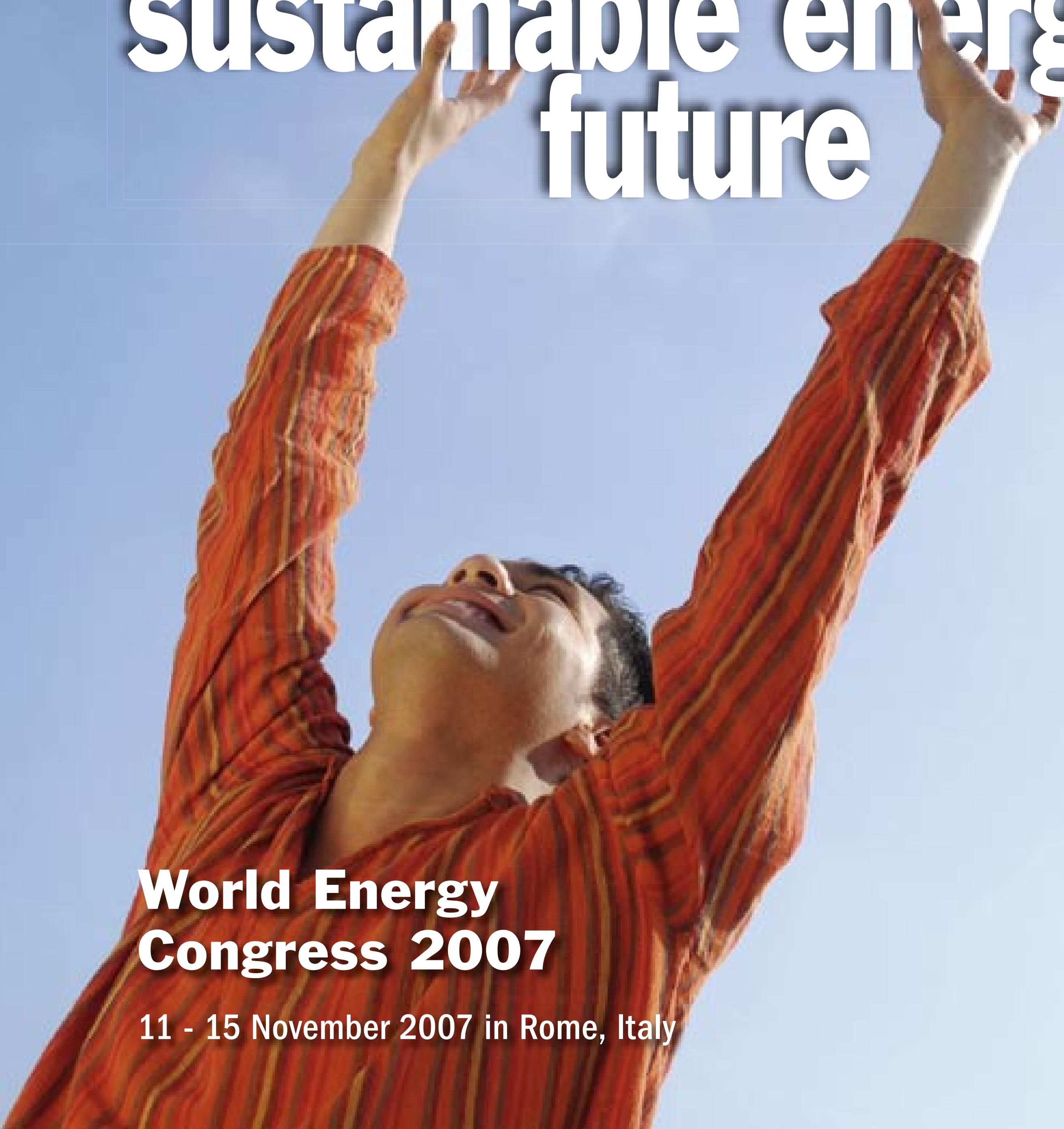
20th WEC Special

ISO Focus

A Special Issue of the Magazine
of the International Organization for Standardization

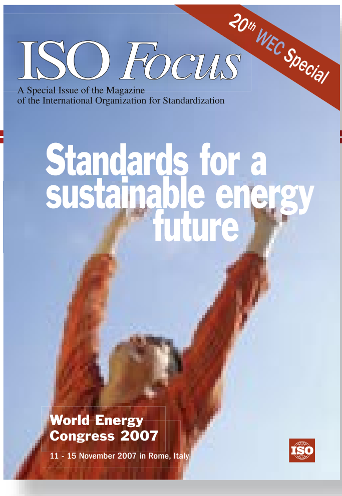
Standards for a sustainable energy future



World Energy Congress 2007

11 - 15 November 2007 in Rome, Italy

ISO



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Editorial

Energy efficiency and renewable sources: How International Standards help

According to the reference scenario presented in the World Energy Outlook 2006 by the International Energy Agency (IEA), based on current trends and on the emergence of new developing economies, the global demand for energy should grow by more than 50 % over the next 25 years, with coal use rising most in absolute terms and fossil fuels still representing some 80 % of the supply by 2030. This trend is clearly not compatible with the depleting and unevenly distributed level of world reserves of fossil fuels and with the imperious need to otherwise reduce the emission of greenhouse gases. Many recent meetings of global leaders at the international or regional level have put energy efficiency and the development of renewable energy sources on the top of the agenda. This is also the case of the 2007 World Energy Congress, held in Rome this November.

Increasing the efficiency of the use of energy is widely seen as the most immediate response, with the development of alternative and renewable sources being, at best, a medium-term alternative. But improving energy efficiency implies acting on the myriads of uses of energy and actors involved, from governments to consumers, from industry to transportation and buildings, from design of products and equipment to the design of networks and infrastructures. The necessary actions imply a mix of regulations, technology, economic incentives, communication and the promotion of good practices.

Many ambitious national policies and programmes have been developed, but, paradoxically, it is only recently that the need for regional and, even more so, international collaboration and commitment has appeared. A spectacular move in this direction was taken at the G8 Summit held in Gleneagles in 2005 and confirmed at their 2007 meeting in Heiligendam. The participating Heads of State took the solemn collective resolution to "*promote innovation, energy efficiency, conservation, improve policy, regulatory and financing frameworks, and accelerate deployment of cleaner technologies, particularly lower-emitting technologies*". More recently, the special summit on climate change convened last September by UN Secretary-General Ban Ki-moon was the climax of international mobilization.

Clearly, International Standards can and must help in this context. They address many of the building blocks necessary to define, implement and monitor both macro and micro policies in this area, such as the harmonization of terms and definitions ; the provision of metrics and test methods to assess, monitor and communicate energy consumption ; the modeling and comparison of energy systems ; or the characterization of materials and products, as well as of their production processes, from the standpoint of optimizing energy use.

"A partnership has been developed with the World Energy Council and the IEA."

International Standards can also be the vehicle for the dissemination of innovative technologies, particularly for alternative and renewable sources, by reducing time to market, creating truly world markets to ensure the critical size for their economic success, as well as objective tools for decisions on public incentives and regulations to encourage their judicious and widespread use.

ISO and the International Electrotechnical Commission (IEC) already have a significant activity related both to the production and to the use of energy, as illustrated in this issue of *ISO Focus*, published specially on the occasion of the 2007 World Energy Congress. But more can certainly be done. The ISO Council has decided to develop a proactive attitude and has launched an ambitious action plan to enhance ISO's contribution – covering such diverse issues as energy management, biofuels, energy efficiency in buildings, industry and transportation, and hydrogen technologies – and to promote standards to support the trading of emission credits and good environmental management.

A partnership has been developed with the World Energy Council and the IEA, with a view to analyse and publicize the current state of play and identify needs and the potential for new developments in international standardization, to assist in promoting energy efficiency and renewable sources on a worldwide basis. A joint position paper was developed between the IEA and ISO. It was used as a background document for the 2007 G8 meeting and is included in this issue of *ISO Focus*. A special session on International Standards has been included in the programme of the World Energy Congress, where interdependence and the imperative for energy efficiency are high on the agenda. We invite all leaders, managers and experts from the private and public sectors present in Rome to support and join forces in the much needed collective effort to disseminate and promote, through the development and use of International Standards and as a matter of urgency, good practices and relevant technologies to address this major challenge to the global village.

Alan Bryden
Secretary-General of ISO

Ron Wood

Ron Wood, Officer and Chair of the World Energy Council Programme Committee, has been a member of the Board of Directors of Black & Veatch since its establishment in 1999. *In July 2001, he became President of the Black & Veatch Energy Engineering & Construction (EE&C) Division, which provides engineering, procurement, construction and related services for electric power stations worldwide. He has overall responsibility for Division operations including planning, policy and financial results. He joined Black & Veatch in 1964 and has been associated with projects for electric utilities throughout his career.*

"ISO and WEC have many common aspects in their respective missions."

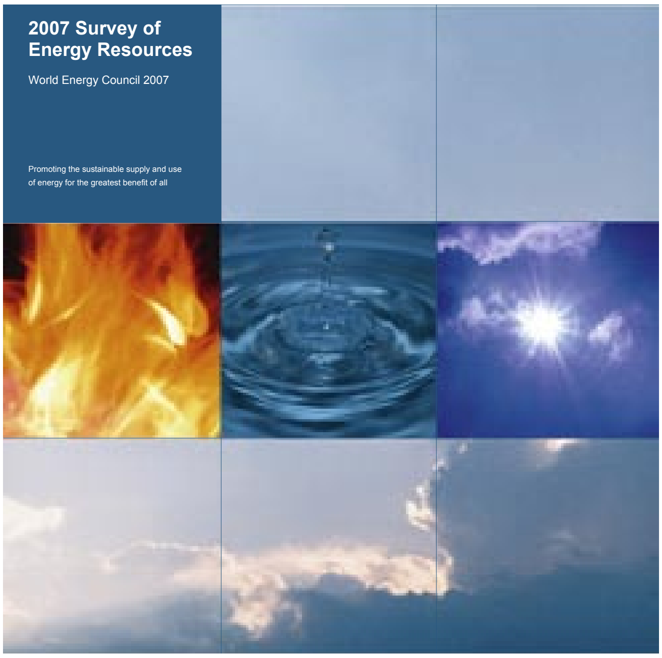
From 1990 through 1998, Mr. Wood was the Division Head of the Black & Veatch unit responsible for electric power delivery system projects and telecommunication projects. In January 1999, that business unit became the Electrical & Telecommunication Business and Mr. Wood was designated President of that business.

Beginning in 1980, Mr. Wood served as a project manager in the Power Division for power delivery and power generation projects. His earlier experience includes procurement management for electric power station projects, with responsibility for equipment and construction specifications, bidding, negotiations and contract documents.

ISO Focus: *As Officer of the World Energy Council, the leading multi-energy organization in the world today, could you please begin by giving our readers some general information about its mission and how it has evolved since its creation?*

Ron Wood: The WEC mission is: "Promoting the sustainable supply and use of energy for the greatest benefit of all." Those few words represent a significant undertaking. Founded in 1924, WEC remains a non-governmental and non-commercial organization providing authoritative analyses, research, energy projections and policy recommendations. WEC comprises member committees from 94 countries; an administrative structure of committees and regional organizations; and, a network of highly qualified and active technical contributors. An important WEC principle is that all energy options must remain open.

ISO Focus: *For the second year in a row, the WEC undertook a survey entitled "2007 Global Energy Survey". This year's survey focused on the topic "Tackling the Three S's: Sustainability, Security and Strategy." What are some of the major issues, concerns and challenges identified by the survey?*

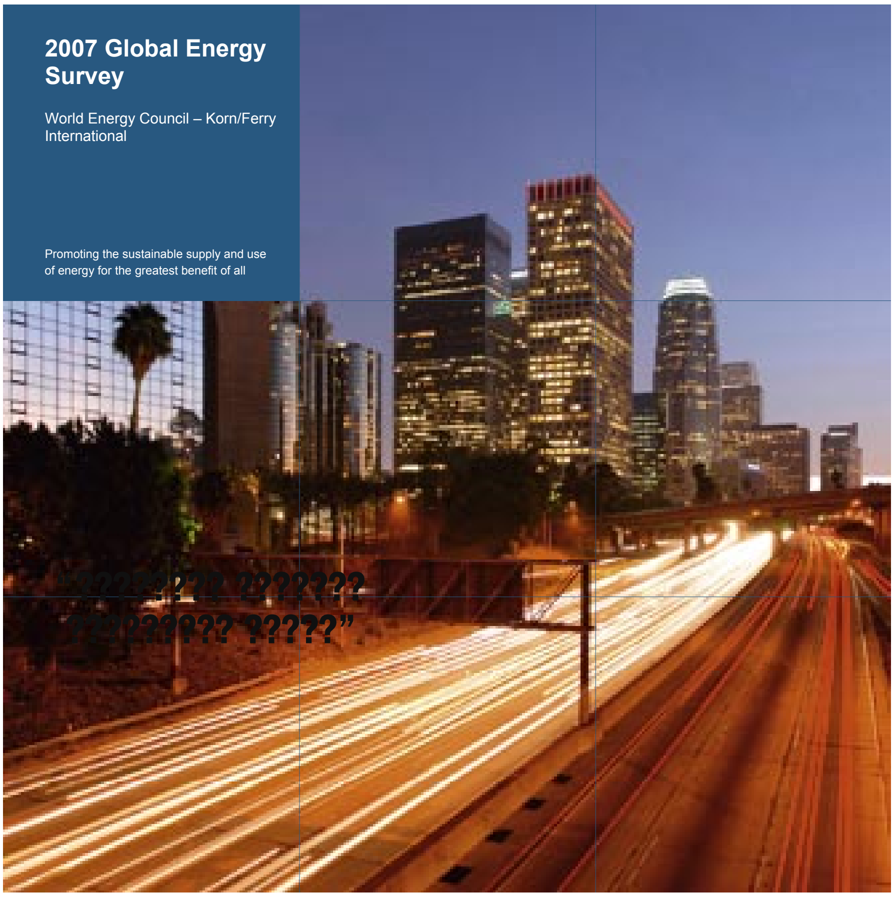


Ron Wood: The survey, prepared by WEC and Korn/Ferry International, is based upon interviews with over 50 international energy executives. The survey acknowledges that energy demand will increase by 50 % by 2030, and a substantial part of that growth will be in developing countries and Asian economies in particular. There will be increasing interdependence of energy markets and increasing collaboration among energy companies. Demand will increase for all types of energy, including nuclear energy and there will also be increased emphasis on environmental issues. Energy companies will face diverse pressures as they seek solutions to energy challenges. The survey publishes an interesting model of those pressures, including *Demand Pressures, Supply Pressures, Political Pressures, and Environmental-Sustainability Pressures*. Demand will be satisfied through, among others, increased reliance on coal and an emergence of new nuclear fueled plants. Environmental pressures will include focus on carbon emissions, but a global concensus is not likely in the near future. Energy supplies may be affected by political uncertainties. Review of the survey is highly recommended and it is available from WEC at:

http://www.worldenergy.org/documents/weckornferry_report2007.pdf

ISO Focus: *With the theme of "Energy Future in an Interdependent World", this year's Congress addresses the interdependence on energy supply and use for the world community. Can you please describe the issues arising from the different dynamic and changing nature of the world energy situation? What, in your opinion, are the challenges, if any, faced by this new world scenario and what are the key actions that need to be taken to address this issue? What role do you see for International Standards?*

Ron Wood: Rapidly emerging Asian economies and turbulence concerning global oil producers are important issues. Global energy supply is, generally, not an issue, but the distribution of supply in relation to requirements is increasingly an important challenge. Particularly, locations of large supplies of renewable energy resources are often great distances from concentrated energy demand locations. As an example, vast hydroelectric resources in Africa, Asia, and South America are not conveniently located and very significant power transmission projects will be required to utilize these resources. WEC has an importat initiative related to large hydroelectric opportunities. Similarly, vast natural gas supplies are far from markets. A significant Liquefied Natural Gas (LNG) industry continues to emerge and it often entails extensive collaboration among energy companies. Regional and global integration of energy resources and demands is being driven by the supply and demand interdependence among nations.



Fossil fuel reserves will remain a very significant part of the energy supply but the continuing discussion of carbon emissions will affect the deployment of new fossil fuel energy production.

An important challenge that may affect development of energy production facilities is the availability of qualified human resources to apply to the very substantial number of global energy projects required to satisfy energy demand. Presently, there is already a shortage of qualified people. Future recruitment and training to provide the required resources may become a difficult challenge.

