APEC STUDIES ON ALGORITHM DEVELOPMENT FOR ENERGY PERFORMANCE TESTING

STUDY 4: SURVEY OF INDUSTRY AND REGULATORS

ASIA-PACIFIC ECONOMIC COOPERATION

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EXECUTIVE SUMMARY

The *APEC Studies on Algorithm Development for Energy Performance Testing* project is one of a series of projects managed by the Expert Group on Energy Efficiency and Conservation (EGEEC) to address the requests of APEC Energy Ministers to strengthen cooperation on energy efficiency standards. As a part of this project, the Survey of Industry and Regulators was conducted during 1 October 2001 to 30 November 2001.

This report presents the results of *Study 4: Survey of Industry and Regulators.* For this particular study, we conducted surveys of the industry (air conditioner and refrigerator manufacturers) and regulators (policymakers, test officials, and experts) involved in energy performance testing and captured what they think about conversion algorithms in terms of their development, applicability, and usefulness in trade within and outside of APEC.

Prior to this survey study, it was not sure whether conversion algorithms would be beneficial, useful, and applicable for APEC economies. The *Survey of Industry and Regulators* intended to resolve this uncertainty. Below, the survey team concludes the findings of this survey study.

Preliminary Industry Survey

Gathering data and contact information of AC & RF industry was not difficult; we rounded up more than 230 AC companies, 84 RF companies, and 76 AC&RF companies. However, the process of identifying whether they were relevant (a manufacturer, an exporter, and/or an importer) was costly and needed more time.

The Preliminary Industry Survey shows that the response rates for AC, RF, and AC&RF were all very low. From the 390 total companies found, only 22 replied (only about 14% response rate). Within these 22 responses, only 11 are relevant companies that are involved in international trade of *household* AC and RF products; therefore, even though some are distributors or importers.

The time constraint (about 1 week) had definitely reduced the value that we could gain from the preliminary survey. No following up could be made. We believe that if more time was available (at least 1 month), it should prove successful and could help filter out many of the irrelevant companies on the list. This, in turn, could help reduce the time and costs that would be incurred by conducting the main surveys.

Response Rates

Although the Preliminary Industry Survey helped to filter some of the irrelevant companies, the survey team still had to send the AC, RF, and AC&RF surveys to those who had not responded. As expected the response rates were low for all three survey sets. The low response rates for the Industry Survey made the Regulator Survey response rate (30%) look quite good. The main problems in conducting this survey are:
- ✔ Low response rate
- ✔ Respondents are reluctant to provide answers as an individual
- ✔ Respondents are unsure of the actual purpose of the survey to APEC
- ✔ High cost of international fax and calls

We summarize some key observations based on the response statistics.
- ✔ The low response rate may be a result of various factors combined:
  - ❖ A survey sent with the APEC Secretariat's certification letter looks very official and substantiated; this official-look can be considered a two-edged sword.
  - ❖ Some companies can be very bureaucratic; answering the survey questionnaire may require approval from managerial level persons. This again may take a lot of time, or the response may never be approved for return.
  - ❖ Certainly, one of the main reasons is that the time allowed for companies to respond is too short. The time official allowed was only one week, but extended to three weeks.
  - ❖ Specifying an early deadline may not be a good idea; alternatively, specifying a deadline that is too far into the future could cause recipients to put off the task and forget about it when the deadline arrives.
  - ❖ Questionnaires may have been addressed to the wrong persons or persons who have left the company due to outdated information; and some were not addressed to anyone in particular.
  - ❖ There is a lack of personal relationship between the survey team and the companies' staff to be able to persuade a quick response.
- ✔ What could be done to alleviate the problems and avoid low response rates in the future?
  - ❖ Allow more time to filter the list of manufacturers/companies and regulators so that international long-distance charges can be reduced.
  - ❖ Allow more time for recipients to respond to the questionnaire (1 month or more).
  - ❖ Certification letters should explicitly and clearly assure confidentiality of data and be designed to be official, yet not too serious.
  - ❖ On the issue of specifying deadlines, the survey team suggests that a deadline is mentioned, however, it should be flexible. We added the phrase, "or as soon as possible" after specifying the deadline.
  - ❖ There is a need for incentives; some kind of "prize" should be given to the company or its staff who respond on time.
  - ❖ Identify the appropriate contact person who can answer the questions quickly and without conferring too much with superiors.
  - ❖ APEC and its consulting teams need to establish closer relationship with manufacturers, at least as we have with regulators. Many of the manufacturers have no knowledge about APEC. Consequently, even with a letter of certification from the APEC Secretariat, they have doubts about APEC and the purpose of this survey.

The low response rates for the surveys indicate a need for an integrated information system for energy standards and testing in APEC economies. As of November 2001, the APEC EWG has consigned funds to develop an internet-based energy standards information system. This information system would provide regulators, manufacturers, users, and researchers with updated contact information of key persons in each APEC economy; through this system, the representatives could exchange information and ideas, discuss, and even make decisions on issues related to energy standards. The system will be especially useful in times of urgency when issues on energy standards and testing arise.

MEPS, Labeling, and Repeat Testing Requirements

The trend for energy performance requirements in APEC is moving towards a more restrictive environment. Most economies are already requiring labeling and more and more are implementing MEPS. Energy performance testing procedure is an important part of any labeling and MEPS program. However, the surveys found that these programs require energy performance of AC and RF units to be tested under many different international and national standards. The difference in test standard requirements has led essentially all relevant APEC economies to require products to be retested when they are imported from economies that use a different test standard.

The fact that repeat testing is unmistakably prevalent supports the need to develop a central basis in some certain form that APEC economies could agree upon that would help remove the need for repeat testing. Conversion algorithms, if proved successful, could be one of the possible forms that the economies could all agree to utilize in order to reduce the cost of trade.

Views on Conversion Algorithms

Benefits of Conversion Algorithms

The majority of Industry respondents agree that a conversion algorithm would be beneficial to them in terms of cost, time, design, production, and equipment. Similarly, more than 80% regulators agree that conversion algorithms could help reduce both time and cost, and open up trade.

Support for Conversion Algorithms

There was a good level of support for conversion algorithms from RF respondents. AC respondents showed an average level of support, with a minority stating that conversion algorithms would not be useful or applicable. A great majority (at least 90%) of regulators would support the regulations that would allow conversion algorithm to be used. They recognize that conversion algorithms could reduce waste, helps trade, and provide benefits to all; but still, many cautioned that a good reference standard would be necessary to gain their support.

Development of Conversion Algorithms

The majority of all respondents prefer that conversion algorithms be "simple but effective," rather than "complex but accurate." Most respondents do not have experience in developing these algorithms while those that do have not been 100% successful.

AC respondents suggested that most attention should be paid to ambient temperature, indoor dry & wet bulb temperature, compressor type, and refrigerant type for AC conversion algorithm development. RF respondents are most concerned with the ambient temperature, refrigerant type, test packs (load), duration & procedure of tests, adjusted volume & wall thickness, and compartment temperature. For air-conditioners, seasonal variation is important in those regions with seasonal climates. Therefore, a modeling-type algorithm would probably be useful. For refrigerating appliances, an algorithm may be considered possibly less necessary and would be more complex.

The most significant barriers would be the difference in testing conditions and environment, different test methods and setup, and reaching a consensus on a reference standard. Regulators are also worried about the difficulty of developing a model that is fully applicable to all conditions. Standardizing a reference test method is also important and the development should start from a small number of test standards. To overcome these barriers, the respondents most often stress the importance of cooperation among economies in working together to reach an agreement.

Views on the Alignment of Standards

The results of both Industry and Regulator surveys showed extremely encouraging signs for the initiative to align test standards in the APEC region. All Industry respondents indicated they would support the alignment of standards, while there were about 70% of the regulators who expressed support. The most preferred standard to align to is the ISO standard for both AC and RF testing. However, because the ISO test standards still had some shortfalls, some still prefer to align to their own economy's test standards.

Overall Supposition

Overall, the survey was successful in gathering views of the Industry and Regulators in APEC economies. The results indicate clearly the need for more activities in APEC in terms of cooperative developments and projects, such as the development of conversion algorithms, which aim to reduce differences in energy performance testing requirements in APEC.

The following are the conclusions that sum up the survey study.

1) The concept of introducing algorithms received very high degree of support from regulators, who before the survey represented the highest potential barrier.

2) Unexpectedly, there was also great support for the alignment of test standards, despite some possible dissatisfaction with the current international standards.

3) Development of conversion algorithms should continue, as it could be an intermediate solution to reduce trading costs from repeat testing until the alignment of standards is realized.

4) There is a need for continued coordination between regulators of the APEC member economies. Possibly this could be in the form of an EGEE&C self-funded project or a workstream of that expert group.

5) Fundamentally, there is a crucial need for a forum where representatives of APEC economies can continually exchange information and ideas on energy standards-related issues. An internet-based energy standards information system that the APEC EWG is developing could be just the solution to increase coordination between APEC economies.

TABLE OF CONTENTS

1   INTRODUCTION

Energy performance requirements can bring tremendous benefits in conserving energy and improving the efficiency of energy-consuming products in all economies; nonetheless, they sometimes exist as restrictive non-tariff barriers to trade. These requirements come in many forms, such as, minimum energy performance standards (MEPS), labeling requirements, energy performance certification by accredited test laboratories, and test standards required to measure energy performance. The Asia-Pacific Economic Cooperation (APEC) devised this project to address a specific issue about the difference in test standards that are required in APEC economies and how it leads to incompatible results and higher costs of trade.

1.1 APEC AND ITS ACTIVITIES

The main purpose of the Asia-Pacific Economic Cooperation (APEC) is to enhance trade within the region and between its member economies and other economies. To achieve increased trade volume, one of the most effective ways is to reduce trade barriers, both tariff and non-tariff. Tariff barriers are well known and dealt with directly by the trade ministers. However, non-tariff barriers are sometimes unforeseen and difficult to identify. Even tougher is to remove non-tariff trade barriers that have already been identified. Some of these are, for example, publicity campaigns to buy local products, long legal process in bringing imported goods to the market, and other technological, environmental, and energy-related requirements.

APEC aims to deal with the various trade barriers through nine working groups, one of which is the Energy Working Group (EWG) whose goal is to maximize the energy sector's contribution to the region's economic and social well being through activities in five areas of strategic importance:
- ✔ energy supply and demand,
- ✔ energy and the environment,
- ✔ energy efficiency and conservation,
- ✔ energy research, development and technology transfer, and
- ✔ minerals and energy exploration and development.

1.2 OBJECTIVES OF THE PROJECT

The *APEC Studies on Algorithm Development for Energy Performance Testing* project is one of a series of projects managed by the Expert Group on Energy Efficiency and Conservation (EGEEC) to address the requests of APEC Energy Ministers to strengthen cooperation on energy efficiency standards. The Expert Group reports to the APEC Energy Working Group.

The objective of this project is to foster the development and use of conversion algorithms to translate between energy performance results obtained under different test standards, with the aim of avoiding expensive multiple testing of appliances to different test standards. The main tasks are to confirm the identity of the products for which the development of test result conversion algorithms will be appropriate, practical, and realistic, and to determine the features of those algorithms. A subsequent project will facilitate the actual development of the algorithms.[1]

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[1] As defined in the Request for Proposal and Annex A of the Contract for the Project (EWG 03/2000T).

There are four parts to this project:

    Study 1: Selection of Product Groups
    Study 2: Study of Algorithms for Domestic Refrigeration Appliance
    Study 3: Study of Algorithms for Domestic Air Conditioners
    Study 4: Survey of Industry and Regulators

This report presents the results of *Study 4: Survey of Industry and Regulators.* For this particular study, we conducted surveys of the industry (air conditioner and refrigerator manufacturers) and regulators (policymakers, test officials, and experts) involved in energy performance testing and captured what they think about conversion algorithms in terms of their development, applicability, and usefulness in trade within and outside of APEC.

Prior to this survey study, it was not sure whether conversion algorithms would be beneficial, useful, and applicable for APEC economies. The *Survey of Industry and Regulators* intended to resolve this uncertainty.

1.3 RATIONALE FOR CONVERSION ALGORITHMS

Energy efficiency and performance requirements are proven as good tools to improve the overall energy efficiency for appliances in individual markets, but their differences may transform these requirements into non-tariff barriers that increase costs of trade, which in the end, becomes a burden on the consumer. If inappropriate, such energy efficiency requirements may even prevent the optimum energy efficiency outcome, which in our opinion is to enhance development of energy efficient technologies in consumer products and boost the distribution of these technologies to all markets.

The idea of conversion algorithms materialized in the 1990s when it became evident that, as national markets become integrated into greater regional and global markets, energy efficiency and testing requirements can act as very restrictive barriers to trade. The first resolve that comes to mind would usually be to align the requirements in each economy; however, the alignment of standards can only be viewed as a longer-term solution at present. Conversion algorithms, on the other hand, may be considered a viable transitional solution.

Part of the objectives of the four studies is to establish grounds for developing conversion algorithms, and to determine whether they are useful and applicable. Many pro-algorithm presumptions have been circulated to support the development of the algorithms, such as:

✔ Repeat testing is prevalent across APEC economies and it affects trade negatively.
✔ Conversion algorithms could be developed to accurately translate test results from different standards.
✔ Conversion algorithms, if successful, could help alleviate the costs of repeat testing and enhance trade between economies.
✔ It is relatively easier to gain support for conversion algorithms than that for the alignment of standards.

These presumptions have been investigated through this survey study. If all or most of them prove true, they could easily persuade the APEC Energy Working Group and representatives of member economies that the development of conversion algorithms is a sound undertaking and can provide true benefits and enhance trade among the economies in an efficient way.

2 SURVEY METHODOLOGY

The main purpose of this survey study was to gather views and suggestions of industry (manufacturers) and regulators (policymakers, test officials, and experts) on the development of conversion algorithms for translating between test results. Two separate sets of surveys were conducted simultaneously: 1) Survey of Industry and 2) Survey of Regulators. The surveys gauged the reaction of industry and regulators to the concept of using algorithms in place of repeat testing, and the extent to which algorithms might be applied.

