ENERGY EFFICIENCY STANDARD HARMONIZATION: THE ROLE OF THE APEC STEERING GROUP ON ENERGY STANDARDS

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INTRODUCTION

WHAT IS A TEST PROCEDURE?

Test procedures (often also called "test standards") are the method of test used to determine appliance performance, energy consumption and hence energy efficiency. They are critical in that they allow the comparison of products on a fair basis.

Test procedures cover all aspects of testing of the product, such as:

- ambient temperature
- water quality and temperature
- test loads
- instrumentation and equipment
- special materials and methods
- duty cycles and/or loading patterns

As appliances and equipment are becoming increasingly complex, test methods have to change to deal with new products and new technologies. Therefore, in the course of trying to reflect local conditions and dealing with new and innovative products, there is a large and growing potential for local test procedures to become unaligned across APEC member economies.

Ideally, a good test procedure should be able to deliver the following:

- Repeatability - get same result each time
- Reproducibility - get same result in different labs
- Reflective of consumer use
- Simple but effective
- Cover existing products as well as new and forthcoming technologies
- Able to represent cultural & climatic influences and user patterns

Unfortunately, it is rarely possible for a test procedure to meet all of these requirements simultaneously. Clearly, the requirement for repeatability and reproducibility is paramount in any test procedure that is used to regulate products or judge manufacturer claims. These are often regarded as a key and fundamental requirements for any test procedure and tend to take precedence over other aspects. Repeatability and reproducibility are of key importance to most groups but to regulators and consumer groups in particular.

The ability to be reflective consumer use is also a key requirement. The problem is that many consumers behave and act in different ways, so more often than not, there is a distribution of use rather than a single value that is typical. Variation in the frequency of use (for example uses per year of a clothes washer) is reasonably easy to determine and reflect in an energy label or an advisory brochure, but selection of different programs by consumers is more difficult to represent, as is variation in say washing temperatures.

While almost all parties would like test procedures to be simple, this is rarely possible, especially where complex technologies are involved. On the other hand, complexity is reflected in the cost of testing, which has to be limited to some degree. Both the cost per test, the time taken to test and the number of tests required for a valid results are all key considerations.

The issue of new and emerging technologies is a critical one. Increasingly, product configurations and types are appearing that were never envisaged by the people that developed the test procedure for a product. The presence of load sensing devices (in products such as clothes washers), automatic dryness sensors (for clothes dryers), adaptive and smart controllers and fuzzy logic (adjusting and optimising the operation and performance on the basis of the previous day/week/month/year of use) make it increasingly difficult to test some product types, especially with outmoded test procedures. The increasing use of variable speed drives in air conditioners is another good example. Many of these devices and controls will actually save energy in actual use. In fact Meier argues that "…. There is good reason to believe that a large fraction of energy savings in future appliances will be achieved by the application of microcontrollers rather than with mechanical improvements. However, some of these savings will be fake, that is, they will appear only in the test procedure" (Meier 1998). The key issue is how to test a product without being tricked into thinking that it is more or less energy efficient than it is likely to be in actual use. A very interesting discussion of this issue is contained in Meier (1998) and Meier (1997). See also the section below in performance.

Probably the biggest single issue with respect to the testing of appliances and equipment is the influence of climate and weather on products that are temperature sensitive (typically refrigeration products and air conditioners) and to a lesser extent the impact of cultural factors on the use of product. The range of local climatic conditions around the world (both indoor and outdoor) is immense and test procedures for these products are usually less than adequate, typically testing at a single temperature condition, which is clearly a poor reflection of actual use. This issue is discussed in more detail in GWA (1999), EES (2000) and Harrington (2001).

WHY ARE TEST PROCEDURES IMPORTANT?

For appliances and equipment, the energy test procedure is the foundation for minimum energy performance standards (MEPS), energy labels, and a wide range of other related energy programs. It provides manufacturers, regulatory authorities, and consumers a way of consistently evaluating energy use and energy savings across different appliance models. A well-designed test procedure services the needs of its users economically and with an acceptable level of accuracy and provides ability to replicate actual conditions. On the other hand, a poorly-designed energy test procedure can undermine the effectiveness of everything built upon it. (Adapted from Meier, 1998)

Energy test procedures are therefore a critical underpinning for all energy programs that seek to measure and improve the energy efficiency of appliance and equipment. This is a fact not often fully appreciated by those who develop energy policies.

