located within and beyond Singapore's shores. For more information on the seminar held, refer to https://scic.sg/index.php/en/component/rseventspro/event/385.

Improving resource efficiency

(i) Water reuse & water efficiency

The demand for water resources has been a primary concern for Singapore. One of the ways to mitigate this is to use water more efficiently. Singapore led the development of the ISO 46001 on "Water efficiency management systems – Requirements with guidance for use" based on local standard, SS 577. ISO 46001 specifies requirements and contains guidance for its use in establishing, implementing and maintaining a water efficiency management system in Singapore. Water efficiency management can aid in promoting sustainable economic activities, industries and ultimately a sustainable environment. ISO 46001 aims to enable organisations to assess and account for their water use, and to identify, plan and implement measures to achieve water savings through the systematic management of water.

With the increased concern on water security, Singapore actively participates in ISO/TC 282/SC 2 Water reuse in urban areas, ISO/TC 282/SC 3 Risk and performance evaluation of water reuse systems and ISO/TC 282/SC 4 Industrial Water Re-use.

(ii) Energy management and Energy Savings

Singapore is active in ISO/TC 301 Energy management and energy savings which develops ISO 50001: 2018 Energy management systems - Requirements with guidance for use. As the chemical industry continues to expand in capacity and

capability, the industry players are strongly encouraged to collectively address issues concerning energy management and performance due to the industry's highly energy intensive nature.

ISO 50001 can be used in conjunction with other standards such as ISO 9001 and ISO 14001, making it easier for organisations to integrate energy management into their overall efforts to improve quality and environmental management.

In addition, ISO/TC 301 developed ISO 17741:2016 General technical rules for measurement, calculation and verification of energy savings of projects, which has been adopted by Singapore since 2017 Credible determination of energy savings is considered essential for all projects stakeholders to have a clear and correct understanding of project energy performancet, ISO 17741 establishes a set of general rules for measurement, calculation and verification of energy saving projects. These rules are considered universal and applicable irrespective of the measurement and verification (M&V) methodology used. The international standard is designed to be used by stakeholders that aim to quantify the energy savings over a specific period in new projects or retrofit projects. It could potentially reduce the technical and financial barriers in the measurement, calculation and verification for energy savings projects.

(iii) Solid Waste Management

Singapore is actively participating in ISO/TC 291 Waste collection and transportation management and led the development of ISO/TC 297/WG 1 Terminology to define terms that are commonly used in waste collection and transportation management. ISO 24161 was published in 2022 to align with terminology that are used internationally.

As Singapore moves towards a more sustainable future, one of the key waste streams identified in the Zero Waste masterplan is packaging waste. Packaging waste makes up approximately one-third of domestic waste disposed in Singapore.

NEA has rolled out the Mandatory Packaging Reporting (MPR) scheme where companies, including many organisations from the chemical industry, would have to submit their 3R plans. The TR 109 on Sustainable Packaging Guiding Framework and Practices aims to provide a guiding framework for companies to adopt more sustainable packaging-related practices such as reduction, collection for reuse and/or recycling, use of recycled content in packaging material and improved recyclability of packaging in line with the objective of the MPR requirements. This TR specifies guidelines, criteria and best practices for implementing the 3R (Reduce, Re-use. Recycle) for business-to-business and business-to-consumer packaging, taking into consideration practices that are sustainable in Singapore's context.

Plastics waste management and e-waste management are opportunity areas being explored for potential standards to be developed to support the zero-waste masterplan.

Supporting environmental sustainability

(i) Environmental management

Environmental sustainability has been identified as a key priority for the Singapore government. The government is actively seeking to raise the level of national consciousness and encourage sustainable efforts across all industries. The chemical industry is impacted by this move, notably the passing of legislation on the carbon tax in 2019 which will incur additional costs to organisations if they do not adopt more sustainable and less energy intensive practices.

ISO 14001: 2015 Environmental management systems – Requirements with guidance for use is one standard which organisation in the chemical industry can use to enhance their overall environmental management and performance in a systematic manner. This standard aims to reduce waste and energy usage and improve efficiency to cut operational costs.

In addition, ISO launched the Net Zero Guidelines (IWA 42) at the recent 27th Conference of the Parties (COP27) held in Sharm El-Sheikh, Egypt, from 6-18 November 2022.

The IWA 42 clarifies key concepts and terminology around net zero, and provides much needed guidance for all who are working towards net zero greenhouse gas emissions for their business, group or country.

Recognising the global relevance, ISO is offering free access to the IWA 42 and its national adoptions to ISO members. This is an apt opportunity for players in the chemical sector to be tuned into the latest developments and discussions with regards to net zero emissions target setting and strategy plans.

To ensure Singapore remains on the forefront, Singapore is a participating member of ISO/TC 323 that is developing standards to support organizations in integrating circular economy principles, strategies and identifying key circularity parameters in their practices. Through participation in ISO/TC323, Singapore aims to decrease carbon emissions, resources consumption and waste generation while increasing municipal and industrial recycling rates and regeneration of resources from the waste back into the supply chain as part of a circular economic model.

(ii) Greenhouse gas emissions management

Singapore implemented a carbon tax, the first carbon pricing scheme in Southeast Asia, on 1 January 2019. The carbon tax provides a broad-based price signal to encourage companies to reduce their emissions, yet gives them the flexibility to take action where it makes the most economic sense. The carbon tax forms part of Singapore's comprehensive suite of mitigation measures to reduce emissions, create green growth opportunities, and transition to an energy-efficient low-carbon economy. To maintain a transparent, fair, and consistent price signal across the economy, the carbon tax is applied uniformly to all sectors including energy-intensive and trade-exposed sectors, without exemption.