2.1 SURVEY TEAM

The survey study was carried out by a team of three researchers:

Project Manager	Mr Sood Ratanadilok Na Phuket, MS, Electrical Engineering
Project Assistant 1	Mr Javasith Nualnim, BS, Computer Science
Project Assistant 2	Ms Atitaya Sornbutnark, BBA, International Business

2.2 SCOPE AND SCHEDULE OF WORK

2.2.1 Target Recipients

The Survey of Industry included manufacturers of *domestic (or household)* air conditioners and refrigeration appliances based in APEC economies, while the Survey of Regulators included policymakers, test officials, and experts on energy performance testing of electrical appliances.

The scope of work required the surveys to cover manufacturers and regulators in APEC economies that have or are considering mandatory energy efficiency requirements (or similarly minimum energy performance standards, or MEPS) for air-conditioners and domestic refrigeration appliances. Note that the scope is limited to the energy performance of electrical domestic (household) scale air-conditioners (ACs) and domestic (household) refrigeration appliances (RFs). It does not cover safety or other requirements. The study is to take account of conditions in all 21 APEC member economies, but need be applicable only to those economies with, or considering, mandatory energy efficiency requirements for the two product groups.[2]

Although some economies do not have MEPS in place, the survey team felt that we should also allow them to express their views regarding conversion algorithms and the issue of standards alignment in APEC. Thus, we increased the scope to cover as many APEC economies as possible.[3] In the next sub-section, we describe in more detail the identification of manufacturer and regulator contacts.

2.2.2 Required Tasks

From the Annex A of the Contract, the survey team is required to perform these main tasks:
- ✔ Study the initial reports from the other three studies under this project
- ✔ Identify manufacturers who trade significant quantities of domestic air-conditioners or domestic

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[2] As defined in the Request for Proposal and Annex A of the Contract for the Project (EWG 03/2000T
[3] To the extent that there are manufacturers in a particular economy

refrigeration appliances
- ✔ Identify the relevant regulators in APEC member economies (for this, EWG may provide contacts)
- ✔ Create a set of survey questions designed to elicit the information required of manufacturers, and a complementary set of survey questions for regulators
- ✔ Submit a draft report to the project manager and other members of the project steering group;
- ✔ Produce a final report which incorporates comments of the project steering group, and includes recommendations to the EGEEC and the EWG
- ✔ Arrange for the final report to be published on an APEC approved website in an agreed format (typically PDF version)

2.2.3 Project Timeline

The study started on 1 October 2001 and ended on 30 November 2001. The Gantt chart below shows our schedule of activities and tasks accomplished.[4]

Figure 1

Project Timeline	Month	October 2001					November 2001			
Activities and Tasks	**Week**	1	2	3	4	5	6	7	8	9
1. Gather Industry contact information		▮								
2. Send out Preliminary Industry Survey			▮							
3. Finalize Regulator contact information and questionnaire			▮							
4. Collect Preliminary Industry Survey				▮						
5. Send out Main Survey to Regulators				▮						
6. Send out Main Survey to Industry					▮					
7. Collect and follow-up on surveys					▮	▮	▮			
8. Produce Draft Report							▮	▮		
9. Revise and submit Final Report									▮	▮

2.3 GATHERING CONTACT INFORMATION

2.3.1 Industry Contacts

The survey team searched extensively for contact information of air conditioner and refrigerator companies. The Internet was our main source for finding company contact information. We also extracted contact information from previous contact lists, such as participant lists from APEC Steering Group on Energy Standards (SGES) workshops. The phone book, particularly, for Thailand was another source of contact information. We also asked our personal contacts in different economies to provide some guidance and existing lists. During the first week of October, we found in APEC economies:
- ✔ 230 air conditioning (AC) companies
- ✔ 84 refrigeration (RF) companies
- ✔ 76 airconditioning and refrigeration (AC&RF) companies

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[4] Blue: supporting activity; Orange: production activity; Green: output/deliverable due

All are either manufacturers and/or distributors in the APEC economies that have substantial contact information that we could use to conduct the survey. At this point, we had not determined whether these companies are manufacturers, distributors, or both. Moreover, most of the contact information did not provide us with a particular contact person that we could ask about energy performance testing. The economies that we could not find any information on local manufacturing companies are Brunei Darussalam, Papua New Guinea, Singapore, and Vietnam. Russia has some air conditioning companies, but no household refrigerator manufacturers were identified.

The survey team deliberated about how to find the right contact person that could respond to these surveys with enough knowledge on the subject. We decided to conduct a preliminary survey to verify each company's contact information, status (manufacturer or distributor, exporter or importer), and type of manufacturer. This preliminary survey served as a tool for us to exclude companies that are irrelevant (manufacturers and distributors at national level) and keep the ones that should be part of the survey (exporting manufacturers or importers).

2.3.2 Regulator Contacts

Most of the contact information on regulators (policymakers, test officials, and experts) was gathered from previous contact lists, such as participant lists from APEC SGES workshops. Combining these lists, we came up with 108 regulators in 17 economies. The four APEC member economies not contacted were Brunei Darussalam, Chile, Papua New Guinea, and Peru.

Since most of the regulators are personally known to the survey team and we knew that they are in the related fields, a preliminary survey was not necessary. Therefore, for the regulators, we decided to start directly with the main Regulator Survey.

2.3.3 Contact Databases

Three separate databases were created for AC companies, RF (including AC&RF) companies, and Regulators. The databases were all created as Microsoft (MS) Excel database files, as opposed to MS Access database files, for ease-of-use considering the survey data characteristics and the type of analysis required. The three databases are included in the CD-ROM as:
  1. Contact List-AC.xls
  2. Contact List-RF.xls
  3. Contact List-Regulator.xls

Overall, the Microsoft Office applications were chosen as the base set of applications because they are commonly used by most organizations, Furthermore, one MS Office application (in our case, MS Word) can readily access data from another application (MS Excel) with ease. In MS Word, we deployed the mail merge tool for accessing the databases in MS Excel to produce personalized questionnaires that can be sent via fax or email directly from the computer. For those that we have to use airmail, the personalized questionnaires, along with their envelopes, were also printed out using the mail merge tool. We found the mail merge tool to be extremely useful, flexible, cost-effective, and a great time-saver.

2.4 PRELIMINARY INDUSTRY SURVEY

2.4.1 Survey Design

As mentioned earlier, the survey team needed to find the AC and RF companies that are actually exporting manufacturers or importers. The survey team felt that this preliminary survey would also act as a good introductory contact with the manufacturers. We contacted the APEC Secretariat office to request for an official letter from the APEC Secretariat, with which we could send the preliminary survey. The official APEC letter introduced the project and its purpose and requested for cooperation from the Industry and Regulators (see Appendix 1).

With the official APEC letter, the preliminary survey questionnaire could be compact and was designed to fit into one A4 page. It had only four questions to determine what type of operation these companies do. The questionnaire asked each company:

1. Whether it produces/sells *household* refrigeration appliances;
2. Whether it is a manufacturer of complete units, an original parts manufacturer (OEM), and/or a distributor;
3. Whether it exports, imports, or only makes/sells domestic products; and
4. Who would be the most appropriate person to contact regarding energy performance testing and certification?

From the answers to these four questions, we could determine whether a particular company was a target recipient.[5]

2.4.2 Survey Dissemination

Due to the high costs of long distance calling and faxing, the survey team deliberated between the use of telephone, facsimile, or electronic mail to send the questionnaires to the AC and RF manufacturers. The least cost way is by email, of course; however, from experience, many private companies still prefer to correspond by fax due to its formality and visibility. In effect, we faxed most of the preliminary survey questionnaires to AC companies, RF companies, and AC&RF companies to find out whether they manufacturer, distribute, export, and/or import. Email was used sparingly; we sent the questionnaire by email only to addresses that represented a particular person in the company, for example, *jsmith@company1.com*. We disregarded email addresses that were vague, such as *marketing@company1.com* and *support@company2.com*.

2.4.3 Survey Collection & Results

We dispatched the preliminary survey questionnaires during 7-9 October and asked for the completed questionnaires to be sent back during that week. Only a short time was given to the companies to reply since the questionnaire was very simple and short. There was no follow-up during this short period.

Since this was only the preliminary survey, the results are brief and presented here in this section. By the end of the week (8-12 October), we received only 22 total responses out of 158 questionnaires sent (13.9% response rate). The breakdown of the number of contacts found, questionnaires sent, and response for each group is shown in Table 1.

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[5] See Appendix X for the full version of the preliminary survey questionnaire.

The Response rate is the percentage of the number of Responses (replies received) compared to the number of Throughs (questionnaires that were sent successfully). From the responses, we break down those who produce and sell *household* appliances, who are manufacturers and/or distributors, and who are exporters, importers, or only produce for the domestic market.

Table 1: Preliminary Industry Survey Results

Group	Found	Throughs	Through Rate	Responses	Response Rate
AC	230	95	41.30%	14	14.74%
RF	84	41	48.81%	6	14.63%
AC&RF	76	22	28.95%	2	9.09%
Total	390	158	40.51%	22	13.92%

Group	Responses	Household	Commercial
AC	14	6	8
RF	6	4	2
AC&RF	2	2	0
Total	22	12	10

Group	Household	Manufacturer / OEM	Distributor only	Export / Import	Import Only	Domestic Only
AC	6	5	1	5	1	0
RF	4	3	1	2	1	1
AC&RF	2	2	0	2	0	0
Total	12	10	2	9	2	1

We can conclude from the above tables the following:
- ✔ The Response rate is low for all the groups (less than 15%).
- ✔ Out of 22 that responded, only 12 make/sell *household* appliances.
- ✔ Out of the 12 household appliance companies, 10 are manufacturers and 2 are distributors.
- ✔ From the 12 companies, we can exclude one company that only operates domestically.
- ✔ All the 11 other companies have some kind of interaction with international trade; therefore, even though some are distributors or importers, all 11 companies should be surveyed for their views on conversion algorithms.

2.5 SURVEYS ON CONVERSION ALGORITHMS

This section describes the survey instruments used to achieve the objectives of the Study, particularly its design, dissemination, and collection processes.

2.5.1 Industry Survey

2.5.1.1 Design

The industry survey aimed to gather views and opinions of air conditioner and refrigerator manufacturers/companies in APEC economies about conversion algorithms and their development. We wanted to find out what manufacturers think about differences in energy performance test procedures, the effects of repeat testing, and the possibility, benefits, and applicability of conversion algorithms.

The Industry Survey was separated into two separate survey sets:
- ✔ Survey of AC manufacturers/companies
- ✔ Survey of RF manufacturers/companies
- ✔ Survey of AC&RF manufacturers/companies

For these survey sets, the instrument used is a simple check-and-fill questionnaire. As such, the surveys can be considered a mail-type survey; this includes, nowadays, dissemination through fax and email, in addition to postage mail. The survey team reckoned that it was inappropriate to conduct personal or phone interviews with the manufacturers, mostly because it would be an unfair to allow a manufacturer to express its answers in more detail than another manufacturer. Another reason is the language barrier for many of the manufacturers in many economies. We found this problem prevalent from searching for and identifying contact persons in different economies.

The AC and RF survey sets have many identical questions, with only a few specific questions that apply to only AC or RF companies. For the AC&RF survey set, we use both the AC and RF questionnaires. Below we categorize the questions of both the AC and RF questionnaires. The full questionnaires can be found in Appendices 4 and 5.

Requirements: MEPS, Labeling, and Repeat Testing
1. What is your product range?
    - ❖ **[AC]** Please give the size range in BTU, ton, or kW (state which) for each type of air conditioning appliance (specify type: split-system, window, etc.)
    - ❖ **[RF]** Please give the size range in litres or cu ft (state which) for each type of refrigeration appliance (specify type: refrigerators, freezers, refrigerator freezers, etc.)
2. Does your economy impose minimum energy performance standard (MEPS) on household **[ACs and RFs]**?
3. To what energy performance test standard(s) does your company perform tests?
4. Test-standard specific question:
    - ❖ **[AC]** Does the test standard that your company uses accurately consider the impact of barometric pressure on the psychrometric calculations to determine cooling capacity? Is the barometric pressure measured?
    - ❖ **[RF]** Are there any special features in any of your models that may reduce energy

consumption in actual use but not under test conditions? If yes, please give brief details

5. Do you export your AC units?
6. Do you encounter repeated testing when exporting to other economies?

Benefits of Conversion Algorithms

7. Would a conversion algorithm benefit the trade of your company's products?
   ❖ In what way? Choices: Cost; Time; Equipment; Production; Design; Other

Support for Conversion Algorithms

8. If a conversion algorithm can satisfactorily translate results between different test standards, would you support the regulations that will allow the use of this algorithm?

Development of Conversion Algorithms

9. Should these algorithms be "simple but effective" or "cumbersome but accurate"?
10. Have you had any experience in developing a conversion algorithm to translate results between test standards?
    ❖ If yes, was it successful?
11. In the development of conversion algorithms, can you prioritize the <u>five</u> most important variables that should be addressed?
    ❖ **[AC]** Choices: Ambient Temperature; Refrigerant Type; Compressor Type; Expansion Device Type; Indoor Dry Bulb Temperature; Indoor Wet Bulb Temperature; Ambient Wet Bulb Temperature; Test Condition Tolerances; Other
    ❖ **[RF]** Choices: Ambient Temperature; Compartment Temperature; Refrigerant Type; Adjusted Volume & Wall Thickness; Food Loads/Test Packs; Door Openings; Test Measurement Duration & Procedure; Advanced Features & Defrost Mechanism; Other
12. What do you see as the most significant problems/barriers in translating results between test standards?
13. Please suggest ways in which the conversion algorithm could be developed to meet the needs of manufacturers such as yourself

Support for Alignment of Test Standards

14. Would you support the alignment (harmonization) of test standards for **[ACs and RFs]**?
    ❖ If yes, to which standard and why?

2.5.1.2   Dissemination

As mentioned above, the survey instruments are mail-type surveys, which means the questionnaires were prepared and sent out through fax, email, or post. Table 2 shows the proportions of the questionnaires distributed by fax, email, and post (those that went through). These surveys were sent to recipients during 13-19 October 2001.

Table 2: Industry Survey Distribution Methods

Delivery Medium	AC Survey (136)	RF Survey (48)	AC&RF Survey (35)
Fax	71% (97)	56% (25)	57% (20)
Email	21% (28)	27% (13)	20% (7)
Post	8% (11)	17% (8)	23% (8)

By Fax

The preferred medium is by fax; although more costly than email, it is the quickest way to get attention of the companies and it can most of the time assure us that someone will receive it and at least physically forward it to the desired recipient. If there are problems or questions regarding the questionnaire, at least they have our contact information.