Energy test data used for regulatory purposes has two main functions. The first is to specify a minimum efficiency requirement for a product via a MEPS level. The second main use of energy test data for regulatory purposes is for energy labelling. The goal of an energy labelling program should be to encourage consumers to purchase the appliance that:

(1) uses the least energy during actual use; and
(2) meets their energy service needs.

It would be of little value (or even misleading) if an energy label ranked a number of models according to a test procedure but that their energy ranking in actual use was different (assuming the provision of comparable energy service). If a test procedure is used to specify requirements for energy labelling but it provides consumers with incorrect advice or information (say through incorrect ranking during actual use), then there should be serious questions regarding its use and validity. Similarly, if a model passes a

MEPS level under the test procedure, but the performance and energy consumption in actual use is vastly different (or vice versa), then the test procedure is failing in its role in facilitating energy policy. There needs to be a strong nexus between test procedures, energy programs and actual use by consumers if policies are to be successfully implemented: all too often these important links are ignored by policy makers.

WHAT SHOULD A TEST PROCEDURE DELIVER?

Probably the single biggest issue with respect to test procedures is ensuring that it is able to deliver to its users what is required. Consumers, manufacturers and governments all use test procedures for a range of purposes and the information required for these uses varies somewhat. Ideally, a test procedure should be able to characterise the operation of a product (both in terms of its performance and energy consumption) under "realistic" conditions of use (or a range of conditions).

Unfortunately, most test procedures do not address the issue of generic performance or actual conditions of use in a very innovative manner. Typically, a single (and often arbitrary) test condition is specified and this may or may not be close to actual use. For some product the point chosen has little real impact on energy consumption and performance, but for others, the selected test conditions are critical. Consequently, information from test procedures (such as energy consumption used to develop MEPS levels or energy shown on energy labels) may or may not rank products according to their energy efficiency in real use. This is obviously a complex area and there is unlikely to be a "quick fix" solution.

WHAT IS HARMONISATION?

Harmonisation, which is also called "alignment" within APEC, will provide reduced costs of testing for manufacturers, which will in turn reduce costs of trade. Reducing the cost of trade is a fundamental tenet of APEC. Alignment in this context does not necessarily mean that all elements of a test procedure have to be identical in each economy (although that is a straight forward and in some cases, desirable way of achieving alignment), but the bulk of the test procedure and its basic elements need to have much in common so that "equivalence" is attainable. There are other ways where the cost of testing can be reduced and the need to retest to different test procedures can be avoided. The most practical way in many cases is the use of a so called "conversion algorithm" to convert from one set of test conditions to another.

In its simplest form, a conversion algorithm is a simple adjustment factor which will allow the measure of energy and/or performance under one test procedure to be converted to an equivalent and comparative value under a different test procedure without the need for additional retesting. In its most complex form, an algorithm could consist of a computer model which is used to simulate the performance and energy consumption under a range of conditions, including different test procedures, or conditions of actual use (say in a factory or household). The development of conversion algorithms that are accurate and reliable is not simple for some products and probably not even necessary or feasible for others.

If conversion algorithms are to be developed, they need to be credible, accurate and robust. In addition, there needs to be some agreement, at least in principle, for regulators to consider the use of such approaches, should they prove to be successful. If regulators cannot or will not consider the use of such conversion algorithms, their development will be largely in vain, except for more exotic data analysis projects and international comparisons.

The development of suitable conversion algorithms has, in effect, the same practical effect as the full and effective alignment of the test procedures themselves – it avoids having to retest an exported product to range of local test procedures. So either the alignment of test procedures or the development of suitable conversion algorithms provides an acceptable outcome in terms of APEC policy requirements and future directions (provided that economies accept the results of a conversion algorithm as credible).

WHY "HARMONISE" OR ALIGN TEST PROCEDURES?

"Harmonisation" or alignment of test procedures (including the development of conversion algorithms) have the advantages of:

- facilitating international trade
- decreasing testing and approval costs for manufacturers
- allowing the free movement of the most efficient products (noting that products with a low energy efficiency may still be barred if they do not meet local MEPS levels)
- facilitating international comparisons
- assisting in the diffusion of advanced energy saving technologies.