ISO Focus : *The need to promote energy efficiency and renewable energy sources was among the priorities put forward at a series of recent meetings on the world scene, including the UN Commission on Sustainable Development, the Energy Ministers at the OECD Ministerial Conference and global leaders at the G8 Summit. How does a portfolio of International Standards supporting energy efficiency and renewable sources contribute to the overall efficiency of the world's energy outlook ?*

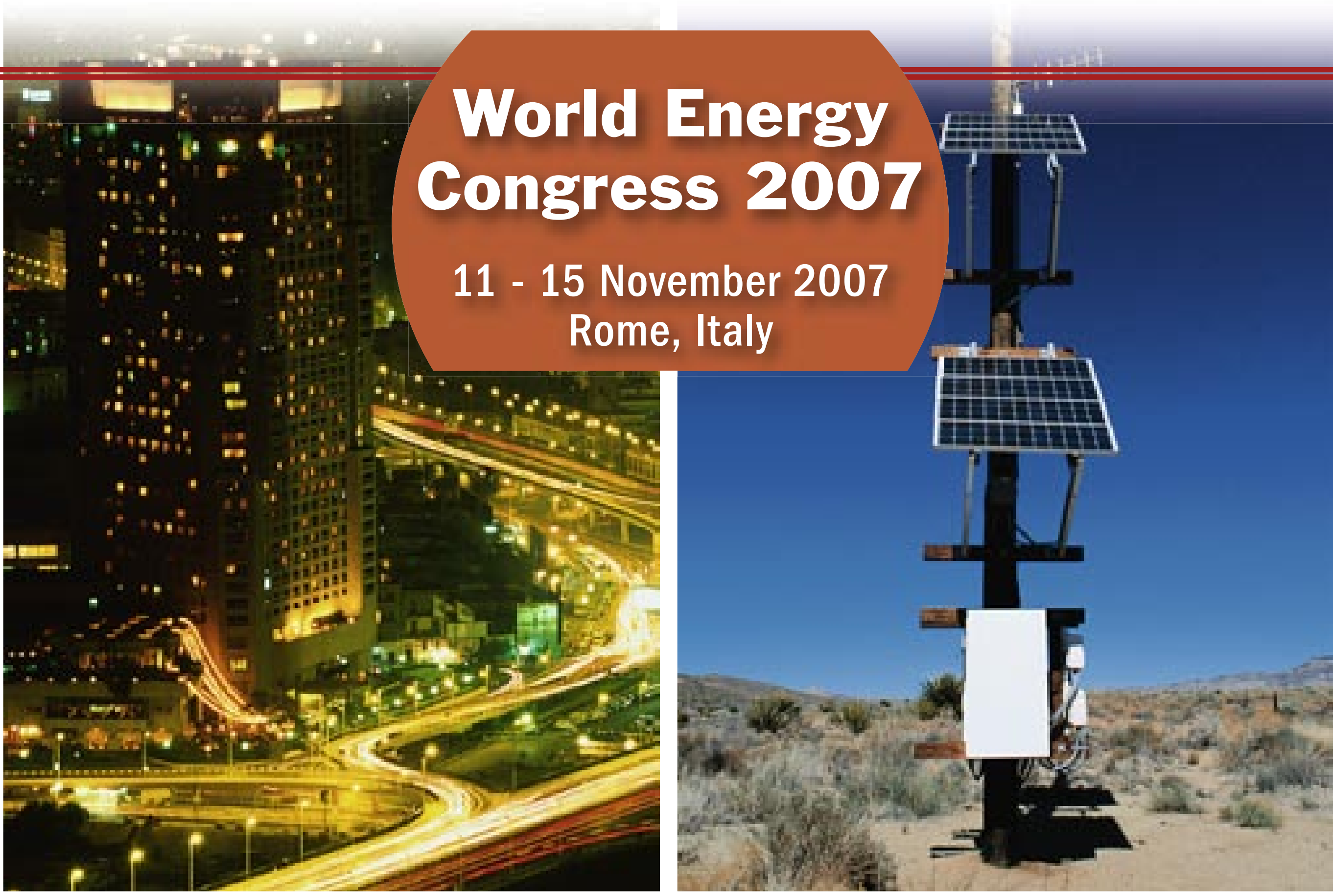
Ron Wood : Increased energy efficiency is an important element in the future energy supply equation. WEC has for a many years supported an ongoing effort to monitor global energy efficiency and there are improvements noted in the energy intensity in various regions. This is an important trend, but the level of energy intensity awareness is uneven among developed and developing countries. Broadly advocated uniform and achievable consumer appliance manufacturing and performance standards can influence the global movement toward optimum energy utilization.

ISO Focus : *ISO 14064 and ISO 14065 provide a methodology to help organizations assess carbon footprints and implement emissions trading schemes. How do you see the evolution of the emission trading market in the coming years and what remains to be addressed by International Standards, and according to what scale of urgency ?*

Ron Wood : Carbon credit trading schemes are encouraging and may offer a framework for meaningful emissions management until technological solutions that achieve emissions reduction and elimination are broadly implemented. ISO standards have made an important contribution toward establishing a uniform framework. Presently, there are diverse approaches to emissions trading and other schemes designed to manage emissions, but the absence of uniformity frustrates effective global emissions management. Continued development and, particularly, strong advocacy of ISO standards can accelerate the emergence of more uniform global requlatory approaches.

ISO Focus : *As international multi-stakeholder organizations, both WEC and ISO with their respective networks/chapters in different countries, draw on the collective experience and resources of professionals worldwide. How do you see the two networks collaborating for the greater good of energy and climate change issues – and how do you see this collaboration evolving in the coming years ?*

Ron Wood : ISO and WEC have many common aspects in their respective missions. The history of each organization and the independence each has established in the global community suggests that effective collaboration between the organizations could be highly beneficial. Particularly, resources might be applied more effectively through collaboration. WEC utilizes a fact-based approach to technical issues and energy policy. ISO, through standards, structures frameworks within which policy can be implemented. It seems there is an opportunity for the two organizations to cooperate and achieve mutual objectives. This concept suggests an initiative to determine areas of potential collaboration and the development of a collaboration protocol. An important aspect of standards implementation is strong advocacy that is only accomplished with effective communication networks. ISO and WEC have global footprints that should enhance the opportunities for advocacy. ■



International Standards to develop and promote energy efficiency and renewable energy sources

The international Energy Agency (IEA) and ISO share the view that International Standards have an essential role to support the advancement of energy-efficiency and renewable energy.

The two organizations are actively cooperating to strengthen the portfolio of International Standards in these domains and to raise the awareness of world leaders on their importance.

The joint ISO/IEA position paper entitled "International Standards to develop and promote energy efficiency and renewable energy sources", was submitted as a background document in the context of the preparation of the G8 meeting in Heiligendamm, Germany, in June 2007. The position paper highlights the key reasons why International Standards matter in this domain and solicits political and business leaders to support and increase their involvement in the development and use of international standards.

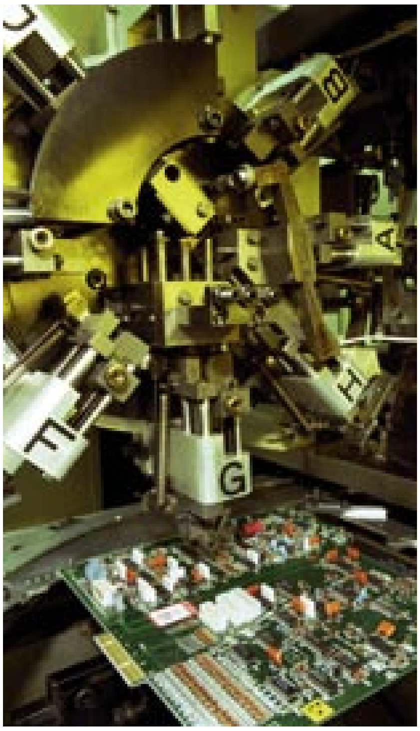
A common position paper by the International Energy Agency (IEA) and International Organization for Standardization (ISO), June 2007

Energy and International Standards

As in many other fields, International Standards have made, and will increasingly make, an important contribution to the energy sector, helping to enhance the safety and efficiency of production, distribution and use by all economic players, assuring quality and security, allowing for variety control, interoperability and interconnectivity, as well as reducing waste and environmental impact. They contribute to market development and the acceptance of energy-efficient technologies and pave the way for the development and use of alternative renewable sources.

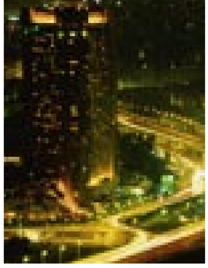
The energy sector is facing new challenges, as highlighted by the heads of state participating at the G8 Summit held in Gleneagles in 2005, who took the collective resolution to "*promote innovation, energy efficiency, conservation, improve policy, regulatory and financing frameworks, and accelerate deployment of cleaner technologies, particular lower-emitting technologies*".

International Standards are a powerful tool for disseminating new technologies and good practices, developing global markets and supporting the harmonization of government policies on energy efficiency and renewable sources on a global scale.



The global energy challenge and the importance of energy efficiency and renewable energy

In recent years, it has become evident that the challenges facing the energy sector have become more acute. Concerns about the environment, energy security and economic prosperity, long identified as the "three Es" that inform and guide the mission of the International Energy Agency, are all three challenged by current energy trends. Over the last few years, global energy demand has outpaced the capacity of new supply to reach markets, and in the longer term the reliance on non-renewable energy sources is, by definition, unsustainable. Before that point is reached, it is now clear that humanity faces the pressing and growing problem of energy's impact on climate. The work being done by the IEA and other organizations such as ISO is increasingly focused upon how best to address these multiple challenges and meet future energy needs in a more sustainable manner. There has been a growing appreciation of the great opportunities to be realized in exploiting untapped end-use efficiency reserves in the near term while making the transition towards lower carbon energy sources, including renewable energy sources, over the longer term. The long-range global energy scenarios presented in the IEA's World Energy Outlook (WEO) both illustrate the scale of the problems and of the opportunities. For example, under the WEO's Reference Scenario, global energy demand continues to grow due to increasing economic activity and is projected to be 53 % higher in 2030 compared with 2004. Fossil fuels are expected to continue to dominate the energy fuel mix and as a result global CO_2 emissions to rise commensurately ; the latter are projected to exceed 40 gigatonnes per annum by the end of the period. By contrast, the Alternative Policy Scenario considers what would happen if the some 1 500 carbon abatement and energy security policies that are currently only partially implemented or under active consideration were to be fully implemented. In that case, global energy-related CO_2 emissions would peak before 2030 and at a level 16 % lower than in the Reference Scenario. Some two thirds of the reductions are attributable to measures that raise end-use energy efficiency, 12 % to increased use of renewable energy, 10 % to increased use of nuclear energy and 13 % through improved efficiency and fuel-switching in the power sector. Moreover, this scenario is less costly than the Reference



Scenario, mainly because of the comparatively low cost of the end-use efficiency gains. Thus, the enhanced deployment of energy efficiency and renewable energy options could contribute almost 90 % of all future carbon abatement efforts in the energy sector. It is for this reason, and for the simultaneous advantages in terms of enhanced energy security and economic efficiency, that there is a pressing need to guide the global energy economy further down the pathway of the Alternative Policy Scenario rather than continue following current trends.

The role of standards

So what is needed to make a transition towards more sustainable yet affordable energy solutions and what role can standards play ? Most technologies, including renewable energy, need to attain economies of scale if they are to advance along a learning curve and achieve cost viability. They also require that appropriate technical specifications be established and standardized in order to accelerate their deployment. In the case of end-use energy efficiency, the barriers are somewhat more complex. Many energy efficiency technologies and practices are already highly cost-effective, but are held back by additional barriers which include :

- lack of awareness of the cost-effective savings potential ;
- missing or partial information on energy efficiency performance and lack of common metrics ;
- lack of consideration of system and process energy efficiency issues ;
- split incentives, e.g. the different economic incentives which exist between landlords who procure energy-using equipment and tenants who pay the energy bill ; and
- the fact that energy efficiency is often a minor determinant of capital-acquisition decisions and is bundled-in with more important decision factors.

"The energy sector is facing new challenges."

As a result of these barriers, the procurement and operation of energy-using equipment is often overly focused on initial rather than life-cycle cost optimization to the detriment of its overall efficiency.

Many measures are needed to help overcome these barriers and technical as well as management standards underpin most of them. In the case of energy-using products, standards enable an otherwise invisible product attribute, namely energy efficiency, to be measurable, comparable and reportable on a common basis. This is an essential step for the most important barriers of low visibility and awareness to be successfully addressed. Where common standards for measuring, defining, comparing, reporting and verifying energy efficiency are adopted, they also provide a level playing field for all market actors. Hence, wherever practicable, the adoption of harmonized standards is desirable. Harmonization of these energy performance standards helps :

- minimize product energy per formance testing and verification costs for increasingly globalized energy-using equipment markets ;
- enable energy performance to be compared on a common basis across broad economic and political groupings ;
- facilitate adoption of more efficient product manufacturing ; and
- accelerate transfer of best practice in policy settings.

Conversely, it is important that International Standards produce energy performance measures that are relevant

to the local context, e.g. that in cases where the energy performance of equipment is sensitive to the prevalent ambient operating temperature, the standards allow locally pertinent results to be derived.

Technical standards in the domain of energy efficiency need not be limited to the measurement and definition of energy performance metrics. They can include the means of testing, certifying and labelling energy performance and could also include broader system and process topics such as energy management and how to monitor, identify and verify energy savings delivered via diverse applications and programmes. The development and adoption of these broader standards is part of the infrastructure that will contribute to the development of more fungible and international energy-efficiency markets,

as they will hasten the day when energy efficiency can be bought and sold as an energy service commodity in the same way that electricity or gas can currently be traded.

What International Standards offer

International Standards thus provide :

- a consistent and clear framework describing technologies and good practices in the fields concerned, including, *inter alia*, terminology, classifications, test methods, performances (along with the modalities of the presentation of test results and performance levels) and good management practices ; and
- state-of-the-art knowledge formalized by recognized experts in the field, based on international consensus from a balance of interests reflecting the technological, economic and public interest conditions in the vast majority of the countries of the world.

International Standards add value in this context by :

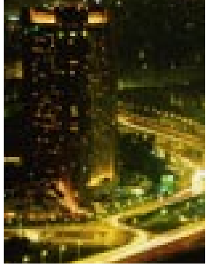
- reducing uncertainty for all the economic players, thus creating a climate favourable to public-private partnership for accelerating the development and marketing of more energy-efficient products and renewable energy sources ;
- supporting international trade of goods and services in these fields and the development of new markets ; and
- helping to significantly improve consumer/user understanding and confidence and thus influencing consumer/user behaviour and choices.

The value of the International Standards system to public authorities

International Standards and the international standardization system offer the following advantages for public authorities.

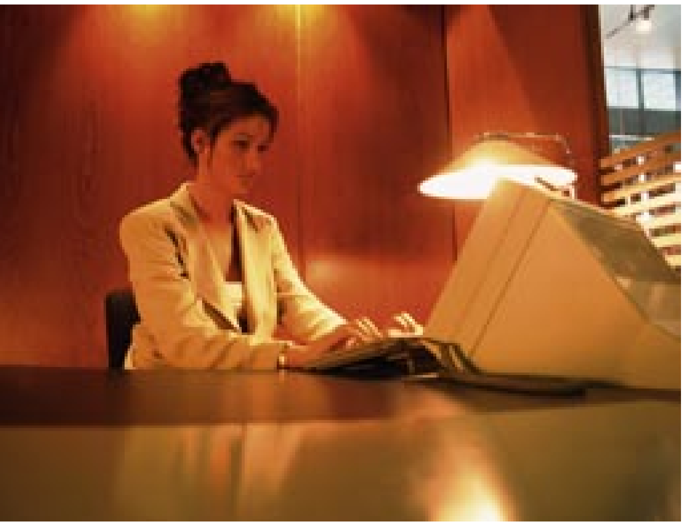
- International Standards can be helpful in supporting cooperation and potential harmonization of public policies in the fields concerned.
- With International Standards, governments can have immediate access to a significant portfolio of documents covering energy efficiency in a variety of domains (buildings, household appliances, industrial products and processes, etc.) and a variety of renewable energy sources.
- The standardization system offers the opportunity to develop, as quickly as demanded, technical solutions addressing requirements and priorities set by public authorities, involving all the concerned parties in an open, transparent and efficient process.
- International Standards are fully compliant with the requirements set by the Agreement on Technical Barriers to Trade of the WTO, and are used worldwide as instruments facilitating the elimination of unnecessary barriers to trade and, whenever needed, as a suitable basis for technical regulations.

Public authorities and intergovernmental organizations are increasingly aware of the usefulness and importance of international standards. An important recent example of this recognition can be found in the Joint Statement on Energy Security and Climate Change, issued at the European Union and United States of America Summit held at the White House, Washington, D.C., on 30 April 2007. The Statement includes among the key priorities the need to "*…overcome barriers to the use of renewable energy sources including through the development of international standards…*" and, inter alia, indicates the commitment of the parties to develop compatible standards for biofuels.



Examples of the use of International Standards to support energy-efficiency policy

A good demonstration of the role International Standards published by ISO could play can be seen in the energy performance of buildings. Buildings use large amounts of energy and produce large amounts of CO_2. There are many opportunities to make savings in this sector, so practical tools are needed for the design and construction of energy-efficient buildings and the retrofit of existing buildings. International Standards provide these tools.



For example, the energy performance of buildings can be calculated using International Standard ISO 13790. Complementing it are several other ISO standards that can be used to calculate the thermal properties of the building envelope (walls, roof and basement) and of the individual construction materials. These provide the reference for expressing performance in trade documents and building regulations all over the world.

The ISO standards by which the thermal properties of building components (*U*-values) are calculated have been adopted as European standards, as national standards in countries like China and Japan, and are referenced in building regulations in many countries.

The ISO standards elaborated by ISO/TC 163, *Thermal performance and energy use in the built environment*, are horizontal in nature and performance based. They can therefore be applied to new, innovative, energy-efficient products and buildings, thus giving them market credibility.

Another important example concerns domestic appliances such as household refrigerators, clothes washers and room air conditioners. These products are major sources of domestic and tertiary sector electricity consumption. Yet, in part as a result of the existence of recognized energy performance test procedures, it has been possible for the world's major economies to develop energy labelling and energy performance standards that encourage the development of more efficient products, while preventing or discouraging the sale of less efficient ones, and thereby save very significant amounts of energy at low cost. By way of illustration, since the European Union introduced energy labelling and minimum energy performance standards for domestic refrigerators, the energy consumption of these products has improved by roughly 40 % over a five-year period. This and similar policies applied to other household appliances in Europe are projected to be on course to save 46 Mt of annual CO_2 emissions and more than €11 billion in net consumer costs for appliances (the sum of the purchase and energy savings costs), once the old appliance stock is replaced by the new and more efficient models. As the value of the energy savings comfortably exceeds the increment in appliance prices, the net cost of CO_2 abatement is negative at a value of – € 241 per tonne. Without recognized and reliable appliance energy performance test procedures, it would not have been possible to implement these measures. Nor are savings from these policy types confined to Europe. Just-as-impressive savings are being delivered in other OECD economies, and many non-OECD economies have now implemented similar measures. Nonetheless, standardization continues to play a key role and there remain many areas in this domain where there is a need for new or improved energy performance test methods and procedures.