By Email

Email is the second preference. Email cost virtually nothing to send the questionnaires long-distance across economies; however, it does not assure us that the recipient will receive it right away. We cannot expect that recipients will check email regularly. Furthermore, an email can be put off much easier than a fax when it arrives among all the junk and other personal emails of the recipient. As done earlier in the Preliminary Survey, we only chose to send questionnaires to email addresses that represent a specific staff person, not to generic email addresses.

By Post

The least preferred medium is post because of its slow, unpredictable, and uncertain delivery time and date. The time allowed to implement the survey study was inadequate to use mail surveys. Mailing questionnaires by airmail was necessary only when the fax and email media are unsuccessful.

2.5.1.3   Collection

The data collection process had very limited time, which was essentially not enough to conduct an international survey such as in the APEC region. The tight schedule only allowed the data collection to start on 13 October 2001 (the first day we sent out questionnaires) to 31 October 2001.

However, most recipients could not reply by the end of October.[6] The survey team started sending out reminders (fax and email) to all recipients, requesting them to return the completed survey form as soon as possible. We found that the reminder was quite effective; approximately 20-25% of the total responses were obtained afterwards.

During the first week of November, the survey team started entering the responses into the databases.[7] We continually entered the responses that were still trickling in. The survey team accepted the responses until 15 November 2001 (when the Draft Report was due) because of the low number of responses and the fact that many recipients still needed more time to "officially" submit their responses. There is a set of completed surveys from the

2.5.2 Regulator Survey

2.5.2.1   Design

The Regulator Survey aimed to gather views and opinions of policymakers, test officials, and experts (combined, referred to as regulators) in APEC economies about conversion algorithms and their development. We sought to determine what regulators think about differences in energy performance test procedures, the effects of repeat testing, and the possibility, benefits, and applicability of conversion algorithms.

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[6] The deadline requested on the questionnaires was as early as 22 October 2001 for those sent by the 13th & 14th; for the questionnaires that were sent on later dates the deadline was accordingly to give at least one week for the respondents.
[7] Since the number of responses were low (less than 50), it is very manageable in MS Excel. For high number of responses, the SPSS application would have been deployed.

The survey is a mail-type survey; the instrument used is a simple check-and-fill questionnaire. It was not appropriate to conduct personal or phone interviews with any of the regulators, mostly because it would be an unfair to allow a regulator to express its answers in more detail than another regulator.

The Regulator Survey asks similar questions to that of the Industry Survey. It is not as detailed on the technical aspects, but focused on the views and suggestions in terms of policies. Each question in the questionnaire applies to both AC and RF; as such, the questionnaire provides two answer columns (AC and RF) for each question. The full questionnaire is shown in Appendix 6.

Requirements: MEPS, Labeling, and Repeat Testing

1. Does your economy impose minimum energy performance standard (MEPS)
   ❖ If yes, to which test standard?
   ❖ If no, is MEPS under consideration?
2. Aside from MEPS requirements, does your economy require energy performance testing for labeling, or other information-related reasons?
   ❖ If yes, to which test standard?
3. For an imported unit that has been tested and certified in a foreign country under a different test standard than the one used in your economy, do your regulations require it to be re-tested?

Effects of Repeat Testing

4. In your opinion, how does repeated testing affect foreign manufacturers importing into your economy?
   ❖ Choices: Positively, Negatively, No Effect, Don't Know
5. How does repeated testing affect local manufacturers exporting to other economies?
   ❖ Choices: Positively, Negatively, No Effect, Don't Know

Benefits of Conversion Algorithms

6. Would a conversion algorithm benefit the trade of AC and RF units?
   ❖ If yes, in terms of what?

Support for Conversion Algorithms

7. If a conversion algorithm can satisfactorily translate results between different test standards, would you support the regulations that will allow the use of this algorithm?

Development of Conversion Algorithms

8. Should these algorithms be "simple but effective" or "cumbersome but accurate"?
9. Have you had any experience in developing a conversion algorithm to translate results between test standards?
   ❖ If yes, was it successful?
10. What do you see as the most significant problems/barriers in translating results between test standards?
11. Please suggest ways in which the conversion algorithm could be best developed

Support for Alignment of Test Standards

12. Would you support the alignment (harmonization) of test standards for air conditioners and refrigerators?
    ❖ If yes, to which standard and why?

2.5.2.2 Dissemination

Questionnaires for the Regulator Survey were distributed during 13-19 October 2001 by fax, email, and post as follows:

Table 3: Regulator Survey Distribution Methods

Delivery Medium	Regulator Survey (100)
Fax	23% (23)
Email	60% (60)
Post	17% (17)

Unlike the Industry Survey, the Regulator Survey deals with policymakers, test officials, and experts most of whom the survey team had contact with in the past. We also know that most of the regulators check email regularly. Therefore, for the Regulator Survey, we chose to distribute the questionnaires by email first, then if unsuccessful, by fax and post respectively. Using email as the preferred medium for distribution saved a large amount of international calling costs, while reasonably effective in getting the questionnaires to the regulators.

2.5.2.3 Collection

The Regulator Survey was collected in the same manner as described for the Industry Survey.

3 SURVEY RESULTS

In this section, we present the results of the Industry and the Regulator Surveys. We have grouped the results into four main subsections:
1. Response Rate
2. Requirements: MEPS, Labeling, and Repeat Testing
3. Views on Conversion Algorithms
4. Views on Alignment of Standards

3.1 RESPONSE RATE

3.1.1 Industry Response Rate

From the results of the Preliminary Industry Survey, the survey team filtered the contact lists so that they contained primarily companies that deal with international trade of ACs and RFs. Many companies did not respond to the preliminary survey; we could not determine whether these companies represent our target recipients. We still managed to trim down the total number of contacts for each group by a substantial amount.

Table 4 Industry Survey Response Rate

Group	Trimmed Total	Throughs	Through Rate	Responses	Response Rate
AC	162	136	83.95%	9	6.62%
RF	62	48	77.42%	6	12.50%
AC&RF	43	35	81.40%	1	2.86%
Total	267	203	76.03%	21	10.34%

Table 4 shows the through and response rates of the Industry Survey. Not surprisingly, the number of responses is about the same as what was obtained by the Preliminary Industry Survey. The one AC&RF manufacturers turned out to be just a refrigerator manufacturer. Therefore, the AC&RF survey set was merged into the RF survey set; now, only the AC and RF survey sets are relevant.

Main observations based on the response statistics:
- ✔ Only some of the responses are the same as the ones obtained during the preliminary survey.
- ✔ The number of responses from the AC group was much higher (14) during the preliminary survey. However, we must compare the responses that are from *household* AC companies. Only six were, while eight others were commercial AC companies.
- ✔ It is very peculiar that companies in the USA showed minimal response.
- ✔ The low response rate may be a result of various factors combined:
  - ❖ A survey sent with the APEC Secretariat's certification letter looks very official and substantiated; this official-look can be considered a two-edged sword. From one perspective, it can be very helpful since companies will not need to question the survey team about the purpose and objective. On the other hand, an official-looking document can discourage companies to answer questions that, to them, are sensitive when they are allowed only a short time to respond.
  - ❖ Some companies can be very bureaucratic; answering the survey questionnaire may require approval from managerial level persons. This again may take a lot of time, or the response may never be approved for return.
  - ❖ Certainly, one of the main reasons is that the time allowed for companies to respond is too

short. The time official allowed was only one week, but extended to two weeks. For manufacturing and sales companies, completing surveys may not be one of the priority tasks. Time must be given for them to "get to it."

- ❖ Specifying an early deadline may not be a good idea; as mentioned that companies need time to respond to an official survey on a technical topic, having a deadline may discourage companies to respond altogether if the deadline is too close. Alternatively, specifying a deadline that is too far into the future could cause recipients to put off the task and forget about it when the deadline arrives.
- ❖ Impersonal bulk faxing, emailing, and faxing do not appeal to most recipients.
- ❖ Questionnaires may have been addressed to the wrong persons or persons who have left the company due to outdated information; and some were not addressed to anyone in particular.
- ❖ There is a lack of personal relationship between the survey team and the companies' staff to be able to persuade a quick response.

✔ What could be done to avoid low response rates in the future?
- ❖ Allow more time for recipients to respond to the questionnaire (1 month or more).
- ❖ Certification letters should explicitly and clearly assure confidentiality of data and be designed to be official, yet not too serious.
- ❖ On the issue of specifying deadlines, the survey team suggests that a deadline is mentioned, however, it should be flexible. We added the phrase, "or as soon as possible" after specifying the deadline.
- ❖ There is a need for incentives; some kind of "prize" should be given to the company or its staff, for example, APEC could offer a free trip for the company's staff to attend a workshop on related issues. Note that there have to be conditions that will encourage recipients to respond as quickly as they can, for example, having a limited number of "winners," use the first-come-first-serve basis, or holding a draw for those who respond on time.
- ❖ Identify the appropriate contact person who can answer the questions quickly and without conferring too much with superiors.
- ❖ Build working and personal relationship with contact persons before conducting surveys.

3.1.2 Regulator Response Rate

There were 112 regulators (policymakers, test officials, and experts) in 17 APEC economies, as shown in Table 5. Four economies that were not surveyed are Brunei Darussalam, Chile, Papua New Guinea, and Peru.

Our total sample size of 112 was reduced to 100 due to wrong contact information and a number of duplicate contacts in individual government agencies. Note that the 30% response rate was obtained by comparing the number of responses (30) to the sample size of 100 (the number of questionnaires that were sent out successfully), not the total number of contacts (112). For the Regulator Survey, 30% is quite a good response rate for a *mail* survey.[8]

Some of the reasons for good response rate are:
- ✔ The APEC entity is an important alliance for all the economies in the region. As government officials, they may feel required to complete the survey since APEC projects are also their economy's project, indirectly.
- ✔ The survey team has a personal relationship with many of the regulators.
- ✔ Most of the time, the questionnaires reached the appropriate contact person in the government agency since we know the name of the person, not just the agency.

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[8] Based on previous mail survey experience. The definition of a "mail" survey can be defined here as a survey that is conducted by mail, fax, and email; it does not include personal and phone interviews.

| Regulator No.	Economy	# of Contacts	Throughs	# of Replies	% Response
1-5	Australia	5	5	3	60.0%
6-11	Canada	6	5	1	20.0%
12-20	China	9	9	4	44.4%
21-24	Hong Kong, China	4	4	3	75.0%
25-27	Indonesia	3	3	0	0.0%
28-31	Japan	4	4	0	0.0%
32-42	South Korea	11	10	2	20.0%
43-54	Malaysia	12	11	4	36.4%
55-62	Mexico	8	7	1	14.3%
63-67	New Zealand	5	3	2	66.7%
68-74	Philippines	7	7	2	28.6%
75-85	Russia	11	5	1	20.0%
86-88	Singapore	3	3	1	33.3%
89-90	Chinese Taipei	2	2	2	100.0%
92-99	Thailand	9	9	2	22.2%
100-105	USA	6	6	1	16.7%
106-108	Vietnam	3	3	1	33.3%
Sample	15 out of 17	112[9]	100	30	30.0%

Still, 70% of the questionnaires sent were not returned. This could be due to many factors:
- ✔ Change in position or movements within the department.
- ✔ Surveys may have been too formal, and for the recipient, responding may seem like giving an official view of the government agency; consequently, approval from a superior was required before returning the survey. This can delay some questionnaires for a very long time; and some may never be returned.

3.2 REQUIREMENTS: MEPS, LABELING, AND REPEAT TESTING

Figure 2

Testing Required by MEPS for AC & RF in 15 APEC Economies
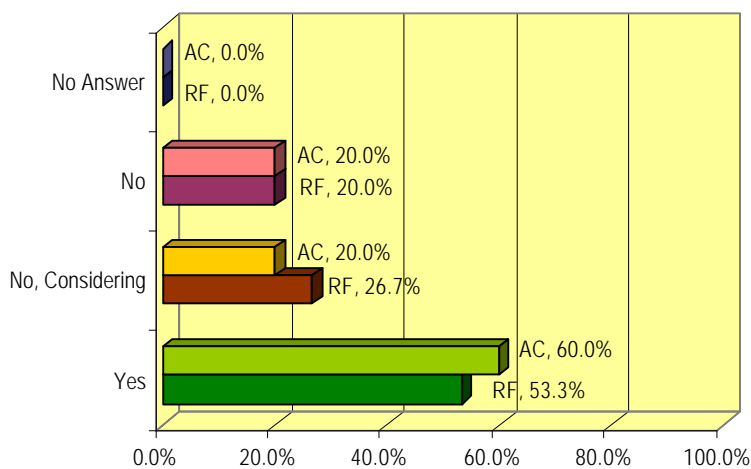
In this section, we take the results from the Regulator Survey (Questions 1 to 3) to derive statistics on MEPS testing, labeling testing, and repeat testing requirements in the 15 APEC economies that responded. These results are also crosschecked with relevant APEC documents about MEPS and labeling requirements.

Figure 2 presents a pair of graphs; they show that MEPS for air conditioners are required in 9 out of 15 economies (60%), while 8 out of 15 require MEPS (53.3%) for refrigerators. Three economies are

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[9] Although Regulator Numbers (first column) runs from 1 to 108, there were 4 additional regulators after we finalized the contact list for sending out questionnaires.