Reducing the cost of trade is a key policy goal of APEC.

WHAT ABOUT MEASURING PERFORMANCE?

The measurement of appliance performance in conjunction with energy consumption is a key issue. Within a particular appliance model, the energy consumption and performance are related (eg, to make food colder in a particular refrigerator requires more energy, increasing the wash temperature of a clothes washer both increases the wash performance and the energy consumption). Performance of products is widely accepted as part of most product test procedures. Things such as internal temperature control in a refrigerator, cooling or heating capacity of an air conditioner, shaft power output of an electric motor and volume of hot water delivered by a water heater are all measures of performance. In fact, consumers and businesses are not generally interested in the energy that is consumed by a product, but rather by the energy service that the product performs. Almost all test procedures measure the performance in some way, although there are a group of products in NAFTA economies (North America) where performance is not normally measured at the present time (most notably washing products – this has created some significant and growing difficulties for regulators).

Performance is critical as the energy service and the energy consumption combine to provide a measure of the energy efficiency of the product – ie the "energy service per unit of energy consumption". Generally speaking, statements of energy efficiency are meaningless unless the level of performance is either specified or declared. One way to avoid the measurement of performance is to include prescriptive design requirements into test procedures to ensure that de facto the energy service is being provided. However, these often stifle manufacturer innovation in the design of their products. At the end of the day, performance of a product is of interest to consumers, not its design or how it provides the energy service.

Some performance attributes are clear cut and easy to specify in conjunction with energy consumption information. For example with clothes dryers, the standard test procedure specifies an initial and final moisture content for a clothes load and this constitutes a definition of "wet and dry clothes" for the purposes of comparative energy consumption and efficiency. In the case of refrigerators, the definition of suitably cooled space for the storage of food is a complex one but can be (and is) defined through a series of tests in the ISO refrigerator standards (operation temperature performance tests). For clothes washers and dishwashers, the issue of what constitutes clean clothes and dishes is a vexed one and to some extent subjective. What is acceptable in one economy may not be acceptable in another. Hence the issue of performance is sometimes overlooked or avoided as being too difficult. However, it needs to be addressed in some form or the potential for energy programs to be undermined increases dramatically.

Some advanced products are able to trick a non-performance test procedure. For example, a dishwasher or clothes washer that has a soil sensor could terminate the washing operation prematurely if a soiled load is not used.. Such machines would only operate with very short program cycles and achieve inordinately high energy ratings under the test procedure, whereas in actual use the energy would be much higher (hence advice based on these tests, such as an energy label, could seriously mislead consumers). Hence a

performance test that gives products a realistic task to perform is a key part of test procedures when they are being used as a tool of energy policy.

APEC STEERING GROUP ON ENERGY STANDARDS

The Steering Group on Energy Standards was formed in 1997 and its role was to encourage work within APEC to achieve the benefits of increased co-operation on energy standards (test procedures).

Details on APEC and some background to the Steering Group on Energy Standards (SGES) and its work program are included in Annex A. SGES first met in March 1997 and its work was concluded in March 2000. The study titled "Review of energy efficiency test standards and regulations in APEC member economies" by Energy Efficient Strategies (Australia) (APEC 1999) was one of the main projects undertaken by the Steering Group on Energy Standards. The main conclusions regarding the potential for alignment of test procedures for each of the major product groups is outlined below.

SPECIAL ISSUES TO CONSIDER WHEN ALIGNING TEST STANDARDS

Few international test procedures are "Generic"

Despite the best intentions and efforts of standards committees and their members, the reality is that few, if any, of the commonly used international test procedures, are in a form that could be considered "generic", in that they can characterise the product under a range of typical uses. For some products, such a "generic" test procedure is quite feasible, but for others, the prospects of a generic test procedure are probably poor. In these cases, a conversion algorithm may be a more suitable option.

Climate considerations

Climatic considerations are critical for some products (especially air conditioners and refrigerators, and to some extent water heaters), and this is generally poorly handled in the existing test procedures (regional and international) for these product types. These products, which may have widely varying temperature performance coefficients for different models, are usually tested under a single static temperature condition, which is neither representative nor facilitates the estimation of performance under other conditions (including real use). Of course, "real use" and a "representative test point" can never be developed – consider an economy such as Australia which has climate zones ranging from cool temperature to humid tropical; a single test condition can never be representative of such a range. For such products, a complex conversion algorithm (ie computer model) is probably the only feasible long term option.