The last example concerns energy management and highlights the importance of international cooperation. National energy management standards have been developed and are in use in various countries, some of which are already exploiting significant savings in energy consumption and reductions in CO_2 emissions.

Considering the developments needed in this area from a global perspective, inclusive of the needs of developing nations, the Expert Group Meeting on Industrial Energy Efficiency and Energy Management Standards organized by UNIDO on March 21-22, 2007, took the resolution listed below:

"The EGM participants reached a consensus that the timing is favorable to move forward with the international harmonization of standards for Energy Management.

Currently, four countries have standards for Energy Management (Denmark, Sweden, Ireland, and the United States) and two have standards under development (China, and Spain). In addition, two other energy management specifications are already in use (Netherlands, Germany), and in some countries, such as Brazil, companies are developing their own energy efficiency standards. Moreover, harmonization efforts within *the European Union have begun under the auspices of the European Committee for Standardization (CEN).*

For these reasons, the meeting participants request that the International Organization for Standardization (ISO), as the appropriate international entity for global harmonization of standards, consider initiating development of an ISO Energy Management standard at the earliest possible opportunity."

IEA/ISO cooperation

Given the importance of International Standards to the advancement of energy-efficiency and renewable energy, the IEA and ISO have begun to cooperate to strengthen the portfolio of International Standards in these domains.

The first step in this cooperation is to conduct a gap analysis of the existing portfolio of International Standards and ongoing standards projects addressing energy efficiency and renewable energy, and to propose the potential development of new standards when clear omissions are identified, in cooperation with organizations such as the International Electrotechnical Commission (IEC), competent for International Standards relating to electrotechnology and electronics.

The second step is to review the portfolio of existing International Standards and ongoing standards projects to see if there are any areas where they should be further promoted, strengthened or re-oriented to better serve public policy objectives in these domains. ISO and IEA will also cooperate to facilitate the dialogue between policy makers and standards developers in selecting and prioritizing subject areas to be covered by International Standards supporting energy-efficient and renewable energy technologies and best practices.

"The IEA and ISO have begun to cooperate to strengthen the portfolio of International Standards."

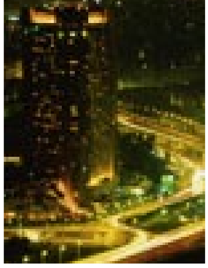
It is expected that the initial gap analysis will be completed in 2007. The two organizations will subsequently focus their attention on the broader review of areas where international standardization should be promoted, strengthened or initiated.

Commitment of political leaders

ISO and IEA welcome the increasing recognition of the role of International Standards in the fields of energy efficiency and renewable energy sources by public authorities and international organizations.

International standardization is a complex endeavour that requires qualified participation of the concerned parties and their continual engagement. This ensures sustained market relevance and the close match of evolving market and societal needs.

The two organizations therefore invite the heads of state to support and increase the involvement of their national stakeholders in international standardization through their national standards bodies and appropriate expert networks such as IEA implementing agreements. ■

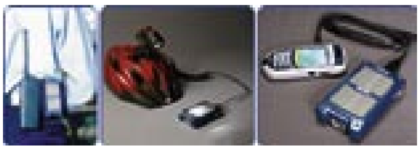


Hydrogen – A sustainable energy solution

by Randy Dey, Chair of ISO/TC 197, Hydrogen technologies

The rise in oil prices, together with the increasing energy demands from China and India, shows that alternate energy sources will have to be considered. To introduce hydrogen successfully into the energy mix for use in transportation and in stationary and portable power, a number of challenges have to be overcome.

Most of the technologies that are required to implement a sustainable hydrogen-based energy system are in either a development or demonstration phase, and are not yet ready to be used on a wider commercial scale. Further work needs to be done to overcome the technological and economic barriers, but this work has already begun in earnest.



Hydrogen-powered micro fuel cell devices.

Hydrogen production challenges

Hydrogen can be produced from a wide range of primary energy sources such as natural gas, coal, nuclear and renewable energies. This makes hydrogen a versatile energy carrier that can be produced from the natural resources of each country, reducing dependence on imported fuels.

Hydrogen passenger vehicle.

The technologies for producing hydrogen are well established. Currently, over 50 millions tonnes of hydrogen are produced on a yearly basis for refinery and industrial uses, mainly via natural gas reforming. Smaller quantities are also produced from coal gasification and water electrolysis.

Before hydrogen becomes a major energy carrier, the cost-effectiveness of hydrogen production techniques will have to be improved. Indeed, it is foreseen that hydrogen production costs will have to be reduced by a factor of between three and 10 depending on the technology used. Cheap CO_2 sequestration techniques will also need to be available, since it is unlikely that the demand for hydrogen in the short and medium term will be met by renewable energies alone.

In the early market introduction phase, small-scale decentralized natural gas reforming and water electrolysis systems can play a very important role in establishing an infrastructure of distributed refuellers for cars and buses. These on-site hydrogen production systems have the advantage of not requiring large investments for the introduction of pipeline distribution systems. This is also an important factor that attracts developing countries like India and China to hydrogen.

Hydrogen cylinders.

In the long run, centralized hydrogen production plants hold the promise of increased efficiency and lower costs. Hydrogen demand will, however, have to increase substantially before the investment can be justified. Indeed, the cost to put in place a hydrogen distribution pipeline will not be negligible. Also, further research and development will still have to be carried out in order to determine to what extent existing natural gas pipelines can be used for transporting hydrogen.

Hydrogen infrastructure challenges

The synchronization between automotive commercialization plans and infrastructure build-up is an important challenge that still has to be overcome. One of the key research, development and demonstration (RD&D) issues resides in defining the optimal on-board storage system.

The use of hydrogen in the energy sector will require the development of a distribution and storage infrastructure. Storage technologies for stationary and mobile applications, pipeline infrastructure, as well as refuelling stations and associated equipment, will be required if hydrogen becomes a major energy carrier and fuel.

"Hydrogen can be produced from a wide range of primary energy sources such as natural gas, coal, nuclear and renewable energies..."

Since hydrogen is currently used in the petrochemical and chemical industries, the technologies for the physical transport and storage of gaseous and liquid hydrogen are commercially available and in use for local transport and distribution.

Technologies for intercontinental transport of hydrogen are, however, in their development phase. In the long term, solid-state transport and storage technologies have the potential to be widely used. The most promising of these solid-state technologies are the nanotubes and the metal hydrides.

None of the technologies under consideration seems to fully meet the needs of the automotive industry. Further work is required to come up with an economically viable storage system that will provide comparable autonomy and storage space as today's passenger cars.

Since the on-board storage tank technology will have an impact on the refuelling infrastructure, it would be premature to deploy a full refuelling station network before this decision is made. Currently, onboard gaseous

Hydrogen fueling station.

hydrogen storage at 35 MPa and 70 MPa and liquid hydrogen storage are available. Solid-state storage at lower pressures is being investigated.

Fuel cell challenges in the transportation sector

Due to their higher efficiency compared to internal combustion engines (ICE), proton exchange membrane (PEM) fuel cells are seen as the most promising technologies for vehicle applications at the present time. However, they have to overcome a number of challenges before they can penetrate the market.

One of the challenges consists of improving the durability and reliability of fuel cells. Achieving the desired target of 3 000 to 5 000 hours in terms of service life will be necessary to gain consumer acceptance in these new products.

To be competitive with conventional ICE technology, PEM fuel cells will need to meet the targeted cost of USD 50 per kilowatt. Also, their sensitivity to hydrogen fuel contaminants is a challenge. Higher temperature fuel cell membrane types are also being developed which may not require the level of fuel purity. Indeed, the fuel purity requirements have a direct impact on the associated price of hydrogen.

Fuel cell challenges in the stationary sector

Fuel cells are also seen as a promising avenue for back-up power and distributed power generation. As hydrogen fuel cell technology emerges, back-up power applications are viewed as the first commercial stationary power market. PEM fuel cells are currently being installed to meet the growing demand for reliable and space-efficient back-up power.

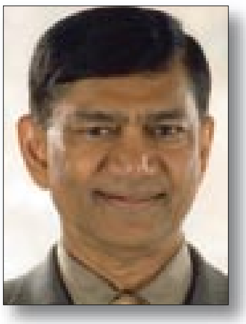
"...this makes hydrogen a versatile energy carrier that can be produced from the natural resources of each country, reducing dependence on imported fuels."

Molten carbonate fuel cells and solid oxide fuel cells are considered as a likely candidate for decentralized combined heat and power units. Their cost still has to be reduced by a factor of between 5 and 10 to become competitive.

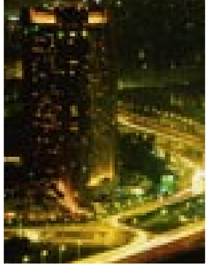
Fuel cell challenges in the portable sector

The convergence of voice, data and multi-media is driving the demand for more power/energy availability in cell phones, laptops, cameras and other portable and micro devices. Micro and portable fuel cell systems provide an interesting alternative to batteries by providing high energy density, extended runtime and fast "recharging" capability. Few challenges have to be overcome before these fuel cell technologies reach commercialization. The advantages they present over the conventional battery technologies will make them attractive to consumers in the not too distant future.

About the author



Randy Dey, President of The CCS Global Group, a strategy consulting firm that he established in 1977. He is an expert in international standards and codes development, compliance and harmonization with a special focus on hydrogen, fuel cells and alternate fuel sectors. Mr. Dey is chair of ISO/TC 197, *Hydrogen technologies,* and holds leadership positions in other codes and standards forums related to hydrogen and fuel cell technologies. He coordinated the ISO Round Table on Global Harmonization of Regulations, Codes and Standards for Gaseous Fuels and Vehicles which was held in Geneva on 10 January 2007.



Environmental and energy security policy challenges

According to the IEA spell-out report, *Prospects for Hydrogen and Fuel Cells*, the business-as-usual trends in energy policy will not necessarily result in switching to hydrogen and fuel cells.

"In an ideal case, governments should first establish credible and long-term energy security and environmental policies and targets, without which no reason exists to switch to hydrogen. They should then foster the establishment of International Standards for hydrogen and fuel cells in close consultation with industry, promote infrastructure investment, and provide incentives for consumers to adopt new technologies," the report states.

It is through the combination of effective climate and energy-security policies that hydrogen can become a significant player in the market as a transport fuel. In this respect, the *Stern Review : The Economics of Climate Change* has highlighted the urgency to reduce greenhouse gas emissions and has shown that the benefits of strong, early action considerably outweigh the costs.

The *Stern Review* forecasts that 1 % of global gross domestic product (GDP) per year should be spent on tackling climate change immediately. The cost of inaction could cost the world at least 5 % of GDP each year.

Conclusion

Uncertainty remains as to how the world will meet the challenges of global warming, energy security and economic efficiency. Hydrogen is an important energy carrier, especially in the transport sector, when compared to the other technologies being considered as sustainable energy solutions.

ISO/TC 197, *Hydrogen technologies*, is actively developing consensus-based International Standards that will facilitate the market entry of these new technologies. Working together, we can help to make hydrogen a sustainable energy solution. ■

A classic example where the energyware coal *is converted to the physical quantity* mechanical work.

Weighting and aggregation of energywares

by Anders J Thor, Secretary of ISO/TC 203, Technical energy systems

Since the Kyoto Protocol was signed, environmental conditions have an important and increasingly market relevance. The new International Standard ISO 13602-2:2006 establishes the guiding principles for the weighting and aggregation of energywares, an important issue for the energy sector and the environment.

The overall size of these makets is huge and it is the largest economic sector. The value of all energywares traded and the investments in all technical energy systems in the world adds up to trillions of US dollars per year.

Because traditional fossil fuels are finite, there is interest in renewable energy, energy conservation and energy management techniques and therefore it is important to be able to compare widely different energy options.

This is not always easy, as can be seen from the ongoing debates over wind power, large hydro power, nuclear power, electric heating, and co-generation of heat and electricity.

There are two situations where allocation between technical energy systems could be necessary; one when a product that is an output from one technical energy system is an input to another technical energy system, or when several products are produced from one technical energy system.

Weighting and aggregation allows the user to make a choice between options, which becomes more important as industry is faced increasingly with legislation regarding emissions targets.

Let us first define the difference between energy and energywares, which was also described in an earlier article of *ISO Focus*, (see June 2005).

Energy

Energy is an abstract physical quantity. According to one of the most fundamental laws of physics, energy cannot be produced or consumed, only transformed from one form to another.

Examples of different kinds of energies are mechanical energy (kinetic energy, work, and potential energy), heat, electromagnetic energy, chemical energy, and nuclear energy.

By coincidence, the name of the steam locomotive is the same as that of the author.

Energyware

ISO/TC 203, *Technical energy systems* makes the distinction between two types of energy carriers, i.e. tradeable and non-tradeable.Tradeable energy carriers have been designated as "energyware" to distinguish them from energy.

Energyware consists of tradable, commercial energy carriers, which can be produced and consumed, e.g. natural gas, oil, coal, grid electricity, and hot water in district heating.

"The new International Standard ISO 13602-2:2006 establishes the guiding principles for the weighting and aggregation of energywares..."

There are now four International Standards published in the ISO 13600-series, all standards which have the introductory element: *Technical energy systems*. These parts are:

ISO 13600:1997, *Technical energy systems – Basic concepts*

ISO 13601:1998, *Technical energy systems – Structure for analysis – Energyware supply and demand sectors*

ISO 13602-1:2002, *Technical energy systems – Methods for analysis* – Part 1: *General*

ISO 13602-2:2006, *Technical energy systems – Methods for analysis* – Part 2: *Weighting and aggregation of energywares*

The latest standard in the series on the weighing and aggregation of energywares is important because the impact on the environment is a very important aspect. A further standard dealing with methodology for energyware statistics and forecasting is planned.

Measuring energywares for transparency and compatibility

In many cases energywares are aggregated simply by their energy content, e.g. heat of combustion. This means that no weighting is performed in the aggregation, and the result is globally valid.

In other cases, aggregation by energy content may not serve the purpose of aggregation and some form of weighting has to be applied, which typically depends on local conditions. Thus, this result will not be globally valid.

For this reason, it is important to establish a procedure for the weighting and aggregating to ensure transparency and comparability.

In the new International Standard ISO 13602-2:2006, the guiding principles for the weighting and aggregation of energywares are established. This will ensure the above-mentioned transparency and comparability at different levels of energyware statistics.

There are several general principles for the weighting and aggregation of energywares. They may be grouped into a few different categories according to

– an inherent physical property, e.g. heat of combustion,

– kind of energy resource, e.g. a renewable or non-renewable energy resource,

– characteristics of the energy conversion process, e.g. emissions such as CO_2 (carbon dioxide) and NO_x (nitrogen oxides), or

– the service provided by the energyware, e.g. mechanical work or heating of a building.

Also, several different quantities (often physical quantities, but also economic quantities) may be used for the weighting and aggregation of energywares. The most common are:

– energy content (heat of combustion), i.e. no weighting is performed and the weighting factor is 1 for all energywares,

– economy, i.e. the weighting is based on the market price of the energyware,

– substitution coefficients, i.e. the relative value of different energywares is decided by their capacity to replace each other when providing a particular service, and

"...this will ensure the above-mentioned transparency and comparability at different levels of energyware statistics."

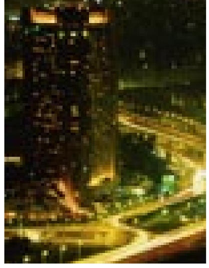
– exergy, i.e. the value of the energywares according to their theoretical capacity of generating mechanical work, given a defined ambient temperature.

Challenges

However, there are problems with all these options, but unfortunately there are no better alternatives. The problem with heat content is that it is very often not possible to use that energy.

For example, there is a lot of energy in the water of the oceans of the world. If you could decrease the temperature of the oceans with one kelvin (= 1 °C) you would get more energy than mankind uses during several years. The problem is that in practice it is technically impossible to use this enormous amount of energy.

The problem to weigh in economic terms is that the market price



varies – often very much – with time. The price of energywares also depends on taxes in different countries.

Substitution coefficients depend on the service under consideration. In many cases a special energyware cannot be used to provide a particular service. For example, you cannot use grid electricity to make an airplane fly, because there are no overhead lines 10 km over the surface of the Earth.

Finally, the problem with the concept exergy is that it depends on the ambient temperature, and that is very different in different parts of the globe and also varies quite a lot over the year in the same place. Because of this dependence on the ambient temperature, a famous physicist has stated that everyone who uses the concept exergy in energy calculations is a liar. Personally, I am very tempted to agree.

In a weighting method a procedure is defined that results in a weighting factor. A weighting factor may be global or local, and may be time dependent.

Requirements on reporting weighted or aggregated energywares, according to the new standard, are the following.

- The base system without weighting shall always be reported based on the energy content of the energy flow for each energyware, and for a specified period of time.
- Weighted measures of energywares shall be separately reported.
- The methods for the calculation of the applied weighting factors shall be reported in a transparent manner.