From now till 2030, the carbon tax will be progressively increased with a view to reaching $50-80/tCO2e by 2030. This will provide a strong price signal and impetus for businesses and individuals to reduce their carbon footprint in line with national climate goals.

As the chemical industry contributes a significant proportion of greenhouse gas (GHG) emissions locally, there needs to be a coordinated and standardised response by the private chemical sector to mitigate the impacts of climate change, one of the ways being the application of the ISO 14060 family of GHG standards to better manage and account for GHG emissions.

The ISO 14064 series provide clarity and consistency of quantifying, monitoring, reporting and validating or verifying GHG inventories and projects. The standards also guide users on how to carry out emissions reduction projects under the guidance of SS ISO 14064 (3 Parts) and TR/ISO TR 14069 to raise their resource efficiency and reduce their carbon footprint. The desired outcome is to empower organisations with the knowledge and resources to support Singapore's long-term fight against climate change.

(iii) Life cycle assessment

Life cycle assessment (LCA) is one of the methods used to address potential environmental impacts throughout a product's life cycle from raw material acquisition through production, use, end-of-life treatment, recycling and final disposal (i.e. cradle-to-grave). Having a holistic understanding of LCA across an organisation's supply chain is especially of utmost importance to the chemical sector where companies are intricately linked to each other across many supply chain networks.

To that end, SS ISO 14040 "LCA — Principles and framework" and SS ISO 14044 "LCA - Requirements and guidelines" allow users to identify opportunities to improve the environmental performance of their products at various stages in their life cycle.

The desired outcome is that organisations will take more initiative and ownership in reducing the environmental impact of their products so as to be more sustainable and garner the support of an increasingly environmentally-conscious consumer market.

(iv) Sustainable Finance

As a global financial hub, Singapore takes a strong interest in ISO/TC 322 which seeks to address the current lack of a globally agreed definition of what constitutes sustainable finance in the global financial sector's practices and products.

ISO/TC 322 has developed ISO standards (ISO 32210 & ISO/TR 32220) which cover the concepts for sustainable finance and guidance on principles, practices and terminology to support organisations aiming to integrate sustainability considerations (environmental, social, governance) as part of their investment and management practices and to facilitate the financing and development of sustainable assets.

These ISO standards will allow banks to have a global perspective in evaluating future proposed green projects to provide them with financial assistance.

(v) Renewable energy

With sustainability being a major concern, many companies are looking into the purchase of Renewable Energy Certificates as part of their sustainability commitment.

Many companies are looking into using Renewable Energy Certificates (RECs) as a means to fulfil their renewable energy and sustainability commitments. A renewable energy certificate (REC) is market-based instrument representing the ownership of the environmental and other non-power attributes of electricity generated from a renewable energy source or generation facilities. One REC represents one megawatt-hour (MWh) of electricity from a renewable energy source delivered to the grid or load. The Renewable Energy Certificates (RECs) represent units of electricity generated can be traded by electricity users to substantiate their renewable electricity use.

SS 673:2021 Code of Practice for Renewable Energy Certificates, initiated by Sustainable Energy Association of Singapore and National Environment Agency, aims to standardise a common framework or set of guidelines on the issuance and management of RECs for the industry. This facilitates a consistent marketplace for RECs and promotes the use of certified renewable electricity.

(v) Paints with sustainability elements

A) SS 678 Specification for solar reflective water-based coating

Singapore's urban landscape is ever changing, with tall buildings sprouting up every few years. The high building density in Singapore coupled with the tropical weather, contributes towards the urban heat island (UHI) effect.

With the development of solar reflective exterior coatings, application of these coatings to building exterior helps to reduce solar heat absorption by building envelops. Thus, improving the quality of urban living and promotes building energy efficiency. However, with the lack of standard guidelines and minimum performance requirements for coatings that are "energy efficient", application of these coatings is not widely implemented.

The standard specifies requirements of solar reflective coatings, with test methods for quality and performance of the coatings defined in the standard. This in turn promotes the use of solar reflective water-based coatings for the exterior surfaces of buildings in Singapore, which has that the capability of reducing solar heat absorption by the building and thus improving energy efficiency.

B) SS 686 Specification for water-based enamel paint and SS 685 Specification for water-based primer for metal and wood

To be in line with global trends to move towards eco-friendly paints and in an effort to shift from the current practice of using solvent-based paints for wood and metal surfaces, two new water-based standards that specifies the requirements of the water-based paints enamel and primer paints for metal and wood surfaces were developed, covering test methods for quality and performance of the paints. This is also in tandem with the focus to further improve users and occupants' comfort and well-being through enhancing indoor environmental quality in Building and Construction Authority's (BCA) Green Building Masterplan.

These greener and eco-friendly paint alternatives help to address the effects of VOCs with the use of water-based paints thus mitigating health and safety issues related to solvent-based paints.

List of Upcoming New Singapore Standards / Technical References

1) Specification and application of oil spill dispersants –
2) Technical Reference on interior floor coatings
3) Technical Reference on interior wood coatings
4) Code of Practice for handling and usage of industrial gases cylinders at Workplace
5) Code of practice for electronic documentation and processes for tracking fuel quantity and quality across bunker supply chain
6) Technical Reference on gaseous hydrogen for hydrogen fuel cells for vehicles & refuelling stations
7) Specification for environmentally sustainable Organisations
8) Technical Reference on methanol bunkering

Visit https://www.enterprisesg.gov.sg/-/media/esg/files/quality-and-standards/standards/singapore_standards_work_programme to view a list of Singapore Standards that are in development.

For more information on the Chemical Standards Committee and Environment & Resources Standards Committee:

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