Agreement to move forward

Many economies regulate products for energy efficiency. Unless there is some sort of plan or agreement with APEC on how to move forward, there is unlikely to be an progress in this area. SGES have developed a policy framework for the alignment of energy standards. APEC leaders have in fact agreed to some level of alignment in test standards by 2010/2020 (APEC 1997). For this to happen, there needs to be either credible test procedures which are worth aligning to or conversion algorithms developed that are credible and acceptable to regulators. There is little point in aligning with a standard that has a poor technical base or is otherwise unsuitable.

New "Smart" Products

The increasing prevalence of electronic controls in appliances and equipment will make testing more complicated and less repeatable. Features such as fuzzy logic, automatic programs and sensors (water level, load detection) and sensors for soil and dirt are becoming common. It is therefore important that

test procedures move with the times to ensure that these smart products don't outsmart the test procedures.

A related issue is that where a test procedure specifies a single test point, it is well known that manufacturers tend to optimise for that test point rather than for real consumer use. This is of little service to the consumers who are supposed to be helped by programs such as energy labelling. Examining energy and performance over a range of conditions (which would typically need to be done in the development of a conversion algorithm) means that there is no advantage for manufacturers to optimise to a test single condition, hence products would hopefully become more versatile and better optimised for real use.

Global international standards

More often than not, international standards committees draw expertise from a narrow base of economies. Many committees which cover energy and performance of products draw heavily from European economies, while input from outside of Europe (including APEC) is usually minimal, if non existent. While it is fair to say (and it is often said) that many of these standard committees are dominated by Europe, it is also fair to say that few APEC economies (or those from other regions) provide any significant input or resources into these areas. So European domination, as such, tends to be by default rather through any systematic plan or conspiracy. Another problem area is that the composition of international standards committees tends to be from manufacturers and to a lesser degree material suppliers and test laboratories. Ironically, there is often a low level of input from regulatory agencies, who in fact are often charged with the ultimate use of these test procedures. If international standards are to become more relevant, regulators will need to provide coherent input and ongoing development resources into these areas.

In a general sense, international standards will need to become more flexible and generic to cope with climatic and usage variations. Where there is an option to develop a technically superior test procedure, this should be done and it should be adopted as far as is possible within APEC. Economies with energy related programs such as labelling and MEPS need to be consider becoming more involved in international standards processes.

OVERVIEW OF STUDY FINDINGS BY PRODUCT GROUP

Refrigerators

- large world trade
- large number of different test procedures
- widely regulated across APEC economies (labelling, standards and other programs)
- no test procedure is clearly superior to others
- some prospects for a conversion algorithm (through computer modelling), but this is likely to be complex and is yet to be proved
- little prospect of alignment in the short to medium term.

Report recommendations for refrigerators:
Alignment in the short term appears to be very unlikely for refrigerators. Further investigations should be undertaken into both simple and more complex computer modelling options for refrigerators to determine their feasibility as algorithms for use with refrigerator test procedures. More extensive use of a test procedure with dual energy temperature test points and controlled internal heat loads may provide some insight and data to assist with modelling and algorithm approaches.

Air conditioners

- large world trade
- mostly similar test procedures, but with many small variations
- widely regulated across APEC economies
- ISO test procedure is used widely but is currently inadequate for modelling actual use, a range of climatic conditions or part load operation (especially inverter type models).
- good prospects for a conversion algorithm, but there is still significant development work to be done
- reasonable prospects of alignment in the short to medium term, probably using ISO standard conditions, but there is a need to address outstanding issues such as part load and climate variations through a modelling approach.

Report recommendations for air conditioners:
For air conditioners the most promising approach would appear to be multi pronged:

- Provide some effort and resources into eliminating the currently somewhat arbitrary (but mostly small) differences in test conditions and tolerance for testing of air conditioners and heat pumps within APEC economies. Aligning to ISO5151 T1 would appear to be a feasible option;
- Work towards the development and adoption of international coding system of definitions for air conditioners within APEC economies to assist with the uniform treatment of air conditioning products in a regulatory sense;
- Examine options for modelling of small deviations from the ISO test method (eg changes in temperature and humidity requirements) and the development of an altitude correction algorithm;
- Undertake further investigations into the feasibility of developing a full simulation model for air conditions as a medium term goal (including a calibration process against actual tests). Such an approach should make particular reference to the accurate estimation of performance under standard rating conditions (for comparative and regulatory purposes), simulation of household usage under a range of climates and more realistically and accurately assessing the performance of variable speed drive compressor systems under conditions of actual use.