Life Cycle Assessment

Depending on the purpose of the weighting, different impact factors on the environment may be used. These impact factors shall be clearly described in the report. Impact factors are based on LCI/LCA data (Life Cycle Impact/Life Cycle Assessment), which shall be calculated according to the rules specified in ISO 13602-2.

Also, depending on the purpose with a study, different service factors may be used. Such factors shall be clearly described in the report.

Measuring Resource Depletion

Calculations are based on the following principles.

- Use of non-renewable energy resources in nature (such as crude oil, coal, uranium, etc.) causes resource depletion and shall be accounted for as a depletion of natural resources, quantified in terms of volume, mass, or energy.
- Use of renewable energy resources in nature (such as solar heat, wind energy, hydro energy, etc.) does not cause any depletion of natural resources.
- Capital goods shall also be included.

A special case is biomass, e.g. firewood and peat, where one of two different principles applies.

Principle 1: If the biomass is re-established, the activities required for the re-establishment (i.e. to start the cycle again) shall be included. The only remaining resource used in this case is solar energy, but this does not cause any resource depletion. Biogenic carbon dioxide shall not be accounted for when calculating Global Warming Potentials (GWP).

Principle 2: If no re-establishment occurs, i.e. no re-plantation is done or occurs naturally, a natural resource has been consumed and therefore shall be accounted for as depletion.

Conclusion

There are two situations in which allocation between technical energy systems could be necessary. One is when a product that is an output from one technical energy system is an input to another technical energy system (open loop recycling), the other when several products are produced from one technical energy system (multiple-output).

If allocation can be avoided by dividing the system into sub-systems, this is always preferable. Otherwise you have to choose between open loop recycling and multiple-output allocation.

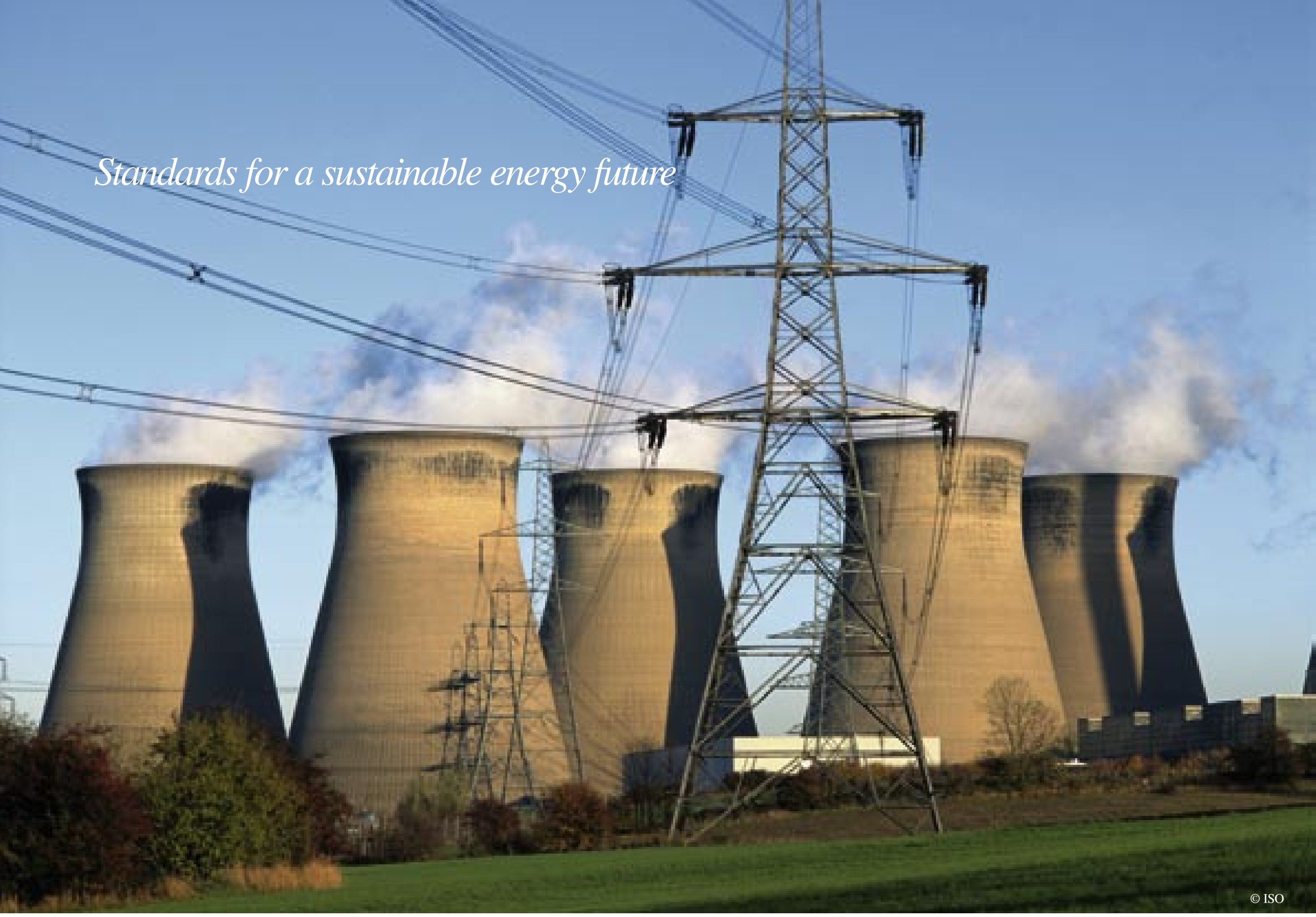
As you can see in the above-given presentation of ISO 13602-2 on weighting and aggregation of energywares, there are several more or less subjective options. The main point is, however, that the chosen option must always be clearly stated.

Economic comparisons are not always possible, because future prices of fuels and equipment are not known, but the definition and quantification of ecological and health impacts are very important. Such analyses were hindered by the lack of common and globally accepted rules to weigh and aggregate different energywares.

Hence International Standards for weighting and aggregation of energywares, and defining and weighting of all economic and ecological factors is the most important task for ISO/TC 203. ■

About the author

Anders J Thor, formerly an Assistant Professor of Mechanics at the Royal Institute of Technology in Stockholm, has been Project Manager at the Swedish Standards Institute (SIS) since 1975. He is Secretary of ISO/TC 12, *Quantities, units, symbols, conversion factors,* and ISO/TC 203, *Technical energy systems,* and also Chairman of IEC/TC 25, *Quantities and units, and their letter symbols.*



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Nuclear energy: A key contribution to a sustainable energy mix

by Bernard Sevestre, Chair of ISO/TC 85, Nuclear energy

In recent years, in a world that has become far more unstable and uncertain, concerns about world energy supply and the environment have grown more pressing.

The increasing cost of oil and gas, the depletion of resources and the uncertainty of energy supply contribute to the current unease.

The key issue of the future is about how to define and optimize a sustainable energy mix. In this context, the financial competitiveness of nuclear power for electricity production is becoming more attractive.

In industrialized countries, the development of renewable energy and new technologies which increase gains in energy efficiency will help stabilise energy demand to a degree, but the foreseeable growth of the world's global energy demand, particularly in emerging economies, will be huge.

The increase in energy demand is occurring in the context of the growing evidence of climate change, as well as a growing consciousness of the future costs of these changes. In this context, the fact that nuclear-generated electricity results in virtually no carbon emissions makes it a candidate for contributing to a future sustainable energy mix.

But this option raises a new question: is nuclear energy sustainable?

The political and public perception of nuclear energy has known ups and downs, but the main issues remain the same. The sustainable development of nuclear energy is based on whether the following four conditions can be met:

- safety of power plant operation
- security of the nuclear industry
- certainty of nuclear fuel supply
- safe disposal of nuclear waste

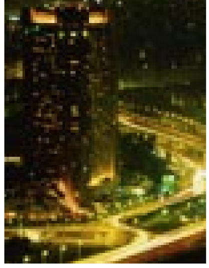
The strong political implications of these issues led to the creation of the International Atomic Energy Agency (IAEA) whose mission is to promote pacific uses of atomic technologies (particularly in nuclear energy, but also in medical, industrial and agricultural technologies) and to prevent the proliferation of nuclear weapons.

The IAEA mission includes the production of international nuclear safety standards. A memorandum of understanding (MOU) defines cooperation between IAEA and ISO in order to avoid duplication of work and create coherence between standards produced by the two organizations.

Let us discuss the four above-mentioned conditions of a sustainable nuclear energy development.

The improvement of safety, security and radiological protection at a very high level has been a constant objective of all stakeholders: the nuclear industry, the national safety authorities, and international agencies and organisations such as the IAEA and ISO.

This has been achieved with the existing power plants through the



permanent improvement of practices, regulations and standards, but also on the basis of national and international research programmes.

The contribution of ISO standards to the safety and effectiveness of nuclear energy is particularly visible in two areas: radiological protection of workers and environment and fuel cycle technology. A number of safety standards have been produced by ISO/TC 85/SC 2, *Radiation protection*, and ISO/TC 85/SC 5, *Nuclear fuel technology*, has produced standards on fuel cycle technology.

SC 2 develops standards on radiological measurements which is a key issue for workers in nuclear plants. SC 5 standards are particularly needed to fix clear references for the industrial market of uranium and fuel.

A new third generation of nuclear power plants is now proposed by the industry, including higher-level specifications for safety and security. This generation of power plants will be able to address the needs of nuclear electricity generation during a large part of the century.

These generation III power plants use the technology of water-cooled reactors, with the benefit of a robust and well-known technology, but with important limitations regarding long-term issues on the two aspects of uranium resources and nuclear waste management.

Natural uranium includes 0,7 % of fissile uranium 235 which is the fuel of generation II and III reactors; these reactors need enrichment facilities which transform natural uranium into two products: uranium 239 (including only residual traces of uranium 235) and enriched uranium including 4 % to 5 % of uranium 235.

The spent fuel of these reactors includes, besides fission products, uranium, plutonium and other actinides in lower quantities. The spent fuel can be stored, partially recycled as mixed oxide (MOX) fuel or treated as waste to be managed in long-term geological storage.

The result is that these reactors need high quantities of fresh uranium from mines and produce important stockpiles of products (– in particular spent fuel on the one hand, and uranium 239 on the other hand) that should be considered as wastes if no other technology is developed.

"The contribution of ISO standards to the safety and effectiveness of nuclear energy is particularly visible in two areas:

radiological protection of workers and environment and fuel cycle technology."

This is a key point of the nuclear energy issue: the present technology of water-cooled reactors can play an important role in the energy mix of the next decades and in the reduction of greenhouse gas emissions during the present century, but this technology cannot be considered sustainable in the long-term.

Innovations

This is why it is important that international collaboration in the nuclear field explores the opportunities of future nuclear technology to sustainable development.

Two international research programmes have been launched: the generation IV programme for fission reactors and the ITER programme for fusion reactors.

Generation IV nuclear power plants might fuel the future for centuries, while power plants based on nuclear fusion, if the ITER project proves feasible, would allow electricity production for thousands of years.

The key objective of the ITER project is to prove the feasibility of energy production based on tokamac type fusion reactors. The tokamak concept is a process in which a hot gas is confined in a torus-shaped vessel using a magnetic field. The gas is heated to over 100 million degrees and will produce 500 MW of fusion power. If the feasibility of fusion reactors is demonstrated by the ITER project, a lot of work will still have to be done before the building of an industrial-scale competitive nuclear power plant: this might occur at the end of the present century.

The objectives of generation IV nuclear power plants and associated fuel cycle facilities are multiple.

The first objective is to reduce the need of uranium: the success of generation III nuclear power plants will lead after a few decades to the depletion of low-cost uranium resources. Generation IV reactors will be able to use almost any cocktail of uranium, plutonium and actinides as a nuclear fuel.

Globally, the energy potential of one ton of natural uranium will be multiplied fiftyfold, and a large fraction of uranium and fuel wastes produced by generation II and III reactors will become valuable resources.

This is related to the second objective of generation IV reactors which is to drastically reduce the volume needed for long-term geological waste storage and to significantly reduce the radiological long-term toxicity of these wastes.

This is also related to the third objective of this generation of reactors which is the reduction of the risks of nuclear weapon proliferation related to the fuel cycle facilities.

About the author

Bernard Sevestre has been Chair of ISO/TC 85 since 2006 and Deputy Director of the Nuclear Activities in the Atomic Energy Research Centre (Commissariat à l'Energie Atomique – CEA) in Saclay, near Paris, since 2005. He worked for 24 years on naval reactors and their fuel cycle, safety and radiation protection. He then focused his professional interest on the safety of research facilities in the CEA.

Over time, knowledge about nuclear science has spread worldwide: the key point related to the prevention of nuclear weapon proliferation is to avoid the access to nuclear material (particularly highly enriched uranium 235 and high isotopic quality plutonium 239).

Generation IV reactors will reduce the need for fuel enrichment facilities and will be able to recycle spent fuel without plutonium separation, which means an important reduction of proliferation risks.

The fourth objective of generation IV reactors is to improve the effectiveness of nuclear energy: higher temperature reactors will permit a better thermodynamic efficiency when producing electricity. This will also offer new opportunities for the industrial use of heat produced by nuclear reactors, alone or in co-generating facilities producing both heat and electricity.

New applications of nuclear energy might include the production of potable water, the transformation of biomass into synthetic fuel and the production of hydrogen, which might be a future polyvalent medium of energy storage and transportation.

As a conclusion, water-cooled reactors offer a robust and safe option for the next decades that will allow the growth of electricity production without any contribution to the greenhouse effect. Future technologies (generation IV reactors, fusion reactors, geological storage of nuclear waste) will address the questions raised by nuclear energy as concerns sustainable development.

In the new context of nuclear energy, two ad hoc working groups were created under ISO/ TC 85/SC 6, *Reactor technology*, in June 2006 to explore the new and future needs of International Standards in the field of nuclear reactors and fuel cycle facilities, including generation III and IV perspectives and the needs related to international research programmes.

Nuclear energy has the potential to become a key contributor to a future sustainable energy mix; ISO has its part to play in this story, and shall contribute to make it a success story. ■

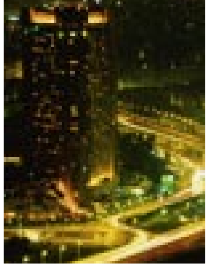
Building environment design: Building performance sustainability, and energy efficiency

By Stephen Turner, Chair of ISO/TC 205, Building environment design

ISO/TC 205 standards address the myriad aspects of building design that help determine the quality of the indoor environment. These aspects of the design process and their seminal influence on building performance are intricately related to overall sustainability in buildings. The Brundtland Commission[1)] of the United Nations stated that development of the built environment is sustainable "…if it meets the needs of the present without compromising the ability of future generations to meet their own needs."[2)] Given

1) In 1987, the World Commission on Environment and Development published a report which came to be known as the "Brundtland Report". It presented the concept of global sustainable development, with guiding principles for sustainable development as it is known today.

2) ASHRAE 2003. ASHRAE GreenGuide. Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.



the profound impact of buildings on the external environment, ISO/TC 205's standardization work is inextricably linked to sustainability.

The unique opportunity afforded ISO/TC 205 is the integrated treatment of these diverse aspects of building environment design. The various aspects of building environment design are often standardized at the national level in disparate technical committees and standards. TC 205 has the opportunity to deliver a coherent family of standards in several closely related sub-disciplines that respect these sub-disciplines while exploring their interrelatedness.

A rich treatment of the subject matter is ensured by broad and diverse participation in the work of ISO/TC 205. With 21 participating P members and 24 observing O members, global participation is ensuring globally relevant standards.

About the author

Stephen Turner is the Chair of ISO/TC 205, *Building environment design,* serving from 2005 to 2007. In the USA, he chairs the committee for the American National Standards Institute and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ANSI/ASHRAE) Standard 55: 2004, *Thermal environmental conditions for human occupancy*, and is the Vice-Chair of the Rhode Island State Building Code Commission. He specializes in building commissioning, sustainable buildings and campuses, and indoor air quality as Managing Director of the Northeast USA regional office of CTG Energetics, Inc., a division of Constructive Technologies Group, Inc., based in Irvine, California.

The work of ISO/TC 205 recognizes that architectural engineering cannot be undertaken separately from the overall design of buildings. The system of standards under development integrates multiple engineering sub-disciplines and vertically integrates architectural engineering with the entire building design process. With the standards developed by ISO/TC 205 providing the proper framework, the results of this integration can be built environments that respect the greater environment and provide safe and comfortable indoor environments.

The three i's in sustainability

ISO/TC 205 is seeking to standardize building environment design, including several aspects of sustainability and environmental responsibility. Its working group WG 1, *General Principles*, published its design process standard this year as ISO 16813:2006, *Building environment design — Indoor environment — General principles.*

This process standard defines *interactive, iterative* design stages to target and achieve *integrated* performance targets. The italicized words are the three "i's" in susta**i**nab**i**l**i**ty. The process in *General Principles* is interactive to allow the many design goals, constraints, and factors to come together at the appropriate balance point for each project. Each stage of the design process is iterative. The check step called for at the end of each design stage ensures that all design targets are met.

Failure to achieve targets – whether energy efficiency, resource use, controllability, or indoor environmental metrics – require the project design team to reconsider in order to meet all targets before proceeding to the next design stage. The process integrates the many interactive facets of indoor environment design to ensure that, for example, good energy performance is not achieved at the expense of comfortable and productive indoor environment for the building occupants.