Figure 3

Testing Required by Labeling for AC & RF in 15 APEC Economies

No Answer — AC, 0.0%; RF, 0.0%

No — AC, 13.3%; RF, 13.3%

No, Considering — AC, 6.7%; RF, 6.7%

Yes — AC, 80.0%; RF, 80.0%

(x-axis: 0.0%, 20.0%, 40.0%, 60.0%, 80.0%, 100.0%)

Figure 4

Repeat Testing Required for AC & RF in 15 APEC Economies

No Answer — AC, 26.7%; RF, 26.7%

No — AC, 0.0%; RF, 0.0%

No, Considering — AC, 0.0%; RF, 0.0%

Yes — AC, 73.3%; RF, 73.3%

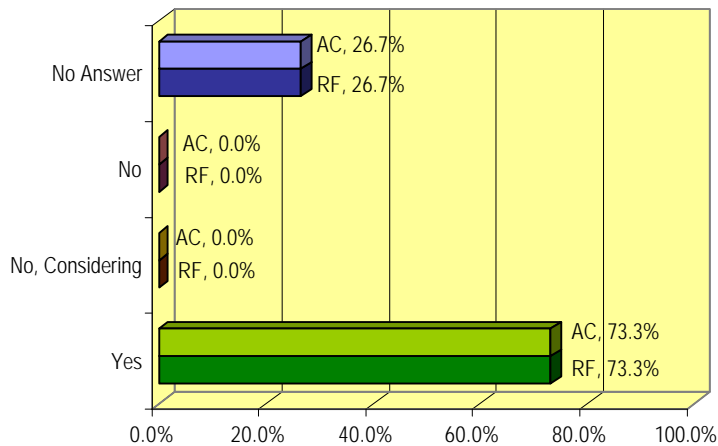(x-axis: 0.0%, 20.0%, 40.0%, 60.0%, 80.0%, 100.0%)
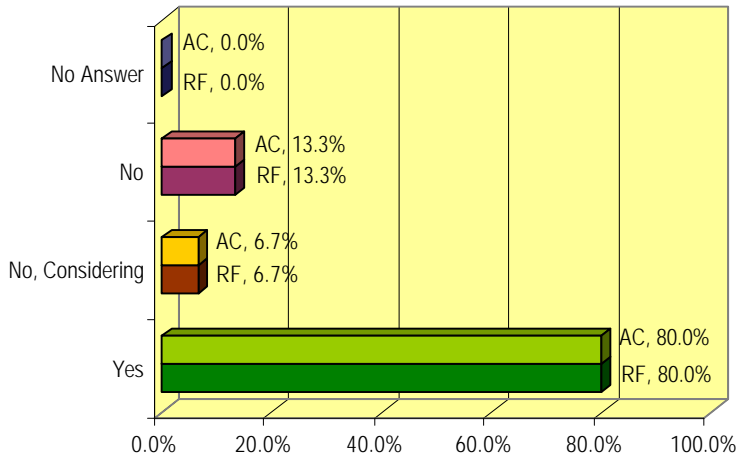
now under the process of considering/ developing MEPS for AC. Similarly, four are also considering MEPS for RF. The other three economies do not require MEPS for either AC or RF.

Energy labeling also requires performance testing. Figure 3 shows that 12 of the 15 economies (80%) require testing for labeling of both AC & RF products. One is still considering a labeling program, but the rest do not require labeling of their products. We can see here that labeling used more widely than MEPS in APEC economies. Even though labeling is less restrictive in terms of allowing products to enter the market, it still requires energy performance testing.

We asked the regulators to indicate whether a product from another economy would encounter repeat testing if they were not tested under the same test standard as required by their own economy. Regulators in 11 economies said "Yes," while the rest did not answer. This requirement is true for both AC and RF products.

The Industry Survey asked manufacturers to indicate whether they conduct energy performance testing on their AC and RF units. The AC respondents indicated that they all conduct energy performance test on their units, while 86% of RF respondents conduct energy performance test on their units (see Figure 5). The one company that does not test their product is a chest freezer manufacturer in an economy that is still considering MEPS.

Figure 5

Energy Performance Testing on AC Units

No — 0.0%

Yes — 100.0%

(x-axis: 0.0%, 20.0%, 40.0%, 60.0%, 80.0%, 100.0%)
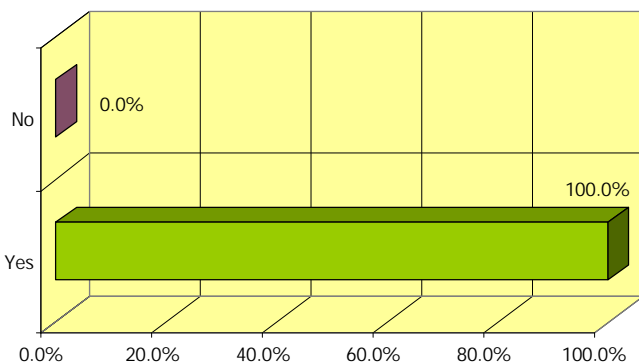
Energy Performance Testing on RF Units

No — 14.3%

Yes — 85.7%

(x-axis: 0.0%, 20.0%, 40.0%, 60.0%, 80.0%, 100.0%)

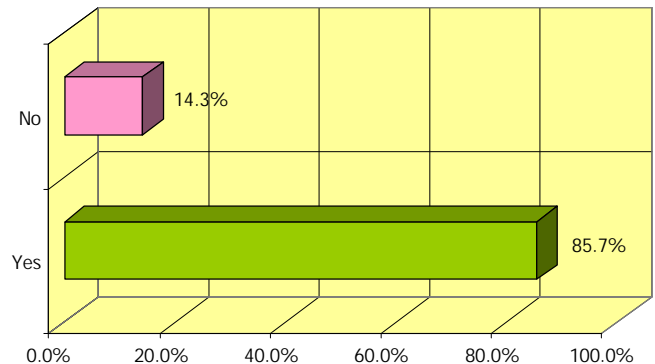Figure 6 shows the proportion of Industry respondents that encounter repeated testing when exporting to other economies. Respondents who did not answer are mostly importers or distributors, not exporters. For those that answered, at least half of them encounter repeat testing when exporting to other economies. All of respondents who answered why they encounter repeat testing say that the reason is the difference in test standard requirements. Some exporters do not encounter repeat testing because some economies do not require MEPS and some economies use the same test standard.

Figure 6

AC: Do You Encounter Repeated Testing When Exporting To Other Economies?

No answer 37.5%
Yes 37.5%
No 25.0%

RF: Do You Encounter Repeated Testing When Exporting To Other Economies?

No answer 42.9%
Yes 28.6%
No 28.6%
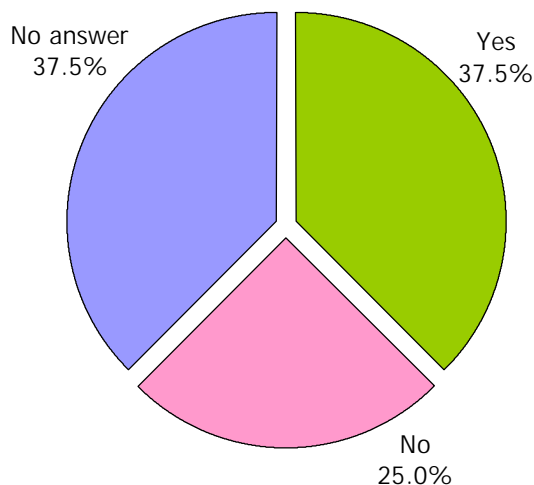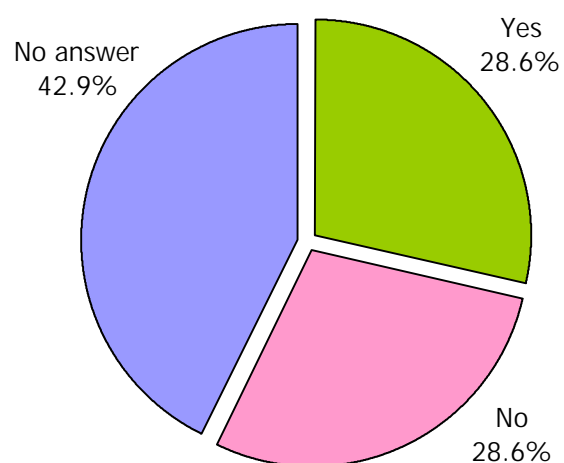
AC recipients were asked to list the test standard(s) they used. We also questioned whether the test standard(s) they use accurately consider(s) the impact of barometric pressure on psychrometric calculations to determine cooling capacity and whether the barometric pressure is measured. The results show that:

✔ 50% believe that the test procedures they use accurately consider the impact of barometric pressure. Their test standards include ISO 5151, AS/NZS 3823, TISI.
✔ The rest said "No." Their test standards include ARI 270, ARI 550-590/98, ISO 5151, AS/NZS 3823, TISI
✔ Some AC respondents use the same reference test standard, but their answers contradict each other.
✔ All those who said "Yes" also answered "Yes" to whether the barometric pressure is measured, except only one.

RF recipients were asked whether their products had any models that have special features that may reduce energy consumption in actual use, but not under test conditions. Only one manufacturer indicated that it had a feature (adaptive defrost) that could reduce energy consumption that could not be measured under the test conditions.

3.3 VIEWS ON CONVERSION ALGORITHMS

3.3.1 Industry Views

Below we present the results of the Survey of Industry in response to questions regarding their views on conversion algorithms, its benefits, drawbacks, and suggestions on its development process.

3.3.1.1   Benefits of Conversion Algorithms

When we asked the companies whether a conversion algorithm would benefit the trade of their products, those who answered have different views. Sixty percent of AC respondents said "Yes" while the rest said "No." For RF respondents who answered, 75% see that conversion algorithms would be beneficial for trade.

Figure 7

AC: Would a conversion algorithm benefit the trade of your company's products?
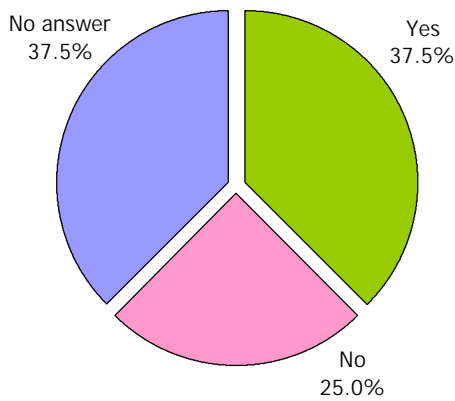
No answer 37.5%
Yes 37.5%
No 25.0%

RF: Would a conversion algorithm benefit the trade of your company's products?

Yes 42.9%
No 14.3%
No answer 42.9%
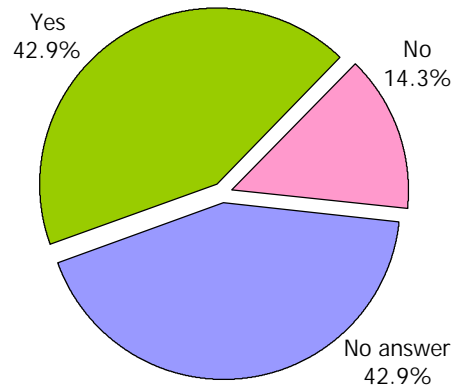
AC respondents who answered "Yes" indicated a conversion algorithm would benefit them in terms of design, production, and cost equally. A less important benefit is time. In contrast, the time factor was considered the most beneficial for RF respondents, followed by cost, design, and equipment. RF companies may consider time more important because refrigerator testing takes much longer than testing air conditioners.

Figure 8

AC: In What Way Would Conversion Algorithm Benefit the Trade of Your Company's Products?
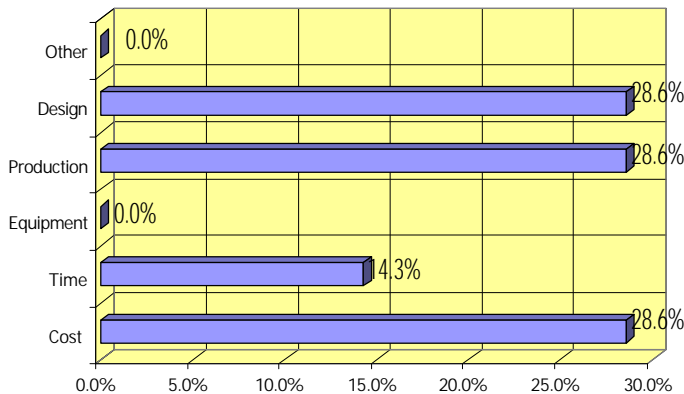
Other	0.0%
Design	28.6%
Production	28.6%
Equipment	0.0%
Time	14.3%
Cost	28.6%

RF: In What Way Would Conversion Algorithm Benefit the Trade of Your Company's Products?

Other	0.0%
Design	14.3%
Production	0.0%
Equipment	14.3%
Time	42.9%
Cost	28.6%
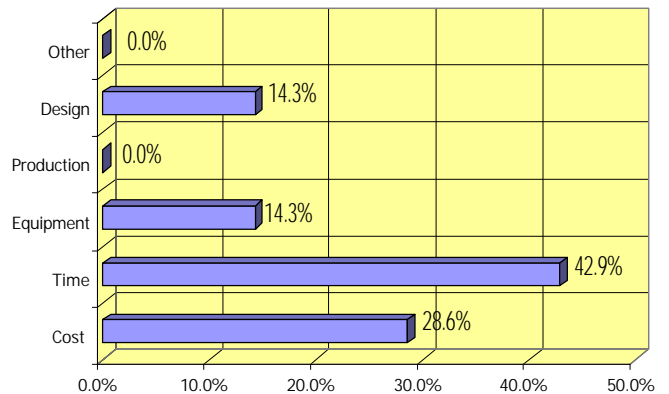
Other notable differences are production and equipment benefits. AC respondents do not think that they will benefit in terms of equipment, but rather the production process; the RF respondents indicated the opposite. The reason for this contrast could be that refrigerators are more complex. Energy performance is affected not only by the refrigeration circuit parameters — often made more complicated by having compartments with different temperatures — but also by the auxiliaries and the cabinet insulation.