AC electric motors

- large world trade
- mostly similar test procedures, but with some significant differences
- some regulation in APEC economies, many economies considering regulation
- IEC test procedure is used widely but currently inadequate. IEEE approach used in NAFTA and is the superior methodology
- conversion algorithm not necessary as new IEC standard under development is adequate
- good prospects of alignment in the short to medium term if current IEC draft incorporating IEEE methods proceeds to publication.

Report recommendations for AC electric motors:
Ensure active participation from APEC economies in the current development of the new IEC motor standard which incorporates the superior methods of IEEE and alignment with this standard once published.

Lighting products

- large world trade
- mostly similar test procedures, mainly based on IEC performance standards, but with some significant differences with respect to measurement of efficacy of ballasts
- some regulation in APEC economies, some under consideration

- IEC test procedures used widely but no suitable test method currently exists with respect to determination of efficacy of ballasts. There is a need to develop a new IEC ballast test procedure based on the superior methods now used in North America and Europe for determination of efficacy. IEC test methods for lamps are adequate.
- conversion algorithm not necessary as proposed standards for ballasts (if developed) will be adequate
- good prospects of alignment in the short to medium term if proposed IEC standards are developed.

Report recommendations for lighting products:
The following recommendations are made for lighting products:
- Active alignment with IEC standards for lighting products other than fluorescent lamp ballasts;
- Review and use of IEC performance standards for fluorescent ballasts where relevant;
- APEC participation in the development of a new IEC standard for the measurement of fluorescent lamp ballast efficacy;
- Alignment with the IEC ballast efficacy standard once developed, if acceptable.
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Electric water heaters

- small but growing world trade
- many different test procedures, wide range of temperature requirements, both static and draw-off tests used. Task type tests (with draw-off) are essential for non electric technologies (where conversion efficiency is critical).
- regulation in many APEC economies, regulation under consideration in some.
- current IEC test procedure is currently inadequate (only provides static heat loss measurement).
- conversion algorithm appears to be the most feasible option. A suitable computer based model (which has the facility to be calibrated with data from physical tests) has already been developed and is probably suitable and ready for adoption as a conversion algorithm test method. Should be able to provide suitable level of accuracy for regulation, plus enough flexibility to accurately model the wide range of existing test procedures as well as actual use. Can be used for other fuels (eg gas and oil) including solar water heaters.
- Poor prospects for alignment.

Report recommendations for electric water heaters:
The prospects for alignment of water heater test procedures appear poor. The only feasible option appears to be the development of a computer algorithm which will allow accurate modelling and characterisation of a wide range of climate conditions and usage patterns. Such a computer model already exists in Australia and is in the process of being developed into an international standard. APEC should provide active assistance in this development, particularly with regard to the specification of input requirements for conventional water heater types.

Clothes washers

- large world trade
- wide range of test procedures, some home grown and others derived from IEC
- some regulation in APEC economies, some economies considering regulation
- IEC test procedure is currently inadequate with respect to performance of top loading machines. Wide range of work is under way with respect to all aspects of the test, but it will be some time before all major issues are adequately progressed. IEC probably best of the existing test methods.
- conversion algorithm not likely to be feasible
- moderate prospects of alignment in the medium term if the IEC standard is developed further with the input of APEC member economies. Still likely to be some local variations as a result of wash temperature.

Report recommendations for clothes washers:

- Active participation in IEC committee SC59D to assist in the development of a relevant international clothes washer performance standard;
- Medium term alignment to the IEC when this is deemed acceptable.

Dishwashers

- small world trade
- three main test procedures – IEC, AHAM, US DOE (also now CENELEC)
- some regulation in APEC economies, no more proposed
- current IEC test procedure is currently inadequate with respect to performance. Wide range of work is under way in IEC with respect to all aspects of the test with input from Europe, North America and Australasia – good progress to date.
- conversion algorithm not likely to be feasible
- good prospects of alignment in the short to medium term if the IEC standard development is completed and accepted within relevant participating APEC member economies.