Recent plenary meetings

The plenary meetings of ISO/TC 205 continue to inform and focus the committee's work. When the *Association Française de Normalisation* hosted our 2006 meetings in Saint Denis, their gracious hospitality included a visit to the exquisite Musée d'Orsay, the showcase for France's consummate impressionist holdings. This 19th century train

station was painstakingly transformed in the 1980s by a team including the Milanese architect, Gae Aulenti, and ACT, the French firm of Mr. Bardon, Mr. Colboc and Mr. Philippon.

In this brilliantly adapted venue, Mr. Michel Clément, Directeur at the *Direction de l'Architecture et du Patrimoine, Ministère de la Culture et de la Communication*, challenged ISO/TC 205 to extend our engagement with sustainability issues by specifically addressing adaptive reuse in building environment design standards.

As efforts to ameliorate the environmental impacts of new buildings mature in the 21st century, the transition from mitigative to regenerative approaches will engender the need for building environment design standards that embrace adaptive reuse. What better way to minimize the environmental impacts of creating space for human use than to optimally utilize already built space?

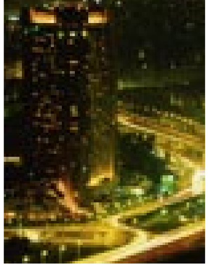
When the Korean Agency for Technology and Standards hosted our meeting in 2005 in Seoul, Korea, Mr. Kisung Cho, Director General of the Department of Safety and Service Standards, told us the story of restoring the Cheonggyecheon, a river in downtown Seoul, after decades of being covered by urban streets. There is a recently uncovered urban river in Providence, Rhode Island, USA, the birthplace of the American industrial revolution and my home today. Having realized the consequences of inattention to nature, two cities on opposite sides of the world have recently undertaken redress. The restored rivers ran through our conversations as poignant examples of correct action with respect to the environment.

Captions (page 19, bottom right, and page 20 below) – *Musée d'Orsay, 19th century train station, adapted for re-use in the 1980s.*

(Left) ISO/TC 205 members at the reception in the Musée d'Orsay.

(Right) ISO/TC 205 members tour the Musée d'Orsay.

"To help assure global prosperity in the future, the impact of the built environment on the greater environment must be minimized, neutralized, or, ideally, made positive in projects that provide safe, comfortable and productive indoor environments."



What powerful metaphors have arisen from our recent meetings for architectural engineering where sustainability is an essential goal ! To help assure global prosperity in the future, the impact of the built environment on the greater environment must be minimized, neutralized, or, ideally, made positive in projects that provide safe, comfortable and productive indoor environments. Energy efficiency alone is not a worthy goal if it results in dissatisfied and unproductive occupants. Instead of buildings that attempt to suppress and overcome nature, why not design buildings that integrate with the environment, on every possible level ?

"Recent progress in member countries shows that reductions of one-third in energy intensity are achievable today with readily available technology and without undue capital investment."

At the 2006 plenary, a new work item was proposed to develop a methodology for assessing the overall energy and environmental impact of building projects using a holistic approach. If successfully adopted, this will mark an important incorporation of sustainability criteria into the family of ISO standards specific to the built environment.

ISO/TC 205 will be hosted by the Egyptian Organization for Standardization and Quality from November 11-13, 2007 in Cairo. In October 2008, the Dutch Building Services Research Institute (ISSO) will host ISO/TC 205 in Delft in the Netherlands. What influence will this have on the future direction of the committee and its work ?

The international standardization work of ISO/TC 205 seeks to lower trade barriers for engineering design and to promote and facilitate the design of high-performance buildings : higher performing as economic assets for their owners, higher performing as buildings that provide amenable indoor environment for their occupants, and higher performing with respect to resource utilization and environmental impact.

About ISO/TC 205, *Building environment design*

There are 21 participating countries and 24 observing countries in ISO/TC 205. The Secretariat is held by the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., on behalf of the American National Standards Institute (ANSI). International liaisons are established with the International Commission on Illumination (CIE), the European Insulation Manufacturers Association (EURIMA), and the World Health Organization (WHO), as well as numerous ISO and CEN technical committees. The Chair can be reached at **sturner@ctgenergetics.com**, the Secretary, Mr. Douglas Tucker at **dtucker@ashrae.org**.

ISO/TC 205 is organized into six active working groups, with two additional task groups evaluating future work items. Truly an international effort, the convenorships are distributed amongst Australia, Egypt, the Republic of Korea, the United Kingdom and the USA.

Energy use in buildings

Working group WG 2, *Design of energy-efficient buildings*, has a significant and growing group of standards intended to build on the important work done in Europe by the European Performance of Buildings Mandate pursuant to the Kyoto Protocol, and in the USA on national energy standards. Each year, buildings in the USA consume one-third of all energy and two-thirds of the electricity produced. WG 2 is squarely addressing this significant aspect of buildings' impact on the environment. Recent progress in member countries shows that reductions of one-third in energy intensity are achievable today with readily available technology and without undue capital investment[3]. Using the WG 1 framework, TC 205 provides standards that allow such achievements while helping to ensure the quality of the indoor environment for building occupants.

Building control systems

Working group WG 3, *Building control system design*, has published to date several parts of a planned seven-part ISO 16484 series of standards on building automation and control systems. Together these standards provide an important unified framework for interoperable controls in buildings. Such systems are credited with the ability to deliver 15 % savings in energy consumption in buildings, independent of individual component efficiency.

3) ASHRAE 2004. *Advanced Energy Design Guide For Small Office Buildings*. Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

Indoor air quality

Working group WG 4, *Indoor air quality*, has approved its draft standard on designing for indoor air quality for registration at inquiry stage. This work represents a monumental effort by participating experts to create a meaningful framework for addressing indoor air quality. By assimilating the leading standards from around the world, this standard will allow universal application but respects the wide range of local practice and societal norms. Liaison with the World Health Organization (WHO) helps this working group address the profound implications of indoor air quality on the well-being of building occupants. In conjunction with the general principles process, this document will help building designers ensure that energy and resource efficiency measures do not preclude occupant comfort and productivity.

Thermal, acoustic and visual indoor environment

In Working Groups 5, 6, and 7, thermal, acoustic and visual indoor environment design work items are being carefully considered in close liaison with other ISO/TCs and the International Commission on Illumination (CIE).

As the family of standards developed in ISO/TC 205 grows, the tools available to designers improve. For countries wishing to adopt international standards that build on the extensive available national and regional standards, this growing kit of building environment design standards is a valuable resource which promotes optimal indoor environments whilst respecting the greater environment. To safeguard a sustainable future, international collaboration is essential. Hence, ISO/TC 205 welcomes increased participation and encourages countries not yet involved to contact the chair or secretary for more information. ■

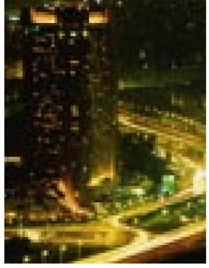
ISO gears wind power into the future

by William A. Bradley III, Vice President of the American Gear Manufacturers Association (AGMA) Technical Division

Wind power is the fastest growing renewable energy source, with an average addition of over 10 000 Megawatts (MW) worldwide for each of the last two years. This represents over a 20 % increase each year. In 2005, wind energy cost one-fifth as much as it did in the late 1990s, and the downward trend is expected to continue with larger turbines being mass-produced. Over 40 countries worldwide increased their capacity to generate electricity by wind power last year. See the tables *(page 23)* for operational wind turbine capacity.

"The future is very bright for the wind turbine industry."

Germany, as one of the leaders in the manufacturing of wind turbine components, currently has about 16 000 turbines installed. Germany is the leading producer of wind power with 28 % of the total world capacity in 2006, which is 7 % of German electricity consumption. A report from Deutsche Energie-Agentur (DENA) indicated a goal of 15 % electricity consumption from wind power is feasible by 2015 without technical or economic barriers. Denmark did not have an increase in capacity last year; however their installed turbines could cover 50 % of the Danish consumption. Their turbines do generate 20 % of Denmark's electricity consumption, which makes it a world leader. The remaining production is sold to other countries.




Spain is next, presently producing 9 % of its consumed electricity by wind power and has the goal to double its capacity by 2012. Although, worldwide less than 1 % of the consumed electricity is produced by wind power, it is becoming more competitive each year.

More consumable wind power

Up until a few years ago most wind turbines were less than 1 MW in capacity. Many units were set up in wind farms and required government subsidies to be practical for generating enough power for consumption. Presently wind turbines between 1,5 and 2,5 MW are commonly being produced and Germany has installed three in the 4,5 to 5 MW range. The economies of larger scale are making it more feasible as an alternative power source, especially being "renewable".

The trend of using more wind power in the energy mix will continue, as larger units become available. European renewable energy agencies are calling for an annual EU research and development budget of EUR 250 million, part of which is to explore increasing turbine sizes between 8 to 10 MW by 2010.

The wind turbine industry is one of the, if not the most, demanding applications for mechanical-electrical systems. It requires relatively small compact high power density gear drives and electric generators to transmit fluctuating loads in a very demanding environment of high vibration and extremes of temperatures.

Today, what has evolved into a commonly produced wind turbine design includes : a very large three bladed, variable pitch, low speed propeller (70 to 104 meters diameter) ; a multistage gearbox to transmit the power and increase speed for efficient generation; an advance electrical generator to produce 50 or 60 cycle power at 1 500 to 1 800 rpm ; all housed on

"There is an increasing demand for wind power as a viable renewable energy source."

OPERATIONAL WIND TURBINE CAPACITY

LOCATION		Percent increase in 2006 (%)	Capacity at start of 2007 (megawatts)
Worldwide		25,3	73 904
Europe		19,2	48 545
1	Germany	11,9	20 622
2	Spain	15,8	11 615
3	USA	26,8	11 603
4	India	41,5	6 270
5	Denmark	0,3	3 136
6	China	90,9	2 405
7	Italy	23,6	2 123
8	UK	45,1	1 936
9	Portugal	61,4	1 650
10	France	106,9	1 567

top of a tower over 80 to 100 meters above land or sea. The objective is to have the system operate with low maintenance for over 20 years.

There was a recognized need to have an International Standard for the design and specification of wind turbine gearboxes, particularly when some designs demonstrated that they were inadequate for the required service. Many of the 600 kW and larger gearboxes experienced bearing and gear failures within the first couple of service years, which seriously detracted from the availability of consumable power generated by wind turbines.

Combining expertise

The ISO technical committee that covers this area of expertise has been ISO/TC 60, *Gears*. However, existing standards for wind turbines had been developed within IEC/TC 88, *Wind turbines*. The IEC standards cover the loading and system performance specifications.

A new work item was proposed by IEC/TC 88 in 2003, specifically for gearboxes. However, many members of ISO and IEC had already been involved in the development of a standard for design and specification of gearboxes for wind power generation i.e., The American National Standards Institute (ANSI), American Gear Manufacturers (AGMA) and the American Wind Energy Association (AWEA), which have developed an American National Standard, ANSI/AGMA/AWEA 6006-A03.

After discussion between ISO and IEC, it was decided to combine the expertise into a Joint Working Group (JWG) between ISO/TC 60 and IEC/TC 88, *Wind turbines,* for the development of an international standard for wind turbine gearboxes.

"It appears that wind power will continue to be the fastest growing in this sector with the present ability to add over 10 000 Megawatts worldwide every year."

The first JWG meeting was attended by 45 people representing ISO, IEC and their Central Secretariats in May 2004. It was agreed to produce one standard that would have both ISO and IEC designations. The JWG completely reviewed a proposed outline of the standard and after discussion of the content and because of the need internationally, it was recommended that the American National Standard, ANSI/AGMA/AWEA 6006-A03, should be fast tracked as a first edition. The JWG would also develop a second edition to extend the document for larger sizes and additional commissioning requirements.

The "fast tracked", ISO 81400-4, *Wind turbine generator systems – Part 4 : Gearboxes for turbines from 40 kW to 2 MW and larger*, is a landmark standard that provides information on specifying, selecting, designing, manufacturing, procuring, operating and monitoring reliable speed increasing gearboxes for wind turbine generator system service. The AGMA committee responsible for its development was made up of gear manufacturers, users, consultants, bearing manufacturers, and lubricant system suppliers from around the world who brought many years of experience with this application to the table. Many of these individual experts are now members of the JWG. As of the writing of this article, the ISO/IEC JWG has been working on a revised international standard to meet the demands of the larger drive systems.

"Germany is the leading producer of wind power with 28% of the total world capacity in 2005, which is 8% of German electricity consumption."

The future is very bright for the wind turbine industry. There is an increasing demand for wind power as a viable renewable energy source. It appears that wind power will continue to be the fastest growing in this sector with the present ability to add over 10 000 Megawatts worldwide every year. As the average size of each wind turbine increases, the economies of scale will make it more feasible for countries to generate electricity by wind power. There is a consolidated effort to make the drive systems reliable for many years of service. The JWG plans to supply the expertise of both ISO and IEC members to develop timely standards to assist this industry's growth.

About the author

William A. Bradley III is presently Vice President of the American Gear Manufacturers Association (AGMA) Technical Division, responsible for facilitating national and International Standards development, technical meetings, seminars and division operations.

His experience includes over four decades in the gear industry, including 24 years in manufacturing power transmission products. Involved in ISO standardization since 1979, he is presently Secretary of ISO/TC 60, *Gears*, a working group Convenor, and Administrator of the ANSI Technical Advisory Group to ISO for TC 60. Most recently, William A. Bradley III has been elected President of the Board of Directors for the Gear Research of the Institute of American Society of Mechanical Engineers (ASME) and AGMA.

© Baxi Commercial Heating

DACHS mini-Combined Heat & Power (CHP) unit at Royal Court, a residential care home in Cheltenham supplied by Bax-Senertec UK, a Baxi Group company.

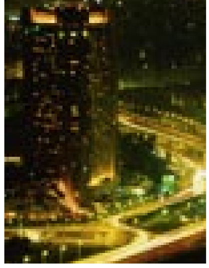
Building for energy efficiency

by Yan Evans, Technical Director, Baxi Commercial Heating

Building regulations, legislation, planning consent and environmental policies and strategies born out of the British Government's 2003 Energy White Paper are driving architects, builders and end users in the United Kingdom to consider low carbon and renewable energy solutions, often referred to as LZC (low- and zero-carbon) technologies, in domestic, residential and commercial properties.

Some local authorities have already introduced planning requirements stipulating that at least 10 % to 15 % of the energy required for a new build property with floor space of 1 000 m^2 and above is derived from renewable sources.

This could include the use of solar collectors for heating hot water,



ground source heat pumps and biomass boilers for space heating, and renewable products that generate electricity such as photovoltaic panels and wind turbines.

Increasing demand is being placed on the building industry to deliver solutions minimizing the carbon footprint of a property. Looking at the situation in the United Kingdom, this article outlines two LZC technologies that have a major role to play in reducing carbon dioxide emissions and how standards contribute to 'fuelling the future'.

Solar hot water heating

The laws of physics determine how far we can improve the efficiency of commercial heating appliances, whether these are boilers or direct-fired water heaters.

Legislation and building regulations in the United Kingdom continue to drive manufacturers to develop products with higher efficiency – the best condensing boiler products on the market are already capable of delivering efficiencies of up to 92 % (based on the gross calorific value of the fuel).

Looking at the broader picture of the building, improved insulation

"Standards have an important role to play in ensuring that products and solutions are developed to deliver beneficial carbon savings."

and better controls can also significantly impact the energy efficiency of a building. But we still need to further reduce fuel consumption and thus reduce the carbon footprint.

Solar thermal solutions harness the energy of the sun for heating hot water. Roof-mounted solar collectors with high transmission and absorption capacities capture energy from the sun, passing the heat into a transfer fluid which, when pumped through a coil of a cylinder, heats the stored water. Solar panels are normally used for heating domestic hot water as during the warmer summer periods when maximum solar irradiation is available, there is little or no need for space heating.

ISO has published a number of standards on solar energy, which include calibration instruments, terminology, the light transmittance of glass, as well as standards on solar-powered water heating systems.

Direct-fired storage water heaters require fuel to raise the temperature of the incoming cold water supply (typically 10°C) to a water temperature of say 60°C to ensure that the stored water is hot enough for use at the outlet and to destroy any legionella bacteria. Solar panels can be used to pre-heat the cold water supply to the heater so that less energy and therefore less fuel is required to raise the water temperature to the desired 60°C.

"Improved insulation and better controls can also significantly impact the energy efficiency of a building."

In the summer months with enough sunshine, the solar collectors may be able to heat the cold water supply to temperatures of up to 80°C, so that the water heater could be bypassed with the solar-heated water flowing directly to the outlets. A thermostatic mixing valve is used to reduce the water temperature and avoid scalding.

Whether pre-heating the cold water feed to the direct-fired water heater or heating the cylinder to full temperature, solar energy can significantly reduce CO_2 emissions – approximately 100 kg CO_2/m^2 of collector array annually when compared with natural gas which in the United Kingdom has a CO_2 emission factor of 0,19 kg CO_2/kWh (source: Department of Trade and Industry).

Solar energy can also be used with commercial boilers to reduce carbon emissions and the latter would only fire up during periods of low solar gain or when high water temperature recovery rates are required.

Glazed flat plate solar collector for hot water heating – the product is supplied by Greenonetec in Austria.

Solar thermal systems have been available for around 30 years in the United Kingdom and there are, for example, British Standards for solar collectors. The standard [BS EN12975-1:2006] stipulates the general requirements with regard to reliability, durability (including mechanical strength) and safety for factory-made liquid solar collector modules. Part 2 of this specification defines the test methods for such collectors.

These specifications are applied in marking solar collectors, in which the collector has to be key marked according to BS EN 12975 which evaluates the optical and thermal performance of the product.

The Low-Carbon Building Programme (LCBP)

The Department of Trade and Industry launched a three-year initiative, the Low-Carbon Building Programme (LCBP), in April 2006 with a budget of GBP 30 million to support the uptake of low-carbon and renewable technologies in both the public and private sector.