3.3.1.2   Support for Conversion Algorithms

The survey asked recipients whether they would support the regulations that will allow the use of conversion algorithms to substitute for repeat testing, if the algorithms could translate the results satisfactorily. AC respondents show average support (37.5%) for using conversion algorithms, another 37.5% preferred not to answer. The rest (25%) show negative reaction to having regulations for conversion algorithms. One reason given was that an unregulated environment is preferred. Another came fro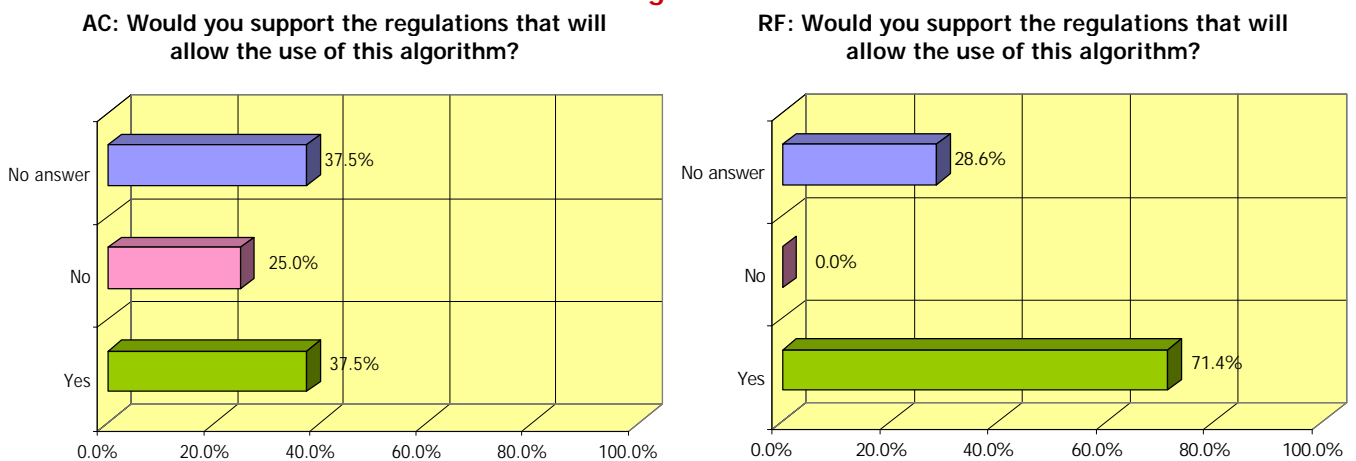m an AC testing laboratory[10] that already had experience in developing conversion algorithms; the respondent commented, "laboratory tests on thousands of units show that this approach would not be reliable."

Figure 9

AC: Would you support the regulations that will allow the use of this algorithm?

Answer	Percentage
No answer	37.5%
No	25.0%
Yes	37.5%

RF: Would you support the regulations that will allow the use of this algorithm?

Answer	Percentage
No answer	28.6%
No	0.0%
Yes	71.4%

3.3.1.3   Development of Conversion Algorithms

When asked about whether the algorithms should be "simple but effective" or "complex but accurate," the majority for both AC and RF respondents favor development of "simple but effective" algorithms.

Figure 10

AC: Should These Algorithms Be "Simple But Effective" or "Complex But Accurate"?

Answer	Percentage
No Answer	12.5%
Complex	25.0%
Simple	62.5%

RF: Should These Algorithms Be "Simple But Effective" or "Complex But Accurate"?

Answer	Percentage
No Answer	14.3%
Complex	14.3%
Simple	71.4%

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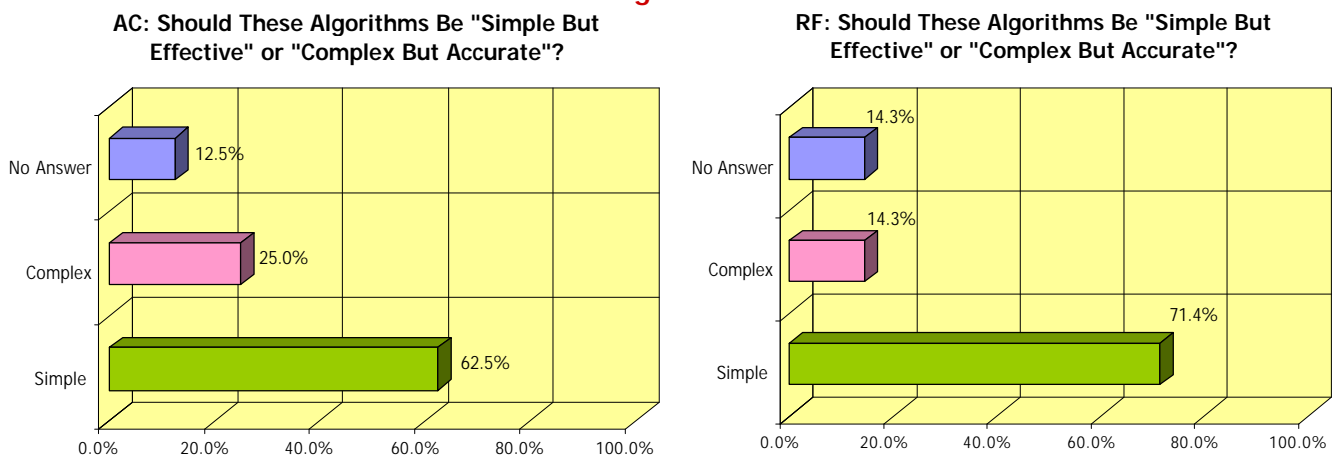
[10] The AC Manufacturer questionnaire was forwarded to the test laboratory by an AC company; otherwise, this respondent would have been surveyed as a regulator.

As anticipated, most of the respondents do not have direct experience in developing conversion algorithms. Respondents who have had experience have not been successful or are still in the development process; two specific comments are:

✔ (RF) It is quite difficult to get true data
✔ (AC) Whilst consisent performance over a range of ambient conditions is normal, individual AC set-ups are almost infinite and will be different for different ambient conditions

Respondents were then asked to rank the five most important variables (out of nine choices) that should be addressed in the development of conversion algorithms. The results are illustrated in the graphs below. AC and RF respondents both felt that the ambient temperature is the most important variable to take into account when developing conversion algorithms.

Figure 11

AC: Important Variables in the Development of Conversion Algorithms
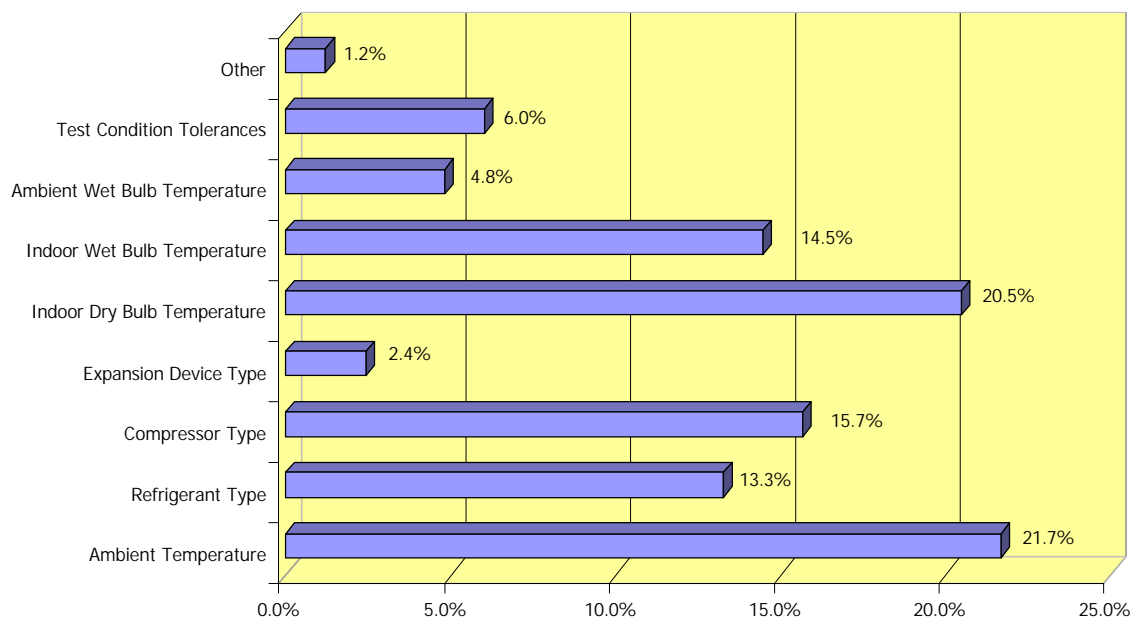
RF: Important Variables in the Development of Conversion Algorithms
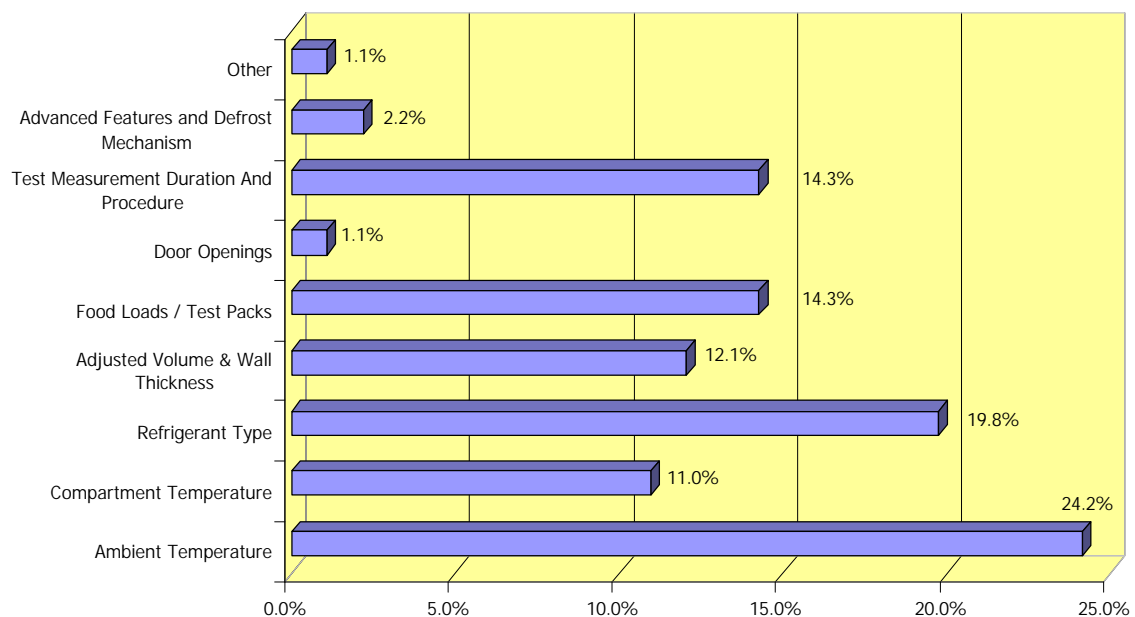
We used an open-ended question allow the respondents to identify significant problems or barriers in translating results between test standards. The results are summarized below.

Figure 12

AC: Barriers in Translating Results Between Test Standards
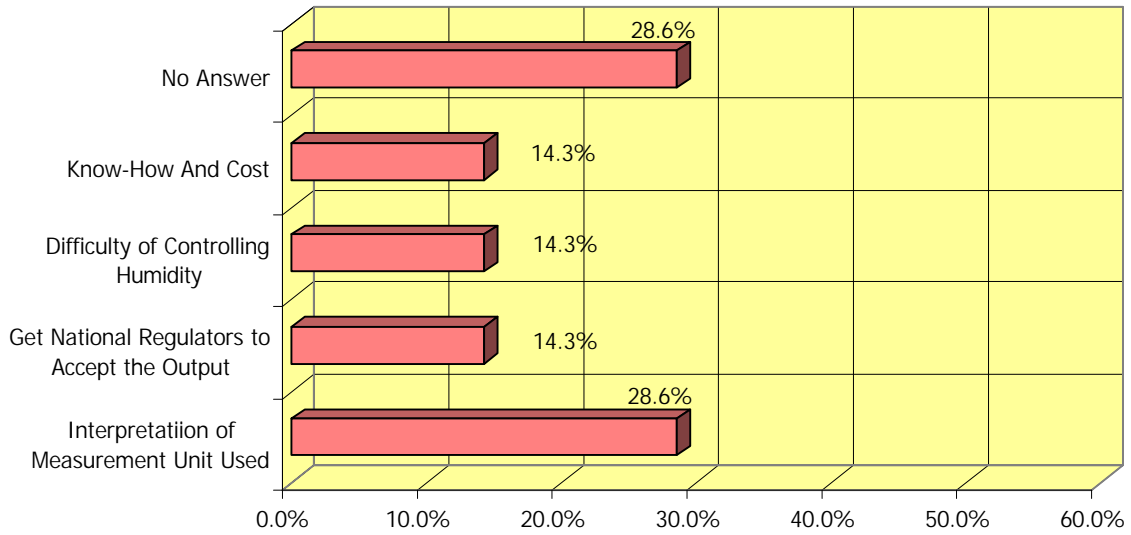
RF: Barriers in Translating Results Between Test Standards
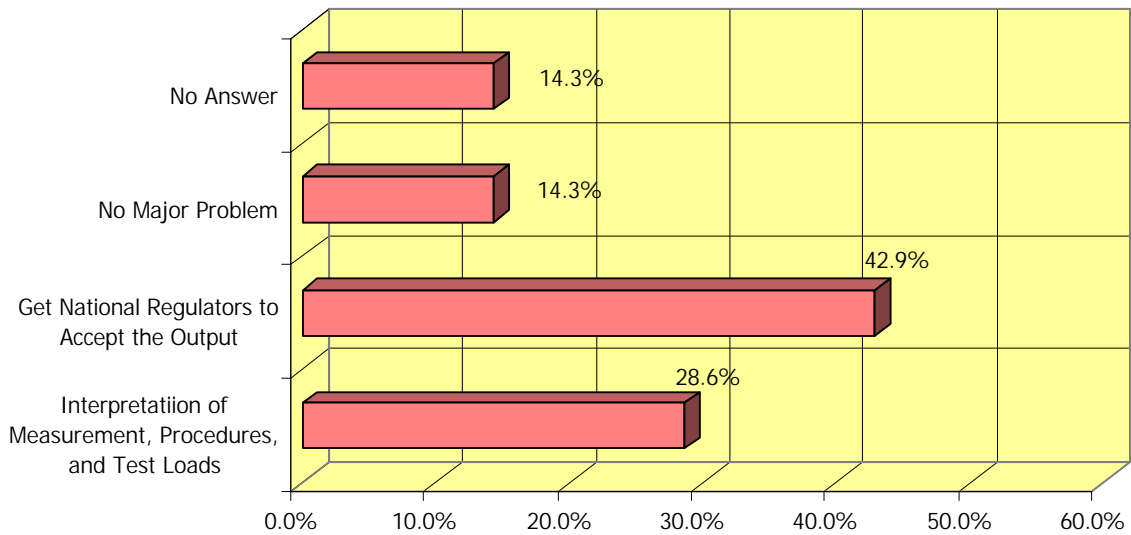
Next, we asked respondents to suggest ways in which the conversion algorithm could be developed. In particular, AC and RF companies were asked what kind of characteristics the conversion algorithms should have that would meet their needs. This question was also an open-ended question; the results are grouped together and presented in the graphs below.