Report recommendations for dishwashers:

- Active participation in IEC committee SC59A to assist in the development of a relevant international dishwasher performance standard;
- Short to medium term alignment to the IEC when this is deemed acceptable.

Clothes dryers

- small world trade
- two main test procedures – IEC and AHAM (US DOE)
- some regulation in APEC economies, no more proposed
- current IEC test procedure is currently inadequate with respect to performance. Needs improvement in the area of energy correction. Also needs to be made more generic allow the estimation of energy consumption over a wide range of initial moisture contents without the need for retesting. Some work under way in IEC. Most existing dryer test procedures have the same inadequacies.
- conversion algorithm probably not necessary if flexible new generic test procedure developed
- fair to good prospects of alignment in the medium term if the proposed IEC standard development is completed and accepted within relevant participating APEC member economies.

Report recommendations for clothes dryers:

- Active participation in IEC committee SC59D to assist in the development of a relevant international clothes dryer performance standard;
- Inclusion of an accurate correction method into the IEC standard;
- Longer term development of a more generalised IEC dryer standard which can accurately estimate energy consumption over a wide range of initial moisture contents;
- Medium term alignment to the generalised IEC standard when this is deemed acceptable.

Office equipment and consumer electronics

- huge world trade, relatively short life, fast turnover, rapid change in technology
- few formal test procedures
- few regulations in APEC economies but widely covered by voluntary programs such as Energy Star
- may be a case for the standardisation of some aspects of the testing of these products (eg instrumentation and accuracy). Most common measurement is for standby electricity consumption.
- conversion algorithm probably unnecessary

- global product specifications and program coverage suggests a strong case for alignment, whether these are formal or informal test procedures.

Report recommendations for office equipment and consumer electronics:
APEC should coordinate approaches for the measurement of standby energy consumption for their various voluntary and mandatory programs. APEC Economies with a direct interest in standby energy consumption should actively participate in the new IEC TC59 project to examine test methods for the determination of standby losses. US EPA needs to play active stewardship role for global products covered by Energy Star.

General Report Conclusions

The general report conclusions are as follows:

- A plethora of local test standards are in use and these are likely to be restricting trade by increasing costs of trade
- Few international standards are "generic" at this stage and many require significant work to make them more applicable for regulatory purposes.
- For some product types, alignment appears to be the only feasible option in the medium term.
- Special attention needs to be paid to new and emerging "smart" products and control systems – while these have the potential to save substantial amounts of energy during actual use, there is also potential that they can "trick" test procedures into measuring fake energy savings which will appear only in the test procedure. Similarly, some products will achieve real energy savings in actual use but will obtain no credit for these in the test procedure.
- Conversion algorithms (computer modelling concept) appears to be a feasible and attractive option for some selected products (especially water heaters), yet this approach is very new and is yet to be proven and receive widespread acceptance.
- A big effort will be required to develop suitable conversion algorithm models to the required level of accuracy for regulatory purposes.
- For those products affected by climate (eg refrigerators, air conditioners and water heaters) a modelling approach is probably the only effective way of ensuring that products are ranked correctly with respect to energy efficiency under conditions of actual use.
- There is a need for change in direction with respect to energy policy within the IEC/ISO bodies – a long term view is needed and member organisations need to more effectively communicate their needs to these bodies.
- There needs to be an increased an ongoing input by APEC member economies into IEC/ISO standards development processes, especially for those products and those economies that regulate on the basis of energy and performance.

Annex A – More Details About APEC and SGES

WHAT IS APEC?

Asia-Pacific Economic Cooperation (APEC) was established in 1989 in response to the growing interdependence among Asia-Pacific economies. APEC began as an informal dialogue group; it has since become the primary regional vehicle for promoting open trade and practical economic co-operation. APEC member economies represent the rich diversity of the region as well as its differing levels of economic development. Despite such differences, there is a growing sense of common purpose and co-operation in the region that is aimed at sustained regional and world growth.

The Osaka Action Agenda, agreed in 1995, was a template for future APEC work that laid out some of the common goals of APEC members. Essentially, the Agenda represented the three pillars of trade and investment liberalization, their facilitation, and economic and technical co-operation. It stressed that for the APEC region to achieve sustained economic development, APEC economies had to pursue activities in each of these areas.