In order for a particular solar thermal collector to be registered under the LCBP it has to be marked according to the standard BS EN 12975. Standards are therefore also used to help qualify products for funding from the British Government, thus contributing to carbon savings.

Combined heat and power

Combined heat and power (CHP) has a wide array of applications. Historically, the use of CHP products was limited to relatively large buildings and sites with significant energy demands, such as hospitals, hotels, leisure centres and processing plants. But more recently, CHP units with smaller outputs have emerged on the market.

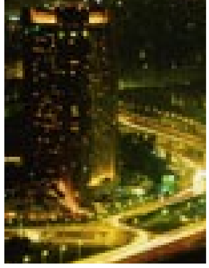
Products with an electrical output as low as around 5 kWe and a heat output of around 13 kWth are now commercially available, although these products have been operating successfully in Europe for many years, making the technology more accessible to a wider number of users for smaller residential and commercial properties.

In simple terms, a CHP unit generates electricity from a single fuel, such as natural gas, LPG, oil or a bio-fuel, and uses the heat produced as thermal energy for space or water heating or for industrial processes.

In conventional centralized power generation, this heat would normally be directed into cooling towers, discharged into the atmosphere and wasted, leading to low overall plant efficiencies of around 40 % to 50 %.

CHP offers energy cost savings and a significant reduction in CO_2 emissions, with some units capable of delivering overall fuel efficiencies of up to 90 % (based on the gross calorific value of the fuel). Compared to electricity generated from a centralized power station and the use of conventional heat boilers, a 30 % reduction in primary energy use can be achieved.

Whereas typical thermal efficiencies of CHP products are in the region of around 40 % to 50 % – clearly much lower than the fuel efficiencies achievable from modern commercial condensing boiler and water heater technology – the economic and environmental benefits result from the electricity being generated at the point of use, thus avoiding loss through the transmission and distribution network.



Based on the current mix of power generation in the United Kingdom, gas, coal, nuclear, Combined Cycle Gas Turbines (CCGT) with a CO_2 emission index of 0,43kg CO_2/kWh of electricity generated, CHP products can offer a reduction of up 30 % in energy use. Indicatively, the ratio between the electrical output of the CHP unit and the savings in tonnes of CO_2 emissions per annum is 1:1, i.e. a CHP unit with an electrical output of say 5kWe would save around five tonnes of CO_2 per annum. This calculation is based on an operating regime of 17 hours a day, 365 days and 90 % availability with running hours of 5 585 annually – typical for applications in residential (non-domestic) and light commercial applications.

About the author

Yan Evans is Technical Director for Baxi Commercial Heating, where he currently leads the development of renewable technologies. Responsible for the Andrews Water Heaters, Baxi Commercial and Potterton Commercial ranges of water heaters and boilers, he has worked in the energy industry for the past 15 years and has extensive experience of the United Kingdom combined heat and power market.

Holding an Honours Degree in Electromechanical Engineering, Yan Evans is registered as a Chartered Engineer in the United Kingdom and Europe.

A member of the Institute of Engineering & Technology, the Energy Institute and the Chartered Institute of Building Services Engineers, he is also involved with the Direct-Fired Water Heater Group of the Industrial & Commercial Energy Association (ICOM) in the United Kingdom on the improvement and development of industry standards.

For smaller CHP installations (i.e. with an electrical output of up to say 30 kWe), where there is a huge opportunity for replication across both residential and commercial markets, the cumulative benefits in reducing carbon emissions could be significant.

CHP is generally best suited to applications that require the simultaneous need for heating, hot water and electricity over extended operating hours, typically 5 000 to 6 000 hours per annum.

Smaller CHP units are usually driven by a combustion engine that uses the water returning from the property's heating system as a cooling medium for engine components, with additional heat recovery from the exhaust.

They should be sized correctly according to the demand in order to maximize the annual running hours and deliver the maximum economic and environmental benefits. Heat demand required above the output of the CHP unit would be provided by an additional boiler plant.

Similarly, the CHP product should be selected on the basis of the demand in order to minimize "spilling" of electricity to the grid, as there is currently no economic benefit in doing so in the United Kingdom. Electricity required above the output of the CHP unit would be imported from the grid as normal.

The Carbon Trust has a project evaluating micro-CHP technologies (with an electrical output of up to around 50 kW, defined in accordance with the European Cogeneration Directive).

Their carbon performance is compared with condensing boilers and used to determine the true carbon-saving potential of the technology on a per site basis and, if appropriate, on a cumulative nation-wide basis if installations were to be replicated.

Applications include houses and residential properties such as sheltered accommodation, social housing developments and nursing homes.

In parallel with the Carbon Trust activities, PAS 67 (Publicly Available Specification), is under development and will eventually become a British Standard. This specification defines the performance and testing criteria for micro-CHP.

With all forms of LZC technologies, the choice of the product for the application is the key to the success of the installation, as certain products and solutions are better suited to some applications than others.

The other critical success factor is control of the technology, which of course would equally apply to non-LZC technologies, such as boilers and water heaters. It does not matter how efficient the product is or how well it has been integrated into the building's systems, unless the appliance is controlled appropriately, the efficiency and carbon reduction benefits can be easily lost.

Low-carbon and renewable technologies have an important role to play in "fuelling the future", helping to improve the energy efficiency of our buildings and to significantly reduce the United Kingdom's carbon footprint.

As an industry, whether we are the end user, architect, developer, builder or product supplier, we all have a role to play in promoting the benefits of LZC technologies and ensuring they are applied, installed and operated to deliver optimal carbon-reducing benefits.

Standards have an important role to play in ensuring that the products and solutions are developed, designed and tested appropriately to guarantee that LZC technologies deliver beneficial carbon savings.

They also have a key role in performance benchmarking to support funding programmes, which in turn, will encourage the uptake of technologies such as solar thermal and CHP.

This will help develop the market for new and emerging technologies in order to reduce the carbon emissions that contribute to climate change. ■

New horizons for **biofuels** in Brazil

by Rosângela Moreira de Araujo

The effects of global warming have been observed in the melting of glaciers, an increase in intensity and frequency of hurricanes, hotter summers and more frequent floods. Compared to developed countries, Brazil displays low emissions levels of the greenhouse gases responsible for global warming. Even though its emissions are lower than developed countries, Brazil nonetheless continues to try to reduce its greenhouse gas emissions even further and it is second globally in the number of registered projects under the Clean Development Mechanism of the Kyoto Protocol.

To reinforce even more its commitment to reducing carbon emissions, Brazil's national emissions limits have become stricter, and specific control programmes for car emissions have been implemented and Brazil has also become a leader in biofuels.

Climate change makes the diversification of the world energy mix urgent. Here Brazil plays a relevant role, as can be observed in the Brazilian energy matrix **Figure 1**, which already shows a striking amount of renewable resources in Brazil's energy use, with 43.6 % of the energy use made up of hydroelectricity and biomass.

With an already high amount of renewable resources in Brazil's energy matrix, new energy policies have been conceived introducing biodiesel fuels and enhancing the potential of alcohol fuel production in Brazil, targeting both the domestic and international markets, thus increasing the use of renewable resources even further.

Nevertheless, the acceptance of a fuel in the market depends on several aspects, of which the transparency and trustworthiness of the product in the market is an important factor. That acceptance depends on an essential point: standardization.

Good standardization has a number of features: definition of the product specification, quality control for commercialization, which, in turn,

Above – *Ethanol plant of Vertente*
Source: Copersucar

Right – top
Castor bean
www.cdcc.sc.usp.br

Right – bottom
Sunflower biofuel
www.revistaalcoolbras.com.br

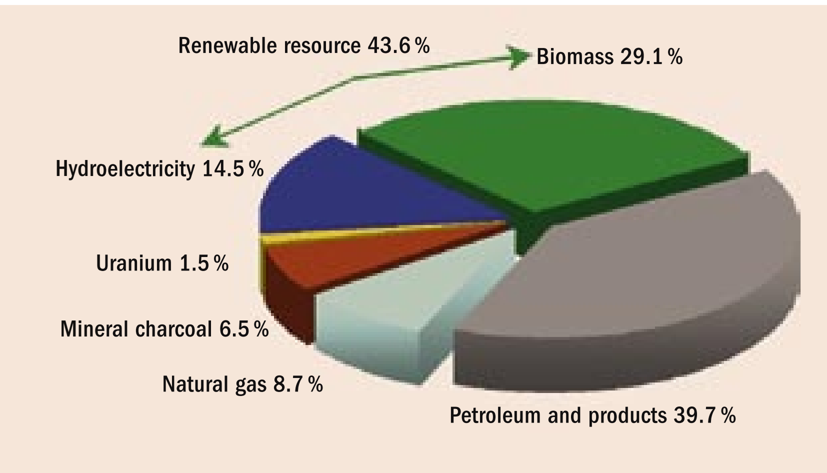


Figure 1 – *Brazil's energy matrix, 2005*

Castor bean Source : Petrobras

requires structural and technical ability and also analytical and metrological competence of laboratories.

Product specification is essential in the fuel market and it is seen as a main condition for communication among the players in its commercialization.

About the author

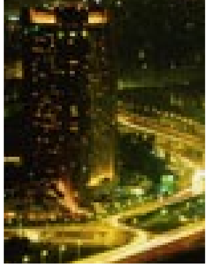
Rosângela Moreira de Araujo holds degrees in chemical engineering and is specialized in regulations for petroleum and natural gas. She is a member of the Biofuels Technical Committee in the Brazilian Association of Technical Standards (ABNT), joined the Fuels Quality Products Management in 1998 and in 2005 became the Coordinator of the Biofuels Quality Group in the Brazilian National Agency of Petroleum, Natural Gas and Biofuels (ANP).

Additionally, according to the World Trade Organization's Technical Barriers to Trade Agreement (WTO TBT), the principles which must be identified are : transparence, openness, relevance, coherence, impartiality, consensus and consideration of the concerns from developing countries.

Regulation and standardization

As the regulatory body for fuels, the Brazilian National Agency of Petroleum, Natural Gas and Biofuels (ANP) defines the structure of the commercial chain, as well as specifying fuel quality.

The ANP strives to enable the expansion of the industrial sector, handling biodiesel and ethanol by developing specifications through discussions with fuel producers, suppliers and engine manufactures. Where possible, these should also be in accordance with society's needs concerning environmental and consumer interests, as well as the economic situation of Brazil.



Standards are set at national level in Brazil by the Brazilian Association of Technical Standards (ABNT), where a diverse range of industries come together with the government, academia and the general public. ABNT plays an essential role in the information infrastructure guiding industry and trade in Brazil's economy.

ABNT's standardization processes can be characterized by : planning, drafting, public enquiry and, after a broad consensus is reached, publication of the final document, which becomes mandatory when referenced in regulations.

Sugar cane

In 2004, a technical committee for biofuels was established in Brazil with two working groups, one for ethanol and another for biodiesel to develop test methods and procedures, to review existing test methods and to keep updated on new developments in the field of biofuels.

The ethanol industry

Ethanol contributed to Brazil's achievement of a global benchmark in the use of biofuels in the 1970s, after the country launched the largest automotive fossil fuel substitution programme in the world: the Brazilian National Alcohol Programme (PROÁLCOOL).

Ethanol plant. Source: Copersucar

In 1979, a new blend was created: gasoline plus 20 % anhydrous ethanol. Gasoline vehicles were converted to be able to run with pure hydrated ethanol. Nowadays, anhydrous ethanol added to gasoline has been fixed at between 20 and 25 %, depending on ethanol production.

Currently, more than 350 plants produce approximately 18 million cubic meters of ethanol, of which more than 90 % have a domestic market, but there are ongoing investments to double this capacity by 2014.

In the Brazilian market, there are two kinds of ethanol:

- anhydrous ethanol blended with gasoline;
- hydrated ethanol, which supplies both the ethanol fleet and the flex fuel fleet. The flex fuel fleet can use anhydrous ethanol blended with gasoline, as well as any other blend of these fuels.

The entrance of flex vehicles in the market took place in 2003 and currently consists of more than 80 % of domestic sales of light vehicles.

Ethanol plant of Moema. Source: Copersucar

Table 1 – *Brazilian ethanol specifications.*

Notes:

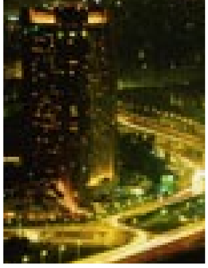
1) Orange dye must be added to anhydrous ethanol.

2) For importation and distribution the density limits are 805.0-811.0.

3) For importation and distribution the alcohol limits are 92.6-94.7.

4) Importation and distribution specification.

Property	Anhydrous ethanol	Hydrated ethanol	Test method	
			ABNT NBR	ASTM
Appearance	Clear and free of suspended impurities		Visual	
Colour	Colourless 1)		Visual	
Total acidity as acetic acid, max, mg/L	30		9866	D 1613
Electrical conductivity, max, µS/m	500		10547	D 1125
Density at 20 °C, max, kg/m³	791,5	807,6 – 811,0 2)	5992	D 4052
Alcohol content, min, °INPM	99,3	92,6 – 93,8 3)	5992	–
pH	–	6 – 8	10891	–
Evaporative residue 4), max, mg/100 mL	–	5	8644	–
Hydrocarbon content 4), max, vol. %	3,0		13993	
Chlorides 4), max, mg/kg	–	1	10894/10895	D 512
Ethanol content, min, % vol.	99,6	95,1	–	D 5501
Sulphate, max, mg/kg	–	4	10894/12120	–
Fe, max, mg/kg	–	5	11331	–
Na, max, mg/kg	–	2	10422	–
Cu, max, mg/kg	0,07	–	10893	–



Property	LIMIT	Test method		
		ABNT NBR	ASTM D	EN/EN ISO
Appearance	Clear and free of suspended impurities	Visual		
Density at 20 °C, max, kg/m^3	Report [2)]	7148 14065	1298 4052	–
Flash point, min, °C	100	14598	93	– 3679
Water and sediment, max. vol. %	0,05	–	2709	–
Viscosity at 40 °C, mm^2/s	Report [2)]	10441	445	3104
Sulphated ash, mass %, max.	0,02	9842	874	3987
Copper corrosion (3h at 50 °C), max.	1	14539	130	2160
CFPP, °C	(2)	14747	6371	–
Distillation T90, °C, max.	360	1160	–	–
CCR 100 %, mass %, max.	0,10	–	4530 189	10370
Acid number mgKOH/g, max.	0,80	14448	664	– 14104
Methanol or Ethanol mass %, max.	0,5	15343	–	14110
Free glycerin, mass % max.	0,02	15341	6584	– 14105/6
Total glycerin, mass % max.	0,38	15342	6584	– 14105
Na + K mg/kg, max.	10	–	–	14108 14109
Oxidation stability at 110 °C, h, min.	6	–	–	14112

Note:

1) Additional analyses must be reported by the producer: total contamination, ester content, total sulphur, Ca+Mg, P, mono-glycerides, di-glycerides and triglycerides must be analysed per producer for the purpose of having a data bank.

2) The density and viscosity of pure biodiesel must be reported and meet B2 limits blended to diesel, B2.

Table 2 – *Brazilian biodiesel specifications.* [1)]

Brazil has gone through the learning curve of production, trade and use of ethanol, so that tests developed by the government and the automotive and petroleum industries for assessment has allowed the introduction of modifications in the specifications, which were first derived and adapted from pharmaceutical specifications.

Nowadays, ethanol specifications established in Resolution ANP n° 36/2005, as presented in **Table 1**, include all relevant properties adopted for optimum engine performance.

With regards to export, the different specifications set forth in contracts by customers may include additional analyses in product certification. It must be emphasized that some of these specifications were developed for non-fuel objectives and others were tested, but not with internationally standardized test methods.

In the case of references to ASTM specifications in a contract, whose basis is anhydrous denatured fuel ethanol based on corn, the exporter must conduct additional analyses.

However, some of these are unnecessary for Brazilian products, mainly due to high levels of pureness (99,3 % minimum of ethanol) of anhydrous alcohol based on sugarcane without denaturant addition.

The biodiesel industry

In 2004, the Brazilian Government authorized the commercial use of biodiesel implementing its National Biodiesel Programme, which meets the specific characteristics of each region for oilseed biofuels.

This programme set the target of introducing biodiesel into the market in order to decrease dependency on foreign diesel, promote social development through creating job opportunities, and increase regional development.

The initial priority set for the programme was to blend with automotive diesel, 2 % of biodiesel in 2005. This level will be mandatory nationwide in 2008 and will increase to 5 % in 2013.

In 2004, Resolution ANP n° 42/04 was issued to regulate quality control and to define the specifications that must be

FUEL	ACTION OF WORKING GROUP (PROPERTY/TEST METHOD)	REMARK
ETHANOL	Acidity (titration) – Review NBR 9866 Electrical Conductivity - Review NBR 10547 pH (Potentiometry) - Review NBR 10891	To be issued
	Density (Glass and Electonic Densimeter) Alcohol content (Cromatography) Chloride and sulphate content (IC) Iron, Copper and Sodium content (AAS)	2007
BIODIESEL	Ester content Mono-/Di-/Triglycerides, Total glycerol Free glycerol Methanol or Ethanol content	Published in 2006 (biodiesel from castorbean)
	(Na+K) content (ICP or AAS) (Ca+Mg) content (ICP) Phosphorus content (ICP) Biodiesel Content (IR) Procedure for handling biodiesel (storage, transport and distribution and quality management)	2007

Table 3 – *Working plan for ethanol and biodiesel working groups.*

complied with for pure biodiesel, B100, before blending it with diesel fuel in quantities of up to 2 % by volume, B2.