Figure 13

AC: Suggestions for the Development of Conversion Algorithms
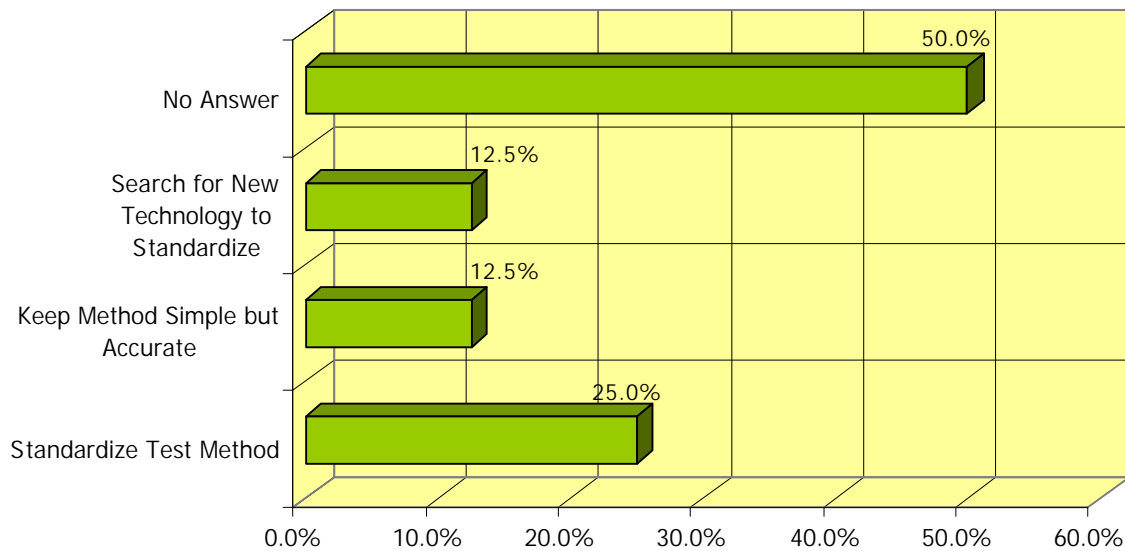
RF: Suggestions for the Development of Conversion Algorithms
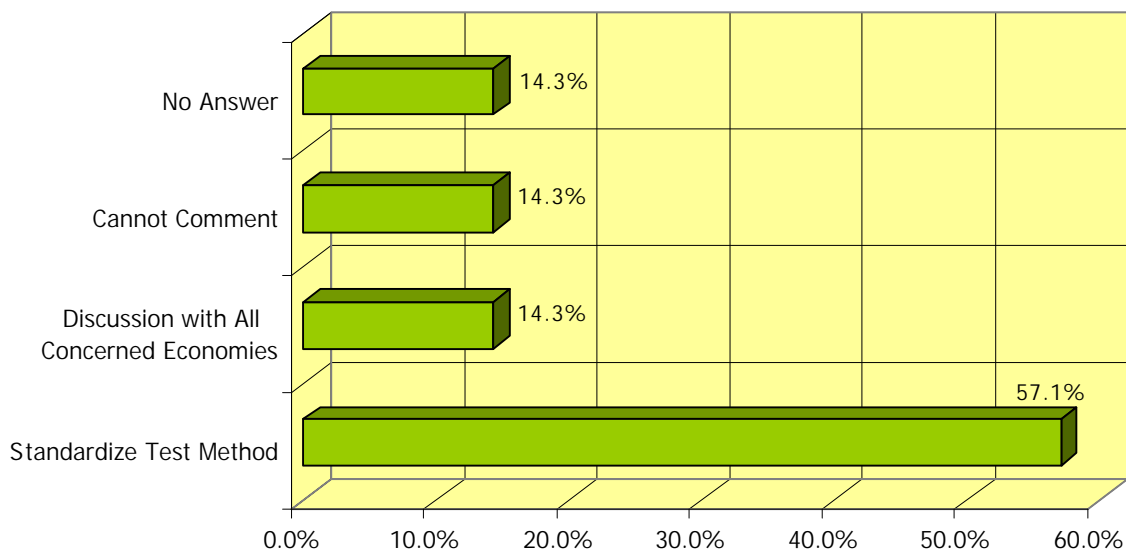
3.3.2 Regulator Views

This section presents the results of the Survey of Regulators. Regulators in 15 economies were requested to provide individual views on conversion algorithms, the benefits or downturns, and the development process. Note that we asked regulators nearly all the same questions in AC and RF perspectives; in effect, each individual usually gave the same answer for both AC and RF. Thus, in this section, it is typical for the AC and RF statistics to be similar or even identical.

3.3.2.1 Effects of Repeat Testing

Repeat testing arises from the difference in energy testing, standards, and labeling requirements. In the view of the EGEEC, repeat testing increases costs of trade. These costs are eventually passed down to the consumers. EGEEC manages various projects that study the differences in energy requirements and regulations in APEC economies. These projects aim to find ways to reduce these differences and the extra costs of trade that arise from them. One may be inclined to agree to the above reasoning when listening from only one perspective. However, do people in other economies think the same, particularly the policymakers, test officials, and experts who are in this line of work? Below are the responses to the questions:

- ✔ How does repeated testing affect *foreign* manufacturers *importing* into your economy?
- ✔ How does repeated testing affect *local* manufacturers *exporting* from your economy?

Figure 14

AC: How does repeated testing affect foreign manufacturers importing into your economy?

Don't Know, 36.7%
Positive, 13.3%
No Effect, 0.0%
Negative, 50.0%

Why Negatively?

Other 13%
Cost 49%
Time 38%

RF: How does repeated testing affect foreign manufacturers importing into your economy?

Don't Know, 36.7%
Positive, 13.3%
No Effect, 0.0%
Negative, 50.0%

Why Negatively?

Other 10%
Cost 50%
Time 40%
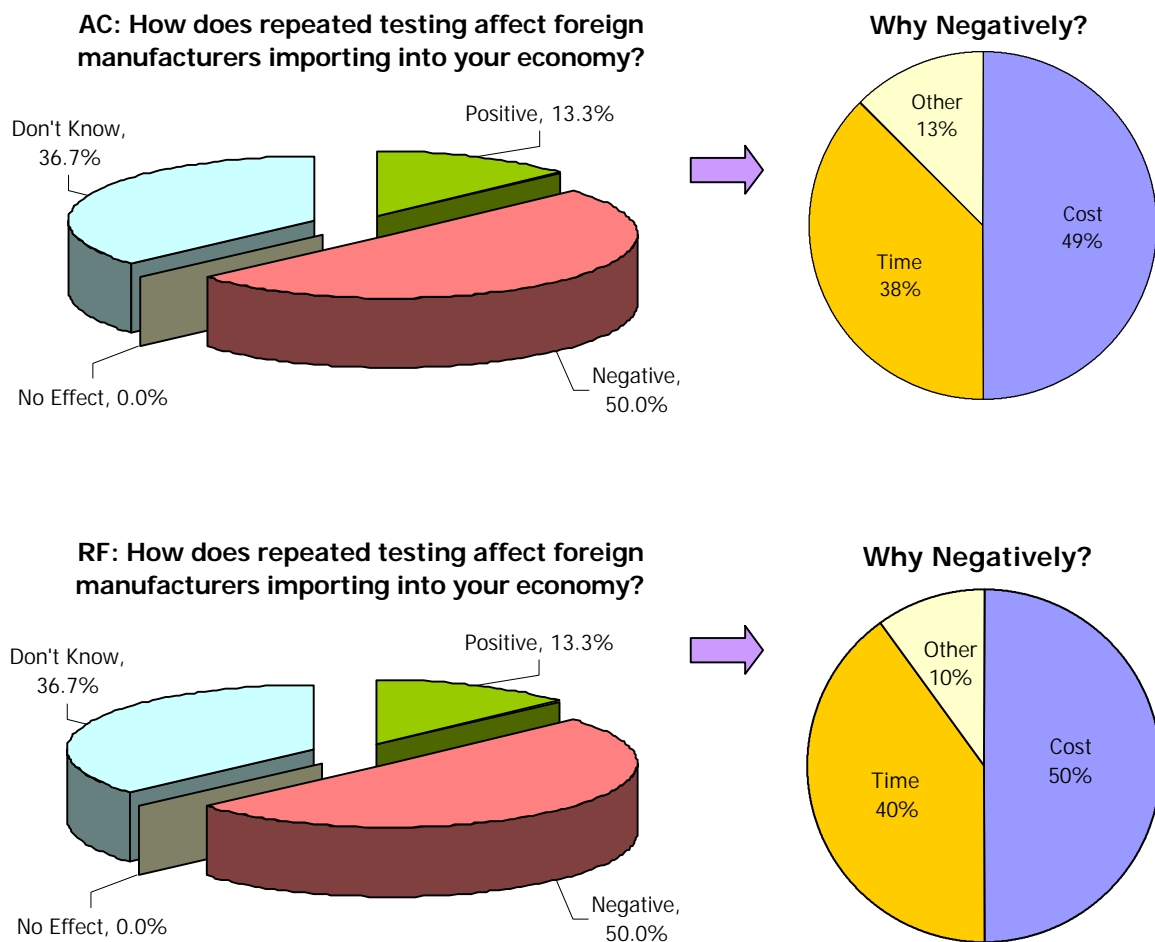
For the regulators who answered this question, the majority agree that repeat testing has a negative effect on foreign manufacturers who import into their respective economies. The most frequent reason for having a negative effect is the increase in costs of testing, followed by the delays in testing (time), and other reasons such as more workload for manufacturers and laboratories. Still, there are those who answered that the repeat testing affects foreign manufacturers positively. Some of their reasons, however, are more like looking from an importing economy's perspective:[11]

✔ High turnover of models means tests are carried out anyway. Overseas laboratories [can use the required test standard of that economy].

✔ It takes more time for repeated testing [to keep foreign products slow in entering the local market].

✔ Repeat testing ensures product quality coming into the economy.

Next, we asked an opposite question: how does repeated testing affect local manufacturers exporting to other economies? Similarly, the results show that majority of regulators (who answered this question) think repeated testing has a negative effect on local manufacturers who export to other economies. The reasons for negative effect are similar as for the previous question: increased cost and time delay.

Half of the regulators who did not answer are from economies that do not have local AC and RF manufacturing industry. The some regulators who answer "Positively" indicated that repeated testing would ensure that products exported would give satisfaction to consumers abroad; in turn, this would make manufacturers more conscious of their product quality.

Figure 15

AC: How does repeated testing affect local manufacturers exporting to other economies?
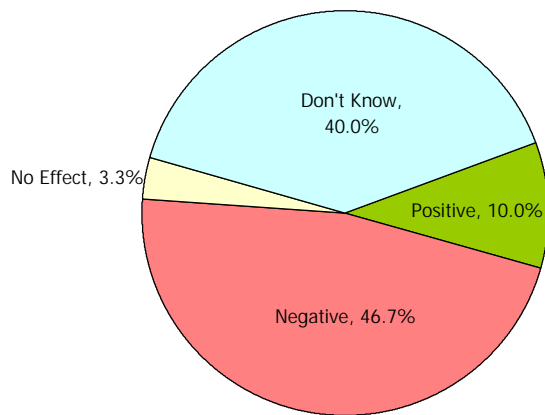
RF: How does repeated testing affect local manufacturers exporting to other economies?

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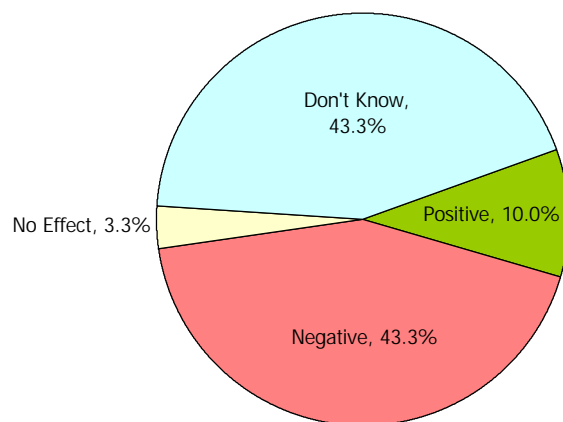
[11] The reasons were briefly written. The survey team interpreted them as above; we added the wording (as best as we could understand) in brackets.

3.3.2.2 Benefits of Conversion Algorithms

When we asked the regulators whether a conversion algorithm would benefit the trade of their products, 83.3% said "Yes," while 13.3% said "No" and only a few did not answer. This shows that most regulators view that these conversion algorithms, if made possible, would benefit the trade of products between APEC economies.

Figure 16

Would a conversion algorithm benefit the trade of AC units?

No Answer	3.3%
No	13.3%
Yes	83.3%

0.0% 20.0% 40.0% 60.0% 80.0% 100.0%

Would a conversion algorithm benefit the trade of RF units?

No Answer	3.3%
No	13.3%
Yes	83.3%

0.0% 20.0% 40.0% 60.0% 80.0% 100.0%
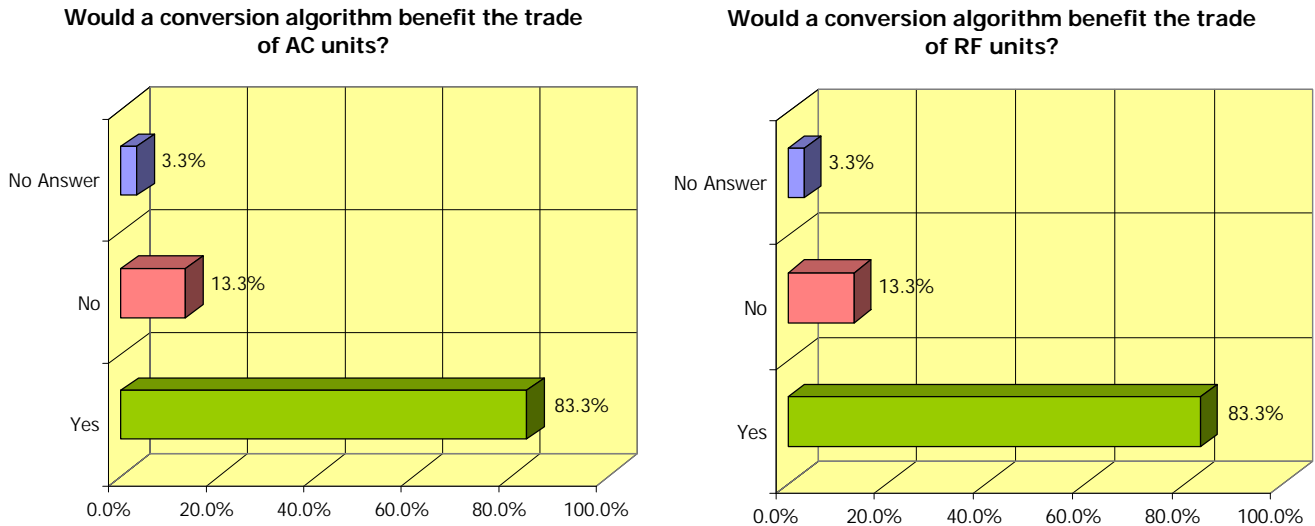
Regulators who answered "Yes" indicated a conversion algorithm would benefit them in terms of in order of importance: reduced resources (time and cost); opening up of trade opportunities; and encouraging standards alignment and recognition agreements. For air conditioners, some regulators said that conversion algorithm and modeling could help predict partial load energy consumption more accurately. About thirteen percent say that conversion algorithm would not benefit trade in any way; a reason given was that a conversion algorithm requires strict and thorough tests before it could fulfill its purpose (or basically, not yet possible).