Standards and Conformance was one of the areas that the Osaka agenda targeted. The agenda set out four goals under Standards and Conformance that a chosen APEC forum would be asked to pursue. These goals were to:

1. Ensure the transparency of the standards and conformity assessment of APEC economies.
2. Align APEC economies' mandatory and voluntary standards with international standards.
3. Achieve mutual recognition among APEC economies of conformity assessment in regulated and voluntary sectors.
4. Promote co-operation for technical infrastructure development to facilitate broad participation in mutual recognition arrangements in both regulated and voluntary sectors.

The Manilla action plan of 1996 also called for the alignment, by 2005, of mandatory and voluntary standards with international standards. In particular, it emphasized the need to align standards on electrical and electronic appliances (air conditioner, television, refrigerator, radio and it parts, and video apparatus), food labelling, rubber gloves and condoms and machinery.

STEERING GROUP ON ENERGY STANDARDS

The SGES was formed after a meeting of APEC energy Ministers in August 1996. The role of SGES was to work together to achieve the benefits of increased co-operation on energy standards by:

- developing firm proposals for establishing a base on which mutual acceptance of accredited test facilities and standard test results obtained at these facilities [could] be achieved;
- working towards the establishment of bases for the direct comparison of the outcomes of testing to different standards so that the need for testing to multiple standards [could] be reduced or removed; and
- developing a general policy framework that would allow for the progressive development and implementation on a bilateral or multilateral basis, and product by product, as technical details [were] established and mutually agreed.

More details of the work undertaken by the SGES can be found in APEC (2000).

SGES KEY MILESTONES AND ACHIEVEMENTS

Performance Testing and Conformity Assessment Study

The first project that the SGES undertook was a study called Energy Efficiency Performance Testing and Conformity Assessment in APEC Member Economies (Nordicity 1997). The study surveyed APEC

economies to identify and compare laboratory facilities, accreditation standards and conformity in assessment practices, products tested and test standards. Ultimately, the study sought to assess the degree to which procedures could be harmonized and to quantify the benefits of harmonization to member economies. The key findings of the report were:

- The laboratory accreditation programs that have been put in place in the APEC economies vary primarily by their stage of development rather than by their requirements.
- There are a number of existing bilateral mutual recognition agreements between APEC member laboratory accreditation bodies. The Asia Pacific Laboratory Accreditation Cooperation (APLAC) is working to establish a multilateral mutual recognition agreement amongst the various laboratory accreditation bodies in the region.
- Differences exist, for the same products, between international test procedures, national test procedures and those test procedures included in member economy regulatory program requirements. While there may be good reasons for such variations, there is scope for reducing and possibly eliminating these differences on a product-by-product basis.

Trade Flows Study

The second project that the SGES undertook was an Overview of Trade Flows of Energy-Using Products between APEC Member Economies (APEC 1998). The Export Council for Energy Efficiency of the United States prepared the study. The study set out to examine trade flows of major energy consuming products between APEC member economies in an attempt to identify products where the greatest benefits might exist from reducing trade barriers. Key findings from the study were:

- There is substantial and valuable trade between APEC member economies in energy-using products, such as (all 1996 values):
    - air conditioners is worth US$3,000-3,300 million per year.
    - industrial motors is valued at about US$2,500-3,000 million per year.
    - household refrigeration totals about US$1,000-1,100 million per year.
    - lighting equipment (e.g. fluorescent lights and ballasts) is worth US$900-1200 million per year.
- Many of these products (indeed the majority in some cases) are regulated for energy efficiency by APEC economies.

These findings helped the Steering Group on Energy Standards develop their program of work on harmonizing aspects of energy efficiency testing and verification within the region.

Mutual Recognition Agreements

SGES was asked for a firm proposal on ways to reduce the need for multiple testing of products for energy efficiency standards. By reducing the need for multiple testing, firms will be able to test a product once, and then sell it anywhere in the APEC region, thereby reducing the costs of trade. In order to accomplish this objective, however, economies must have confidence in the results of testing performance laboratories in other APEC economies. As a result, it seemed to the SGES that a mutual recognition arrangement that operates through a specialist body that accredits national laboratory systems, such as APLAC, was a reasonable way to meet this objective. The SGES also recognized the existence of specialist bodies that accredit laboratories and facilitate trade at a regional and international level. The main conclusions were:

- International Standards Organization (ISO) Guide 25 (ISO 17025) is probably adequate for laboratory certification of most energy product testing.
- Given the variability of conformity assessment regimes in APEC economies, mutual recognition would be necessary for certification and verification organizations as well as for laboratory testing in order to meet the "test once, sell anywhere" objective. APLAC offered a mechanism to achieve this within APEC.