Currently, there are 14 authorized biodiesel plants whose capacity is in the order of 400 million litres per year, but other ongoing investments in development stages can double this capacity in the short term. Most of these plants were designed to use methanol or ethanol and diverse feedstock such as soybeans, castor beans, palm, sunflower, tallow and others.

In Brazilian specifications (**Table 2**, *previous page*), 10 properties must be analysed separately on a quarterly basis (process and feedstock) to provide the data for a database which will provide information for any specification revision.

Additionally, there is a task force with representatives from engine manufacturers, the fuel industry, government and regulators to evaluate the suitability of blends B5 and B20 for use in diesel vehicles. The aim is to technically validate the gradual increase in biodiesel proportion in diesel blending through engine bench tests, durability and effects. The preliminary field tests showed positive results with respect to biodiesel obtained from soybeans or castor beans and ethanol.

Success stories of biofuels

In Brazil, researchers and industry have resolved many key technical issues regarding biofuels such as developing new PETROBRAS processes – one single step for extraction and transesterification of castor bean oil – and HBIO, which is a catalytic hydroconversion of diesel fractions and vegetable oil blends.

The first patent regarding biodiesel and biokerosene was obtained already in the 1980s by Dr. Expedito Parente.

Standards to be developed

As for ethanol, test methods have been developed during the last decades by the ABNT and adopted in Brazilian specifications in addition to the American Society for Testing and Materials (ASTM) test methods.

Concerning biodiesel, most of the test methods adopted in the specifications are ASTM and European Standards (EN)/EN ISO standards. The verification of these methods showed that some existing test methods were not appropriate for biodiesel derived from castor beans.

The first step for the biodiesel working group was to develop specific test methods, as reported in **Table 3** below, which shows the working plan of the ethanol and biodiesel working groups.

Moreover, the need for evaluating suitability of adopted test methods for different biodiesel qualities (raw material, production technology) shall be tested in round robin tests. In addition, the precision data must be defined, not only for some ethanol but also for new biodiesel test methods.

Fuel Quality Monitoring Programme

Fuel quality in Brazil is monitored under the Fuel Quality Monitoring Programme carried out by 23 universities and research centers, which are hired to analyse approximately 150 000 samples yearly. ANP quarterly promotes its interlaboratory programme by means of its own research laboratory – the *Centro de Pesquisas de Análises Tecnológicas* (CPT).

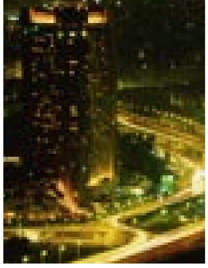
Major challenges

As ethanol and biodiesel fuels are growing industries, this will increase the need for quality, affordable and accurate analyses. Through participation in international technical forums, the developing analytical field will mature. Most Brazilian laboratories are looking for quality systems in ethanol, and for biodiesel it will be a further step.

Also, discussions are underway relative to studies and research developments concerning new test methods and the production of certified reference material.

It is worth noting that the government is fostering innovative processes or products focusing on biofuels by means of allocating funds to different areas like turning cellulosic biomass into ethanol and development of new processes to benefit coproducts obtained from the biodiesel process.

Additional governmental funds will supply analytical equipment for universities and research centres which work on biodiesel research and quality control. Most of these labs will work by means of regional analysis networks and will support the regulatory agency.



Conclusions

The experience Brazil has accumulated through research and use of ethanol fuels has provided infrastructural conditions for the successful implementation of the biodiesel programme allowing Brazil to handle further challenges and maximize the nation's competitiveness in a relatively short period.

In the international scenario, alcohol fuel and biodiesel markets are currently at different stages of maturity. However, there is one point in common between them: the diversity of specifications, resulting from processes associated with specific crops, which can cause problems for international commercialization.

International agreements and decisions concerning trade are increasingly calling for mutual recognition of standards, measurements and tests among nations, which is why ISO standards are so important for providing the international normative framework for biofuels.

Therefore, it is urgent to create an International Biofuels Technical Committee. This committee could prepare a proposal for harmonization of test methods and where possible the characteristic limit of fuels.

This would allow more agility and transparency in future international transactions involving biofuels and would help the decision-making process for regulatory authorities and investors.

Finally, concerning current global energy challenges – energy security, economic and energy growth, climate change, the entrance of renewable fuels into the market – all of these topics play a very important role in the discussion about the global energy supply.

Thus, the standardization of biofuels becomes even more critical as an essential tool for their acceptance as valid products and their maintenance in the market.

These standards can stimulate innovation, accelerate the discovery and transference of biofuel technologies into engine applications and thus help reduce negative impacts on the world's ecosystem. ■

Lifetime performance of buildings

by Dr. Christer Sjöström, Dr. Wolfram Trinius and Dr. Hywel Davies

Buildings and civil engineering works consume considerable resources in all economies to build, operate and use. Besides being the largest single material-consuming industrial sector, construction is also responsible for roughly 46 % of the total energy consumption in the European Union; internationally the figure is commonly reported as 40 %[1].

The environmental impact of this energy demand is considerable: in the United Kingdom, for instance, 46 % of CO_2 emissions originate from buildings[2].

So it is vital to improve the energy performance of buildings and the built environment if we are to achieve sustainable development, whilst ensuring that the buildings perform the functions that the owners, operators and users expect of them.

1) "Built to last, service live planning", *ISO Focus*, Sustainable building, December 2005.

2) Renewable Energy Resources for Buildings, CIBSE TM38:2006, London 2006.

With building replacement rates varying between economies at between 1 % and 4 %, it is obvious that addressing improvements to new buildings and new building design alone is not sufficient.

Strategies for energy optimization in the operation, renovation and refurbishment of existing buildings play an even more important role in striving to significantly reduce the energy demand of the building sector.

The Swedish forum for construction developers/owners has for example agreed that major refurbishments in the building stock must lead to a 50 % increase in the building's energy performance. United Kingdom regulations have recently been extended to cover the renovation and refurbishment of existing commercial buildings.

Smart building design

Research and development projects as well as demonstration projects and best-practice design of buildings display the potential of new and innovative solutions for the supply of buildings with locally available, renewable energy sources.

At the same time, smart building design can dramatically reduce design-energy demand, even to zero in some cases. The combination of smart design with an innovative "sustainable" energy supply has a realistic potential to significantly contribute to moving the building sector towards sustainability.

One potential threat in the application of "sustainable" energy systems in buildings appears to be that these systems' performance as well as the physical conditions of the building must be ensured over time.

Materials and components with properties relevant to energy demand or energetic gains as well as the technical systems providing energy need to be scrutinized for their long-term performance – over the life of the system or even the building.

Only then can it be avoided that small reductions in performance of parts of the system lead to insufficient performance of the whole system, with its associated negative influence on cost performance, as well as environmental performance and reliance on an external back-up provision of energy.

Sustainable building standards

International standardization is addressing these issues. The standards on service life planning (ISO 15686), for instance, address long-term performance of products and systems.

"The combination of smart design with an innovative "sustainable" energy supply has a realistic potential to significantly contribute to moving the building sector towards sustainability."

The developing standards of ISO/TC 59/SC 17, *Sustainability in building construction* [3], and CEN/TC 350, *Sustainability of construction works*, pave the way towards assessing the technical performance of building products in relation to their ability to meet sustainability requirements.

Additionally, the sustainability scope is enlarging from environmental aspects of sustainability [4] towards the inclusion of the non-environmental aspects of sustainability, namely the economic and social aspects.

As the standards developed in ISO/TC 59/SC 14 and SC 17 have a global scope, they are successful in setting out the principles to be followed, but they do not usually establish a detailed application, content and clear rules, as this is very difficult to do on a global scale.

From a European perspective, the SC 14 and SC 17 standards constitute key inputs in the development of CEN standards which must be more specific. At the same time, the CEN standards need to relate to European directives, such as the Construction Products Directive (CPD) [4] or the Energy Performance of Buildings Directive (EPBD) [5].

More practical guidance documents are being published in parallel, either based on international research activities, such as the EU project PRESCO (Practical Recommendations for Sustainable Construction) [6], on the initiative of national governments; one such example is the *German Guideline for Sustainable Building* directed towards the government's own building stock and projects.

Some documents reflect the demands of various actors for information and guidance, such as the guide on renewable energy resources for buildings [7] produced by the Chartered Institution of Building Services Engineers (CIBSE, United Kingdom), or the standard cost structure for life-cycle costs in the United Kingdom.

An upcoming EU project, Smart-ECO [8], will address questions related to the extent to which innovation, both technical and non-technical, can contribute to promoting sustainability in the building sector. The project embraces the EU concept of "Eco-buildings" and relates the ISO/TC 59/ SC 17 and SC 14 standards, as well as the CEN work, to an overall "vision of sustainable building".

That vision will be developed for the project, reflecting stakeholder demands, the state of the art and the current position in international standardization.

Another relevant EU project STAND-INN [9], with participation from non-European countries, addresses standards

3) "Social and economic aspects of building construction", *ISO Focus*, Sustainable building, December 2005

4) *ISO Focus* Environmental sustainability, June 2006

5) CEC, Council Directive of 21 December 1988, 89/106/EEC

6) CEC, Council Directive of 16 December 2002, 2002/91/EC

7) **www.presco.nl**

8) **www.smart-eco.eu**

9) **www.europe-innova.org**

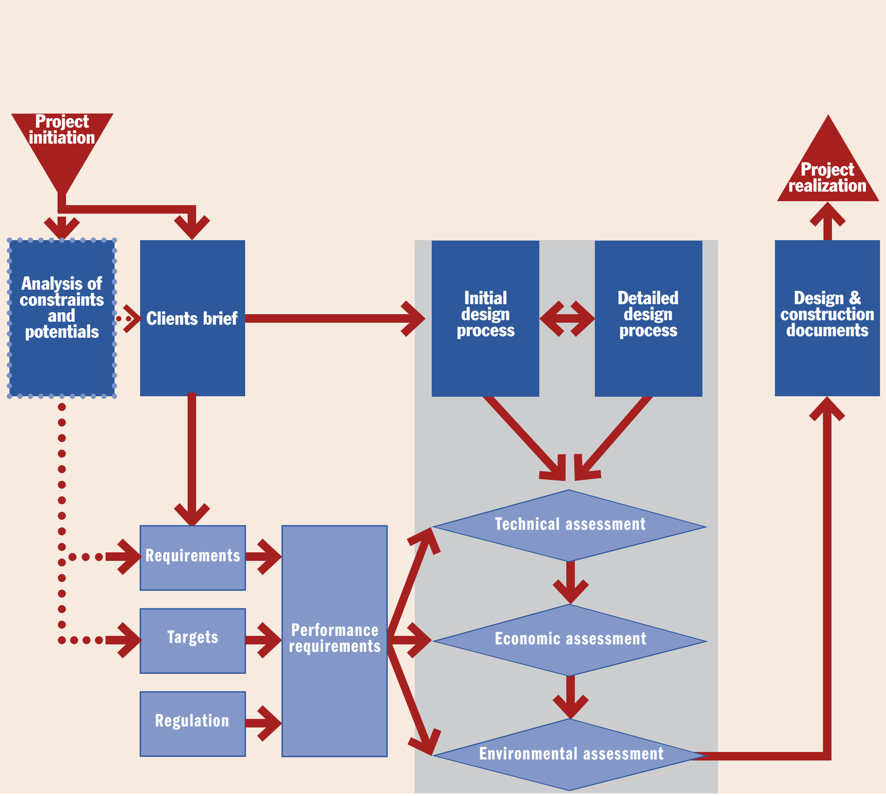


Figure 1 : *The service life planning process.*

and innovation, aiming to bring together standards related to sustainability and service life with standards on building information modules and industrial foundation classes (IFC) [10].

Here the ultimate goal will be to allow designers and other actors in the design processes preceding new construction, planning of facility management or refurbishment, to integrate long-term performance aspects, life-cycle costing and environmental Life Cycle Analysis (LCA) into their decision making.

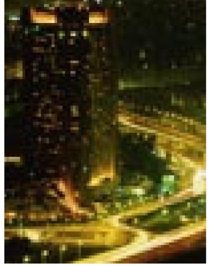
In these two research projects, the work on design life and sustainability

10) **www.iai-international.org**

carried out at ISO provides major modules that form the basis for the work. In order to enable a fair and just discussion of sustainability in building construction, the long-term performance of the options assessed needs to be quantified and evaluated.

It is essential to enable practitioners, stakeholders and decision makers to set reasonable but challenging long-term requirements. These requirements need to reflect the demands made on buildings from a sustainability perspective.

By meeting these requirements, we can design buildings that meet and can be maintained at these levels of performance.



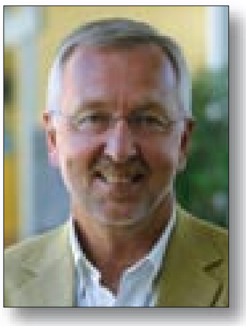
Systems for facility management based on Advanced Information Technology (IT)/Geographic Information System (GIS), which allow a lifetime approach [Life-cycle Management System (LMS)] to performance management, are under development.

With the relevance of energy consumption to the global agenda, energy demand and supply will remain a primary aspect of concern. However, the methodologies and concepts developed in ISO, CEN and numerous research projects are equally applicable to other aspects of sustainability – provided that a building's contribution to these aspects is quantifiable.

The general principles for sustainability in building construction include "holistic approaches" and "long-term concerns", consequently efficent use of energy and renewable resources is a necessary, but not necessarily sufficient, step towards sustainability in building construction.

It is clear that ISO standards form the basis for CEN standards, guidelines and research projects and networks, which illustrates the importance of International Standards. The route from from generic international standards to regional implementation for policies and analysis regarding the potential of innovative technologies is successful in improving the sustainability of the largest energy and material consuming industrial sector. ■

About the authors



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Dr. Wolfram Trinius is the Chair of the ISO and CEN working groups, under ISO/TC 59/SC 14, ISO/TC 59/SC 17, and CEN/TC 350. In addition to running a consultancy in Hamburg on life cycle assessment and sustainable construction issues with a special focus on international standardization and R&D projects, Dr. Trinius holds a research position at the Centre for Built Environment, Building Materials Technology, of the University of Gävle in Sweden.

Vice-Chair of ISO/TC 59/SC 14, **Dr. Hywel Davies** is a consultant in construction research and standardization, specializing in whole-life performance and sustainable construction issues.

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Expanding solar water heating market needs ISO standards

by Ken Guthrie, Chair, ISO/TC 180, Solar energy, *and Emeritus Professor Graham Morrison, University of New South Wales, Australia*

Solar thermal energy systems currently provide over 100 GW (Giga watts) of energy supply capacity worldwide saving the equivalent to over nine billion litres of oil each year – capacity that is expanding at about 15 % each year, according to the International Energy Agency Solar Heating and Cooling Programme.

This growth is driven by different needs and systems around the world. For example, the USA and Canada are dominated by unglazed solar swimming pool heating systems, while in Europe glazed flat plate collectors providing domestic hot water make up most of the sales.

Approximately three quarters of all solar hot water systems are sold in China, where the evacuated tube collector is the key technology. The demand is being driven chiefly by rapidly developing lifestyles and security of supply issues for conventional fuelled water heaters. And although there are an estimated 1000+ manufacturers in the country, performance test requirements are hindered by a limited number of testing laboratories.

In contrast, the European and Australian markets are supported by government incentives to reduce greenhouse pollution.

Under review

International Standards developed by ISO/TC 180, *Solar energy,* must accomodate these widely varying market and technology needs. As a result, the technical committee is currently reviewing the existing range of system performance standards, and developing new versions. Within its scope is a five-part standard relating to solar water heater system test and performance evaluation methods.

The five parts of ISO 9459, *Solar heating – Domestic water heating systems,* provide different test methods to meet these varying needs. Three procedures have been adopted as International Standards and two are in the drafting process. They cover three separate means of evaluating performance :

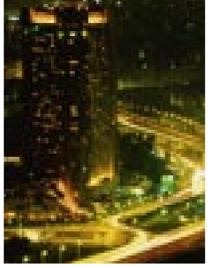
- rating test based on indoor testing ;
- outdoor test procedures for solar-only, and solar plus supplementary systems ;
- outdoor testing of components or complete systems and annual performance modelling, using computer simulation.

Five-part standard

The five parts of the International Standard are the following :

ISO 9459-1:1993, *Solar heating – Domestic water heating systems* – Part 1: *Performance rating procedure using indoor test methods*. This is a one day test in an indoor simulator under a standardized set of reference conditions which indicate the relative performance of solar water heaters, rather than predicting annual performance. The standard is used in the USA, and is under review.

ISO 9459-2:1995, *Solar heating – Domestic water heating systems* – Part 2 : *Outdoor test methods for system performance characterization and yearly performance prediction of solar-only systems*. This test is applicable to solar-only systems and solar-preheat systems. The performance test for solar-only systems produces a family of 'input-output' characteristics. Test results can be



used directly with daily mean values of solar irradiation, air temperature and cold water temperature data to predict annual system performance. The test involves daily energy collection and ambient conditions measured over 10 to 15 days. It is used in a simplified form in China and in a modified form in Taiwan, Korea and Japan. Performance can be predicted for a range of loads and operating conditions, but only for an evening water draw-off. This International Standard is under review.

ISO 9459-3:1997, *Solar heating – Domestic water heating systems* – Part 3: *Performance test for solar plus supplementary systems*. This is a 'black box' system test procedure that produces a correlation equation to characterize system performance for use with daily mean values of solar irradiation, air temperature and cold water temperature data, to predict annual system performance. The test requires inputs and outputs to be monitored over a period of six to eight weeks, but does not require details of component performance to be monitored during the test. It is limited to predicting annual performance for the load pattern used during the testing, and provides a well-accepted result. However, it is not currently used due to the time required, and is under review.