Figure 17

AC: Yes, in terms of..

- Reduced resources (time and cost) 35%
- Opens up trade 26%
- Standards & Recognition 13%
- Partial Load Prediction 13%
- Other 13%

RF: Yes, in terms of..

- Reduced resources (time and cost) 42%
- Opens up trade 26%
- Standards & Recognition 16%
- Other 16%
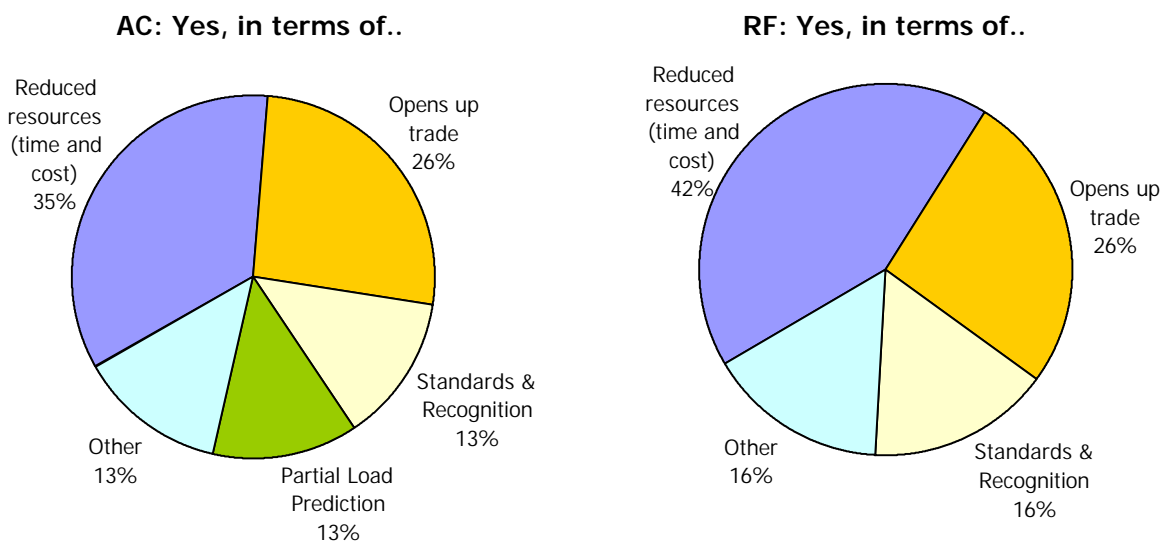
3.3.2.3 Support for Conversion Algorithms

The survey asked regulators whether they would support the regulations that will allow the use of conversion algorithms to substitute for repeat testing, if the algorithms could translate the results satisfactorily. Regulators show very high support (at least 90%) for using conversion algorithms for both AC and RF repeat testing.

Figure 18

AC: Would you support the regulations that will allow the use of this algorithm?

No Answer	6.7%
No	3.3%
Yes	90.0%

RF: Would you support the regulations that will allow the use of this algorithm?

No Answer	6.7%
No	0.0%
Yes	93.3%
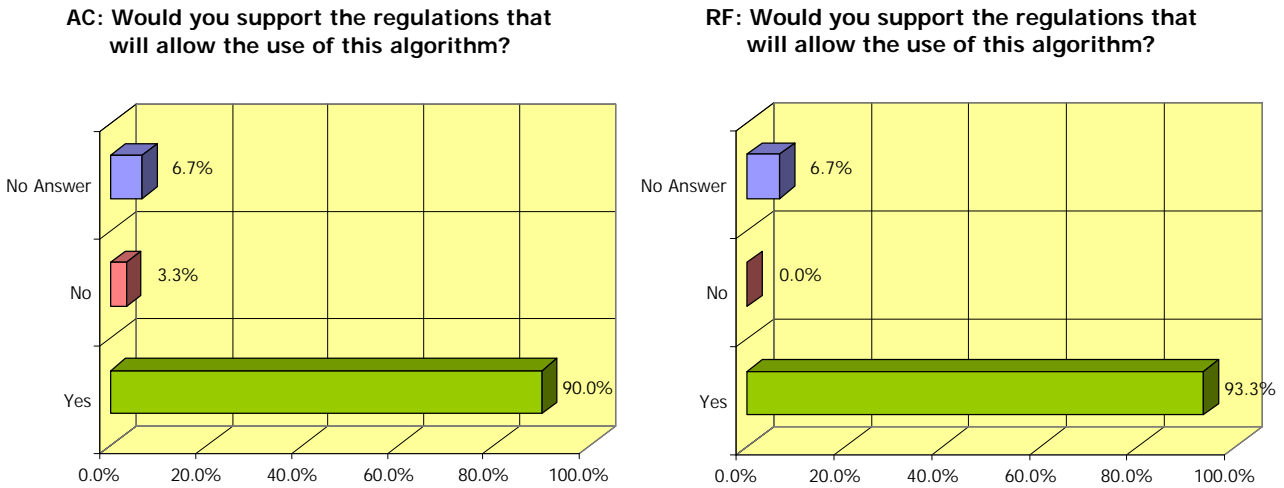
This result is extremely encouraging for the continuation of conversion algorithm development. The following pie graphs the comments from the regulators who said "Yes." The most frequent comment stresses on the need for a good test standard on which to base conversion algorithm. Many expressed that they support the regulations, because the conversion algorithm would benefit all economies and industries, by helping trade and reducing wastes (time and equipment needed).

Figure 19

AC: Yes.. comments
- Other 18%
- Need good reference standard 28%
- To benefit all 12%
- Helps trade 18%
- To reduce waste 12%
- Support regulations 12%

RF: Yes .. comments
- Other 20%
- Need good reference standard 28%
- To benefit all 13%
- Helps trade 13%
- To reduce waste 13%
- Support regulations 13%
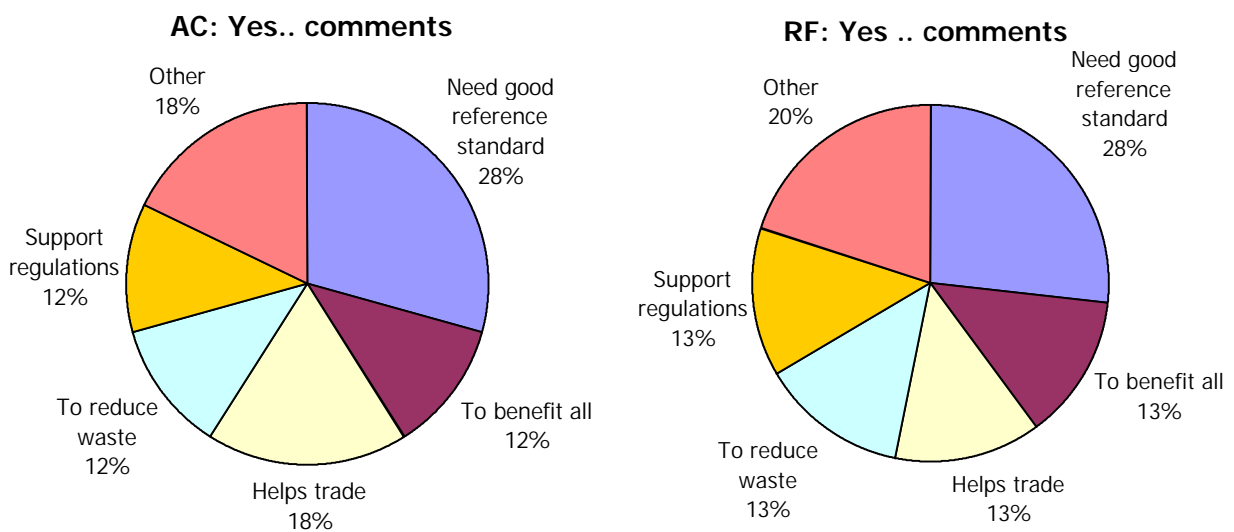
3.3.3 Development of Conversion Algorithms

When asked about whether the algorithms should be "simple but effective" or "complex but accurate," the majority of regulators (53.3%) favor development of "simple but effective" algorithms for both AC and RF. However, some regulators (36.7% for AC and 40.0% for RF) would rather have algorithms be "complex but accurate." In this case, the decision is not clear-cut, and will need further consideration.

Figure 20

AC: Should these algorithms be "simple but effective" or "complex but accurate"?

RF: Should these algorithms be "simple but effective" or "complex but accurate"?
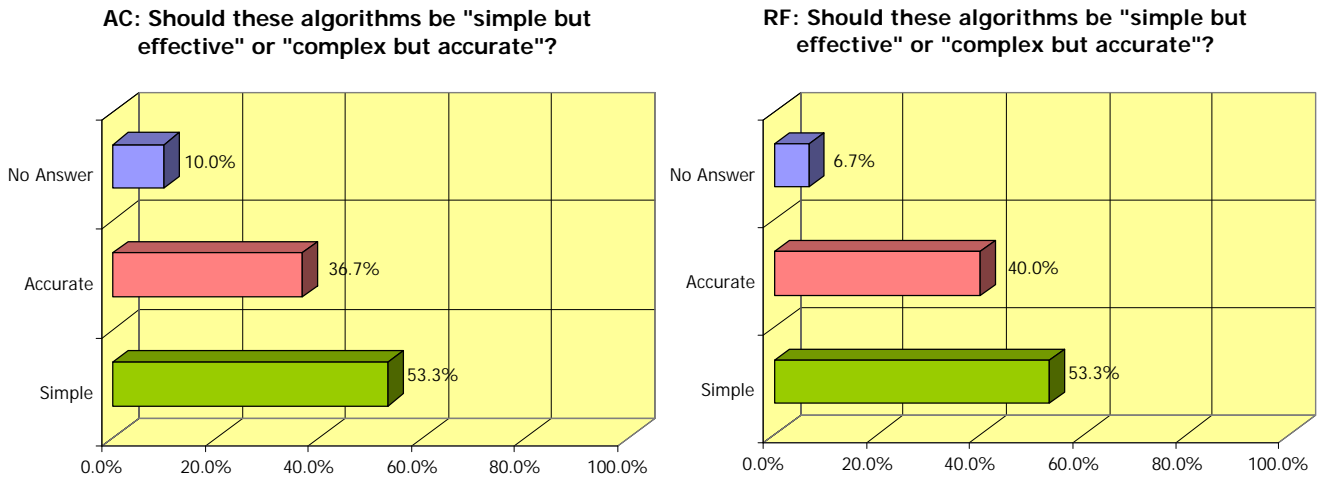
Next, we asked the regulators whether they have had experience in developing conversion algorithms for translating results between test standards. Their responses are summarized below.

Figure 21

Any experience in developing conversion algorithms for AC test results?

Any experience in developing conversion algorithms for RF test results?
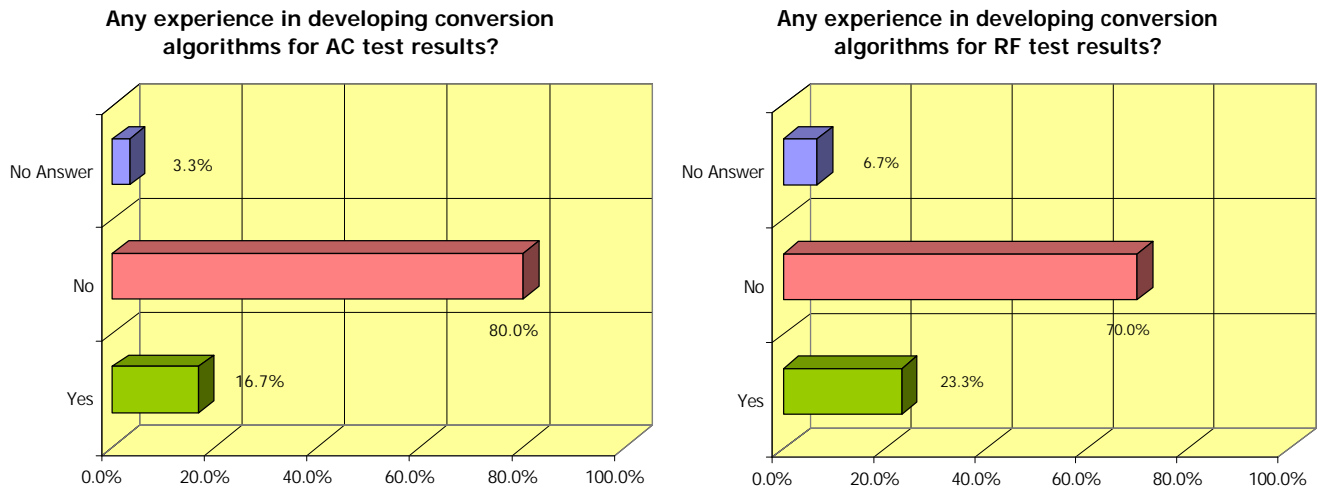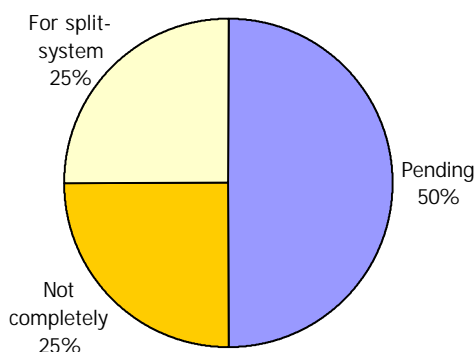
Yes.. Successful?
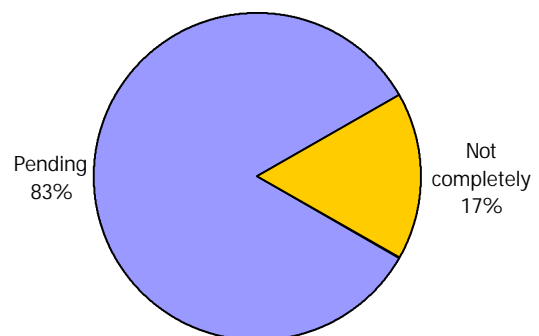
Yes.. Successful?