Test Performance Workshop

The SGES and the Philippine Department of Energy organized a Workshop on Setting-Up and Running an Energy Performance Testing Laboratory. The workshop was held on 6-8 July 1999 in Manila, Philippines. More than 40 representatives from 16 member economies attended the workshop to share technical expertise and experience related to setting-up and operating energy performance laboratories. Participants also discussed the requirements and steps needed to obtain laboratory accreditation.

Energy Efficiency Test Procedures and Regulations

The third study that the SGES commissioned was the "Review of Energy Efficiency Test Standards and Regulations in APEC Member Economies" (APEC 1999). EES of Australia prepared this study. The scope of the study covered all electrical products that are regulated for energy efficiency and that require testing. Practically, the study focused on major product groups including air conditioners, motors, lamps, ballasts for fluorescent lamps, electric water heaters, clothes washers, dishwashers, clothes dryers and refrigerators. In order to carry out the project succinctly, the study looked at every APEC economy as a separate entity in order to identify those products regulated for energy purposes, such as performance standards and labelling, and to document the technical requirements of those regulations within each economy. The main finding of the study were:

- A plethora of local test procedures are in use and these are likely to be restricting trade by increasing costs of trade. Furthermore, few international test procedures are "generic" and many require significant work to make them more applicable for regulatory purposes.
- For many product types, the alignment of test procedures appears to be the most feasible option in the medium term.
- Conversion algorithms (computer modelling concept) appears to be a feasible and attractive option for selected products (especially water heaters). The approach, however, is very new and has yet to be proven and receive widespread acceptance.
- There needs to be a change in direction with respect to the treatment of energy performance within the standard development activities of the International Electrotechnical Commission (IEC) and the International Standards Organization (ISO). There also needs to be an increased and ongoing input by APEC member economies into IEC/ISO standards development processes, especially for those products and those economies that regulate on the basis of energy and performance.

Based on this study, the SGES developed a three-pronged, product-by-product approach to remove or reduce the need for testing to multiple standards. Its major elements are:

1. For a few products (e.g. lamps): adopt a common test procedure from among those existing in the region.
2. For a number of products (e.g. dishwashers, ballasts & motors): influence the development of new and existing international test procedures that could be adopted by most or all APEC economies (e.g. through ISO or IEC).
3. For certain products (e.g. electric water heaters): develop algorithms to convert the results of one test procedure to meet the requirements of another test procedure.

Many of the findings of this study are covered in the body of this paper.

Colloquium on Energy Performance Standards

The Korean Ministry of Commerce, Industry and Energy, and the Korea Energy Management Corporation, hosted a Colloquium on Technical Issues of Minimum Energy Performance Standards in Seoul, Korea on 6-8 October 1999. Thirty key participants from eleven APEC economies attended the colloquium. Generally, those economies that attended were those that have, or are actively contemplating, mandatory minimum energy performance standards (MEPS) for the two product lines considered by the colloquium – namely, domestic air conditioners and ballasts for fluorescent lamps. See GWA (1999) and EES (1999) for background information on the colloquium.

Symposium on Refrigeration

A symposium on improving energy efficiency test procedures for refrigerators and freezers took place from 6-8 March 2000 in Wellington, New Zealand. Thirty-six delegates representing thirteen APEC economies attended. See EES (2000) for background information.

SGES Future Work

The APEC Steering Group on Energy Standards held its final meeting in March 2000. However, it made several recommendations and developed a number of ongoing projects to be managed by the APEC Energy Working Group:

- SGES developed a broad policy framework which will assist in the medium term alignment of test procedures.
- A project to examine the development of algorithms or computer models to convert between different test procedures.
- A web based standards notification procedure within APEC economies.
- The appointment of an Energy Efficiency Test Procedures Coordinator.

More details of all of these proposals can be found in APEC (2000).

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