Draft ISO 9459-4, *Solar heating – Domestic water heating systems* – Part 4: *System performance characterization by means of component tests and computer simulation*. This draft standard is a procedure for defining system performance that uses measured component characteristics in the computer program TRNSYS (Transient Energy System Simulation tools).

"Solar thermal energy systems currently provide nearly 100 Giga watts of energy supply capacity worldwide."

Tank heat loss and mixing, and heat exchanger performance are characterized by tests defined in the draft standard. Collector performance is defined by the collector efficiency test procedure in ISO 9806-1:1994, *Test methods for solar collectors* – Part 1: *Thermal performance of glazed liquid heating collectors including pressure drop,* or ISO 9806-3:1995, *Test methods for solar collectors* – Part 3: *Thermal performance of unglazed liquid heating collectors (sensible heat transfer only) including pressure drop*. The annual performance of the system is evaluated by simulation using TRNSYS. This method, under development for an International Standard, is currently used in Australia and the USA.

Draft ISO/CD 9459-5, *Solar heating – Domestic water heating systems* – Part 5: *System performance characterization by means of whole-system tests and computer simulation*. This draft International Standard is in the final stages of committee consideration. The test procedure includes:

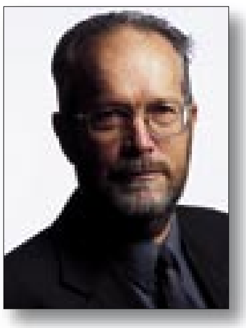
- short time step system performance monitored over a few weeks;
- performance simulation for measured weather conditions;
- identification of system parameters to match simulated and measured performance.

The model defined can be used with hourly solar irradiation values, air temperature and cold water temperature data to predict annual system performance. This method is currently used in Europe.

Expanding challenge

As the market expands and new technologies are deployed, the challenge for ISO/TC 180 is to develop and update test methods to meet the changing needs of the international marketplace. In rapidly developing markets where there may be thousands of products to be tested, direct outdoor testing as defined in ISO 9459-2 provides a fast and low cost procedure for rating products into broad performance categories. In mature markets where a more product specific rating may be required, procedures such as ISO 9459-4 (draft) and ISO 9459-5 may be more applicable. It is anticipated that component or systems testing combine with computer simulation as in 9459-4 and 9459-5 will ultimately replace the performance correlation methods defined in ISO 9459-2 and ISO 9459-3, however the time scale of this development will depend on the market development in each area. ■

About the authors



Ken Guthrie is Chair of ISO/TC 180, *Solar energy*, and Manager, Renewable and Distributed Energy, Sustainability, Victoria, Australia.

He has 25 years' experience in solar thermal systems and energy efficiency and is active on a number of solar and energy efficiency standards committees in Australia.

Graham Morrison is Emeritus Professor of Mechanical Engineering at the University of New South Wales in Sydney, Australia. His interests include operation of outdoor solar thermal testing laboratory and modelling of thermal systems. He has developed a range of routines for modelling solar water heaters, and commercially available simulation packages for designing solar and heat pump water heating systems (POOLHEAT) and air-conditioning systems performance rating software (HPRATE).

Energy efficiency of household appliances

by Fabio Gargantini, Chair of CENELEC TC 61, and IEC TC 59

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> **"International Standards give consumers a way to save money by cutting electricity use, as well as reducing levels of pollution."**

ISO Focus :

How do International Standards help increase the efficiency of household appliances ?

International Standards help increase the efficiency of household appliances by giving authorities in different countries an objective and largely recognized tool to be considered as reference in the measurement of consumption and performance and hence the comparison between appliances on their market.

Additionally, International Standards foster Research and Development (R&D) as an underpinning tool for manufacturers to place more energy-efficient appliances on the market and phase out the ones responding to out-of-date technical criteria.

International Standards give laboratories a clear and commonly agreed list of requirements, thus avoiding undue or non-harmonized verification approaches, which reassures consumers that they are using a reliable and understandable system to choose the most energy-efficient appliances.

ISO Focus :

How have they helped shape the development of energy-efficient appliances ?

International Standards give consumers a way to save money by cutting electricity use, as well as reducing levels of pollution from the power plants that produce electricity, and energy-efficiency standards have played an important role in creating the framework for continuous research on energy-efficient appliances.

Energy labels or energy rating systems foster competition to develop efficient appliances : marketing departments of companies stress this aspect of the appliances and the research and development that their company does to achieve more efficient appliances.

This has had the effect that since 1992, when the European Directive on energy labelling of household appliances was issued, EU industry has become a world market leader.

ISO Focus :

How do you foresee this market developing in the coming years ?

Energy-efficiency improvements in electrical household appliances can play a role in assuring a sustainable energy future and socio-economic development, and at the same time mitigate climate change.

Savings due to energy-efficient appliances are projected to more than double over the next 20 years, even without new action. If new and updated standards are adopted, these savings will more than triple.

In Europe, it is planned to upgrade energy labels towards fostering even more ambitious "super efficient" appliances ; for instance refrigerators consuming 15 to 20 % of what they did in the early 90s !

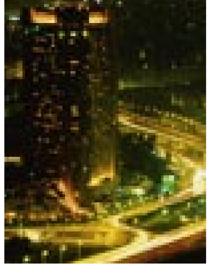
The activities of IEC TC 59 and its subcommittees will concentrate on International Standards suitable to support the need for clear, complete, reliable and globally recognized energy-efficiency standards.

The future activity of TC 59 will be dedicated to trends in technology concerning energy saving, energy labelling and other environmental matters requiring standards covering these aspects. Particular attention will also be given to develop standards for measurement of standby modes.

ISO Focus :

How do consumers benefit ? What is the added value for manufacturers ?

Consumers get innovative appliances, masterpieces of technology, they can reduce their electricity bills and contribute to mitigating climate change through indirect CO_2 emissions reduction.



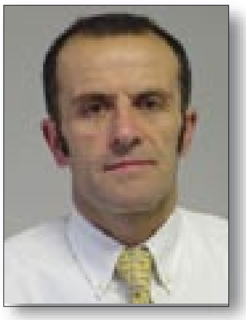
Goods such as fridges, washing machines and dishwashers account for a significant portion of household energy consumption and greenhouse gas emissions. By selecting these appliances carefully, consumers can save money and reduce their energy consumption without changing their lifestyle.

An energy-efficient appliance will allow saving hundreds of euros over its product life, as well as reduce the consumption of water and other natural resources.

In most countries, significant subsidies or tax allowances have been set up to help consumers purchase energy-efficient appliances.

As far as manufacturers are concerned, a recovery of energy-efficiency investment can be obtained through rebates for energy-efficient appliances and this is the reason why, for instance at the EU level and as far as the household appliance industry is concerned, EU coordination of public incentives is sought to accelerate replacing the nearly 200 million out-dated appliances still in use with energy-efficient appliances.

About the author



Fabio Gargantini is a Senior Consultant in the field of standards preparation and interpretation and technical support for analysis of standards and related legal requirements. With in-depth knowledge of technical and standardization matters in the household appliances field, he has been active for many years in standards development at both the national and international level. Since 2005, he is Chair of CENELEC TC 61, *Safety of household and similar electrical appliances,* and since December 2006, he is Chair of IEC/TC 59, *Performance of household and similar electrical appliances.*

ISO Focus :

What is the link between standards for this sector and technical regulations in different countries and regions ?

Standards are used as a measurement reference for the definition of the rating systems, used in different countries worldwide, to indicate energy-efficiency classes of household electrical appliances, e.g. A to G classes used in the European Union Energy Label and compliance with the European Union Energy Labelling Directives.

The standards and their consequent recognition at country level in specific laws and regulations, e.g. the above Energy Labelling Directives in the EU, have made energy efficiency an important factor in market competition as consumers look at energy performance when choosing an appliance.

The EN standards for the purpose of energy labelling are based on IEC standards (ISO standards for refrigerators and freezers) and help international comparison as countries like China are also using the same international standards for Chinese energy labelling laws.

ISO Focus :

How, in your opinion, can International Standards help the challenges of the future?

Many energy performance standards for a large number of products are available worldwide.

Most of the available standards deal with the used phase of the product life, so there is scope to also consider energy consumption during other parts of the product cycle, i.e. the production and disposal phase of the product life cycle. Further possibilities include broadening the product range in respect to both the measurement and reduction of energy consumption.

Energy-efficiency measures related to electrical household appliances is one of the most cost-effective actions to reduce CO_2 emissions, and have given, through the huge investments made in the design of energy-efficient appliances, the opportunity to increase the security and reliability of energy supply.

In developing countries, efficient electrical household appliances are vital to improve living conditions and reducing local pollution. Moreover, efficient electrical household appliances are a key to the further development of renewable energy sources, which can only supply a limited amount of energy.

In some cases, market, policy, trade and information barriers impede the further penetration of energy-efficient electrical household appliances, resulting in a missed opportunity for climate change mitigation and socio-economic development.

The two big challenges for the future will be :

1. to shorten the lead time for the preparation and issuing of standards ;
2. to have standards which can be developed and recognized globally.

If commonly-agreed International Standards are quickly developed and then adopted in more countries, including those still isolating themselves with national standards, there will be a real benefit for all standards users: manufacturers, authorities and laboratories and finally for the consumers.

All countries should adopt energy labels or energy rating systems based on IEC-ISO standards: in this way, world-wide competition will move to energy efficiency with benefits for everyone. ■

Fuelling the future – ISO task force addresses key issues in meeting global energy demands

by Dr. George Arnold, ISO Vice-President (policy)

Recognizing that the growth in demand for energy has become a critical issue for global society, and that International Standards play a major role, a strategic task force was established in March 2007 by the ISO Council – which performs most of the organization's governance functions. The goal of the task force is to examine the landscape and make recommendations for ways in which ISO's standardization activities could further develop and promote energy efficiency and renewable energy sources.

This strategic effort represents an enhancement in ISO's approach to the development of standards in innovative and emerging new fields that address broad societal issues. For the most part, ISO identifies needed standards developments through a "bottom up" process, in which standards projects are proposed within existing technical committees. This process has worked extremely well and ensures that standards which are developed are in line with market demands.

There are some issues, however, that are so far reaching and cut across so many technical domains that a higher-level perspective is needed to ensure that the collective portfolio of ISO standards address the issue adequately. Such is the case with energy.

Getting the "big picture"

The ISO Council charged the task force to look at the " big picture ", beginning with an understanding of:

- the key issues in meeting global energy demand ;
- the role that International Standards play ;
- the existing portfolio of published standards and active work items, both in ISO and other organizations ;
- what gaps exist ; and
- actions that ISO should take to ensure that needed International Standards are available.

Recognizing the importance of the problem, the Council wanted to move swiftly. The task force was charged with completing its work and reporting its findings to the Council in a six-month time frame – a very aggressive schedule. In addition to experts named by ISO member bodies, the task force included observers from the International Energy Agency (IEA) and the International Electrotechnical Commission (IEC), which are key partners in this work.

"Global demand for energy will grow 70 % over the next 25 years."

The task force began its work by understanding the overall global energy landscape. The IEA projects that global demand for energy will grow 70 % over the next 25 years. The great majority of this demand will continue to be met by fossil-based fuels including oil, coal and gas. Nuclear energy will continue to play an important role. Biomass-based fuels such as ethanol, biodiesel and biogas will continue to grow in importance ; however, by 2030 they will only address about 10 % of global energy demand. Thus, despite the hype, biofuels are only one piece of the global energy puzzle. Other renewable sources, such as solar, wind, geothermal and marine, will grow rapidly, but will also represent a small part of the overall energy supply.

Since there are limits to the rate at which new and renewable energy sources can be developed, what other solutions exist ? Clearly, the efficient use of energy in order to reduce demand must play a critical role.

How can International Standards help ?

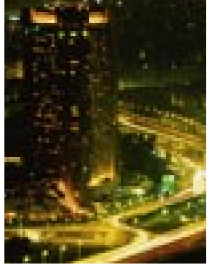
One of the effects of energy consumption is production of CO_2, which the IEA projects will increase about by 40 % by 2030 in its reference scenario. An alternative scenario studied by IEA that encourages greater efficiency and increased use of renewable and nuclear sources that do not emit CO_2 can cut this increase in half. Seventy-eight percent of the reduction in this scenario is due to energy efficiency. Only 22 % comes from greater use of renewable and nuclear energy. Clearly, energy efficiency is an urgent priority, and represents an area in which standards can have more rapid impact.

How can International Standards help ? Standards can provide common measurement and test methods to assess the use of energy and reductions attained through new technologies and processes. They provide calculation methods so that comparisons can be made to understand the impact of alternatives. They provide a means to codify best practices and processes for efficient energy use and conservation. Especially important to the introduction of new energy sources, they can provide specifications needed to achieve interoperability, or to integrate new technologies into existing infrastructures for distribution and delivery to energy-using products and systems.

The task force, aided by the effort of ISO's Central Secretariat, catalogued the portfolio of existing standards and work items related to both energy efficiency and renewable sources. Within these broad categories, the portfolio was further classified, covering:

- under energy efficiency – power generation, transmission and supply, building (including heating and air conditioning), household appliances, lighting, industrial products and processes, transport, and office equipment ; and
- under renewable sources – solar (both heat and photovoltaic), wind, biofuels, wood, hydrogen, hydroelectric, geothermal, and marine.

The task force analysis noted in the ISO portfolio the extent to which



standards had been published, their age, and active work underway. It is important for ISO to be aware of the related work of other organizations so that duplication of effort can be avoided and collaborations undertaken. Thus, the portfolio included not only ISO's programme, but also that of IEC as well as other standards developers with multinational input, including the American Society for Testing and Materials (ASTM), the European Committee for Standardization/European Committee for Electrotechnical Standardization (CEN/CENELEC), the Institute of Electrical and Electronics Engineers (IEEE), and others. Since energy is a field with public policy and regulatory interest, the task force also compiled a listing of energy-related regulations adopted by the European Union and the USA.

Recommendations for a sustainable way forward

It is of the utmost importance to include, in the standards development process, the views from public policy officials involved in energy efficiency and renewable sources. This should be done at both the national level through the ISO members and at the international level through cooperation between ISO and international organizations such as the IEA, among others.

There is an urgent need for harmonized terminology and calculation methods regarding energy efficiency, consumption and savings. Harmonized methods and criteria to calculate energy yield of different primary energy sources would be very valuable.

Energy management standards should be developed to help all types of organizations take a systematic approach to the continual improvement of energy performance. National energy management standards have been developed and are in use in various countries, resulting already in significant savings. There is strong interest in an International Standard that would facilitate harmonization and sharing of best practices internationally.

The task force supported the ISO Technical Management Board's (TMB) recent decision to initiate work on liquid and solid biofuels, and recommended that this work be extended to include biomass and biogas. The need for standards for sustainable production of biofuels should also be investigated.

Most of the focus of standards development is on newly-created things. In the area of energy efficiency, however, much greater attention needs to be placed on standards for retrofitting and refurbishing. Standards can help with the upgrading of established installations and systems (e.g. buildings and industrial plants), for which there is substantial market demand with high potential for energy savings.

"The efficient use of energy in order to reduce demand must play a critical role."

Buildings are a major consumer of energy, and there is already a high level of ISO standardization activity related to energy efficiency. Nevertheless, the task force identified a number of recommendations to further strengthen ISO's work programme in this area, including greater coordination and ensuring global relevance.

A new opportunity for which there is market demand is developing standards to support specific qualifications of personnel working in the building sector to implement energy efficiency measures.

In addition to these broad recommendations, the task force made a number of recommendations for standards related to specific renewable energy sources, including solar, wind, wood, hydrogen and geothermal.

The specific needs of developing countries need to be taken into account throughout ISO's work in all these areas.

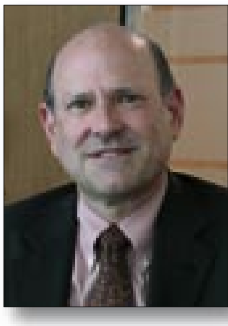
Finally, the task force recommended that a standing strategic advisory group be established under TMB to pursue the implementation of these recommendations and further study in a number of areas that the task force did not have time to investigate in depth.

Providing solutions

Clearly, International Standards play a critical role in facilitating increased energy efficiency and broad use of renewable alternative energy sources. This role is recognized by political leaders around the world who have called on the standards community to provide the necessary standards solutions.

ISO, in partnership with its sister organization the IEC and international agencies such as IEA, is committed to providing leadership in the creation of a coherent and complete portfolio of standards addressing this urgent societal need. ■

About the author



George Arnold has been appointed ISO Vice-President (policy) for the 2006-2007 term. He was Chairman of the American National Standards Institute (ANSI) Board of Directors in 2003-2005, after having served as Vice-Chairman, and has held several positions as a leader and active member of numerous ANSI committees. From the time that he joined AT&T Bell Laboratories in 1973, Dr. Arnold has held a wide range of technical and managerial assignments in research and development. From 1996 to 2001, he was Vice-President of Standards and Intellectual Property at Lucent Technologies, and then served until 2006 as Senior Advisor to the company's executive leadership on standards strategy and intellectual property. He is currently Deputy Director, Technology Services, at the US National Institute of Standards and Technology (NIST). Dr. Arnold is also President of the IEEE Standards Association 2007-2008. He has been involved in the US-Europe Trans-Atlantic Business Dialogue (TABD). He has an academic background in engineering and applied sciences.

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