Figure 21 above shows that only a small percentage of regulators have experience with developing conversion algorithms (17% for AC and 23% for RF); and most efforts have not been 100% successful or the results are still pending. Only one AC regulator claims that a conversion algorithm can be successfully developed for use with split-system air conditioners.[12] The graphs above show these results.

The survey contained two open-ended questions to gather qualitative views on the problems and barriers in translating results between test standards and suggestions on the ways by which a conversion algorithm can be developed. As mentioned earlier, the responses to the open-ended questions are placed together into common groups by their relevance; and the number of suggestions in each group reveals its overall rank.

Figure 22

AC: What do you see as the most significant problems/barriers in translating results between test standards?

RF: What do you see as the most significant problems/barriers in translating results between test standards?

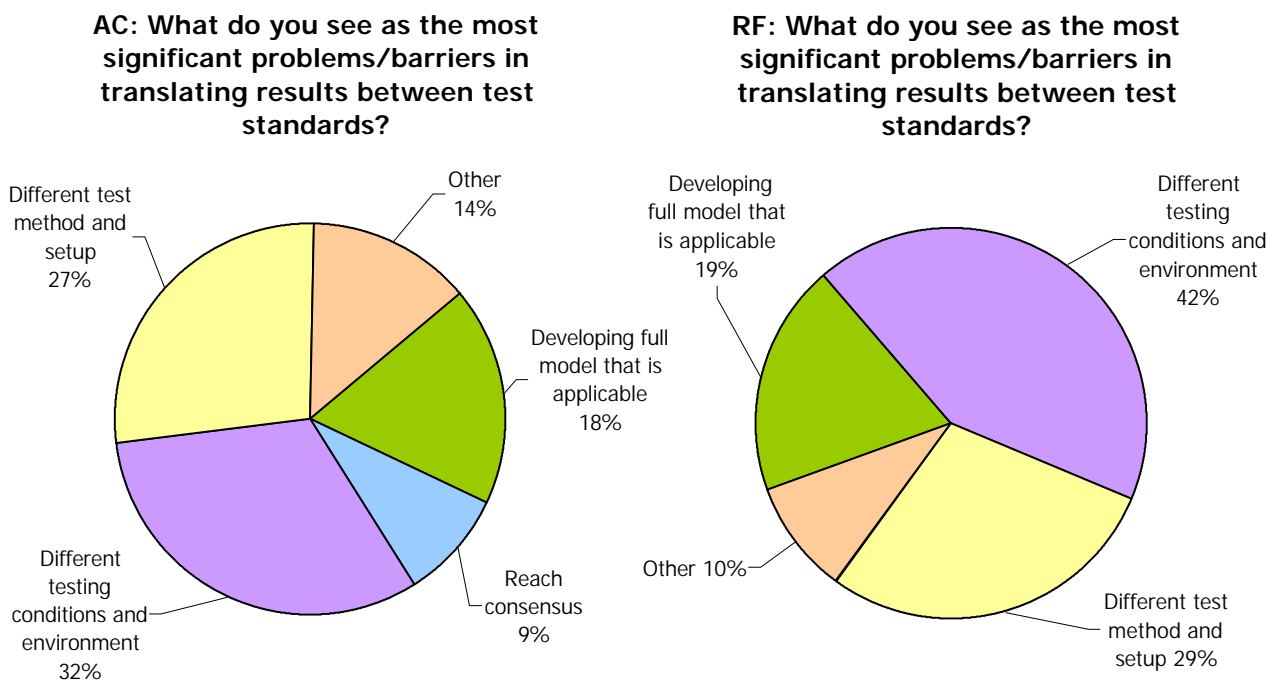From both AC and RF, the following graphs show that the most evident barrier to translating the test results of different test standards is the difference in testing conditions and environment, followed by the difference in test methods, procedures, and setup, then the difficulty in developing a full model that is applicable and useful in real conditions. Not being able to reach consensus on test parameters is also one of the main barriers. Other problems include the complexity of AC systems, lack of standardized AC systems,[13] and the fact that matters such as conversion algorithms need policymakers to make them valid.[14] Some specific comments that present some of the difficulties for comparing test results:

✔ The fact that [conversion algorithms] cannot be done by simple means. One needs to develop a full simulation model. However, such a model would have additional useful applications.
✔ Various differences makes it very difficult to actually compare results (compiled from many responses):
  ❖ Test procedures and sequence
  ❖ Test conditions (operating and ambient)

---

[12] Regulator 10 believes that "it is technically feasible if there is adequate consensus on key test parameters in the test standard" and that there needs to be a "prototype [algorithm] followed by round robin application in all interested APEC Economies."
[13] We understand that this comment mean that ACs can be assembled easily and variably for different use and applications of the products (design and purpose of use).
[14] For last this factor, we can assume that the policymaking process takes a long time in most economies; this is why having to involve policymakers and policymaking would be one of the problems.

- ❖ Power supply voltage and frequency
- ❖ Equipment tolerances and calibration
- ❖ Design considerations of test facility
- ❖ Design considerations of product
- ✔ Ambiguities & complexities of each test standard are difficult to overcome, as well as the constant updates and amendmendments.
- ✔ AC: Although the basic test ISO 5151 is used almost everywhere, there are differences that make it hard to make comparisons. For example, one economy tests variable speed motor ACs at partial load, but another does this at full load; therefore, the results are not comparable even though both use ISO 5151.
- ✔ RF: As long as the test method is exactly identical (including test temperature, load in the refrigerator, period of cooling etc.), then the results should be comparable already. But some economies will include open-door tests for refrigerator energy use, and that means that the results are not comparable to the country where such test are not done.
- ✔ RF: Difference in customs and ways of living (use of refriegerator) among cultures makes it harder for algorithms to be applicable across economies.

Figure 23

AC: Suggested ways by which converison algorithms could be best developed
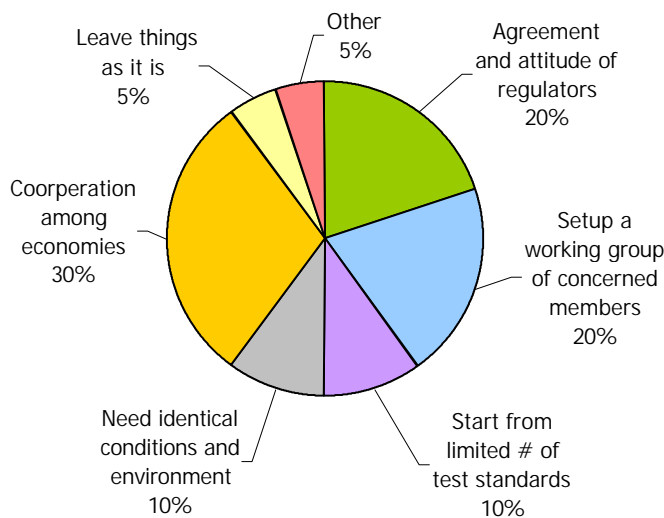
RF: Suggested ways by which converison algorithms could be best developed
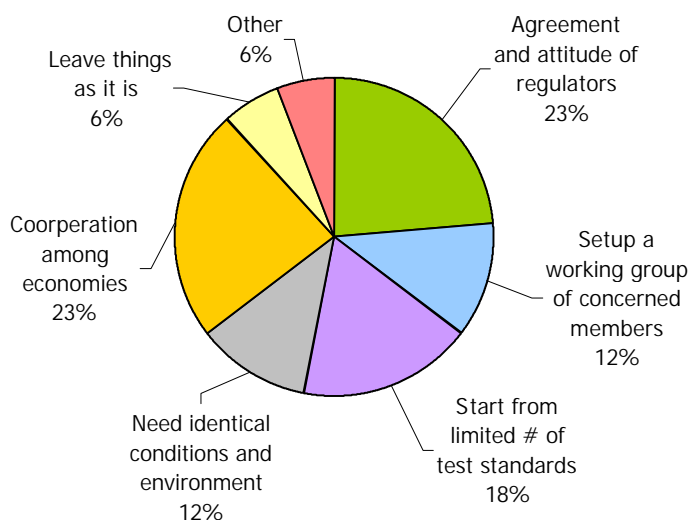
The graphs in Figure 23 summarize what the regulators suggest regarding the development of conversion algorithms. Cooperation among member economies is the most frequent suggestion from the regulators for the development of conversion algorithms for both AC and RF. Subsequently, regulators feel that the attitudes of other regulators would be very important to achieve cooperation in APEC. It is obvious that without agreement of regulators, there will be little progress towards any cross-border initiatives such as adopting conversion algorithms for use in APEC economies (if it proves applicable).

Another important suggestion is more of an action item: to set up a working group or expert group comprised of representatives of concerned member economies. Regulators also stress the importance of starting the development of conversion algorithms based on only one or a few number of test standards. Some regulators suggested that development should start with their national standards. Nevertheless, many suggested the ISO standard; in the next section, we will also see that the ISO test standard is the most popular standard for alignment, if ever it happens.

Still, many are skeptical and stress the difficulties involved in developing conversion algorithms. They emphasize the need to define an identical set of conditions and environment for test procedures in order to make successful translation of test results using the algorithms. Another caution mentioned the need for sufficient tests and verification before applying the conversion algorithm in real use.

There is, on the other hand, also a view that the differences in test results do not need to be addressed and that it should be left as is. For this suggestion, there were no further comments to elaborate the meaning and reason.

3.3.3.1 Seasonal Energy Efficiency Requirement for Air Conditioners

The last question of the Regulator Survey asked whether it is important that MEPS predict the seasonal energy and efficiency for air conditioners used in the local economies. To rephrase, the question asked whether seasonal energy efficiency performance should be a requirement for MEPS in the local economies.

Figure 24

AC: Is it important that MEPS predict the seasonal energy and efficiency for your local economy?

Yes, why?
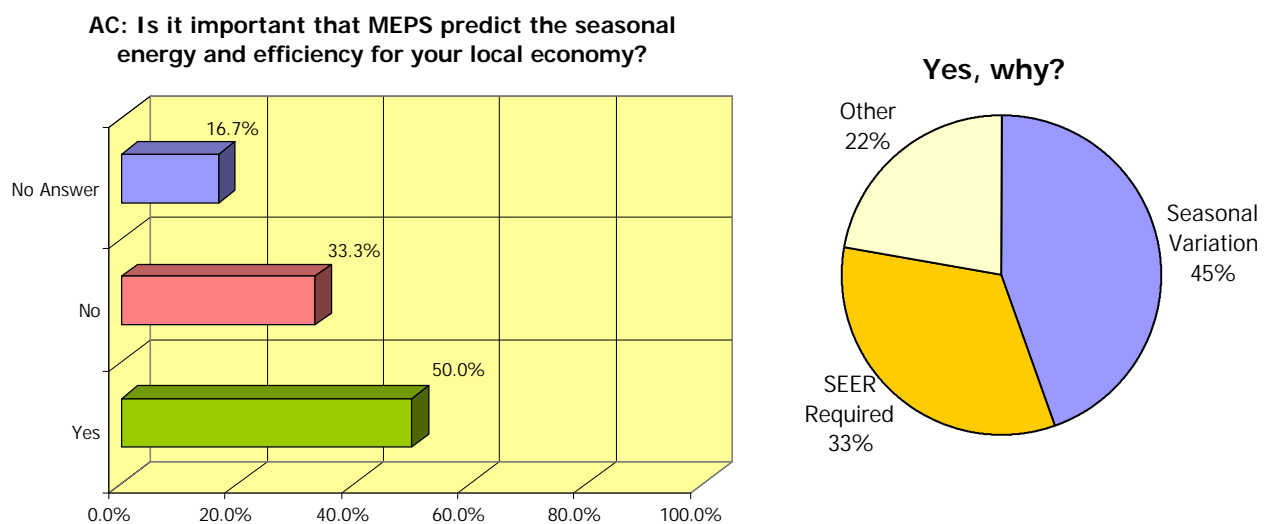
Half of the regulators say that that the seasonal energy efficiency ratio (SEER) should be the measure that local economies should require for compliance to MEPS. The most important reason for requiring SEER is the fact that seasonal variations exist and that AC units would not be require the same amount of energy in different climates. Variable speed drives and inverters are used to react to the seasonal temperatures. The compressors could run at partial load during cool months; therefore, partial load measurements would be more accurate. The second most frequent reason is that SEER is already required by MEPS in that economy. The 33.3% who said "No" are mostly from economies with tropical climate that has little seasonal temperature variation; thus, for these economies, the regulators do not see the need to require SEER measurements.

When asked whether the nominal values determined in ISO 5151 test standard is sufficient for ranking the relative performance of ACs, most of whom responded said that the standard is not sufficient. However, for a tropical climate, a regulator commented that ISO 5151 would probably suffice.

3.4 VIEW ON ALIGNMENT OF STANDARDS

Since this survey study is related to the differences in test standards in APEC economies, the survey team decided that we should tag along a question about aligning standards. We asked the respondents, both Industry and Regulators, whether they would support the alignment of test standards in APEC economies for air conditioners and refrigerators. We present the sum of responses below.

3.4.1 Industry Views

Industry respondents unanimously chose in favor of the alignment of test standards for air conditioners and refrigerators. This is a surprisingly positive response for the alignment of standards.

Figure 25

AC: Would You Support the Alignment of Test Standards for Air Conditioners?

RF: Would You Support the Alignment of Test Standards for Refrigerators?
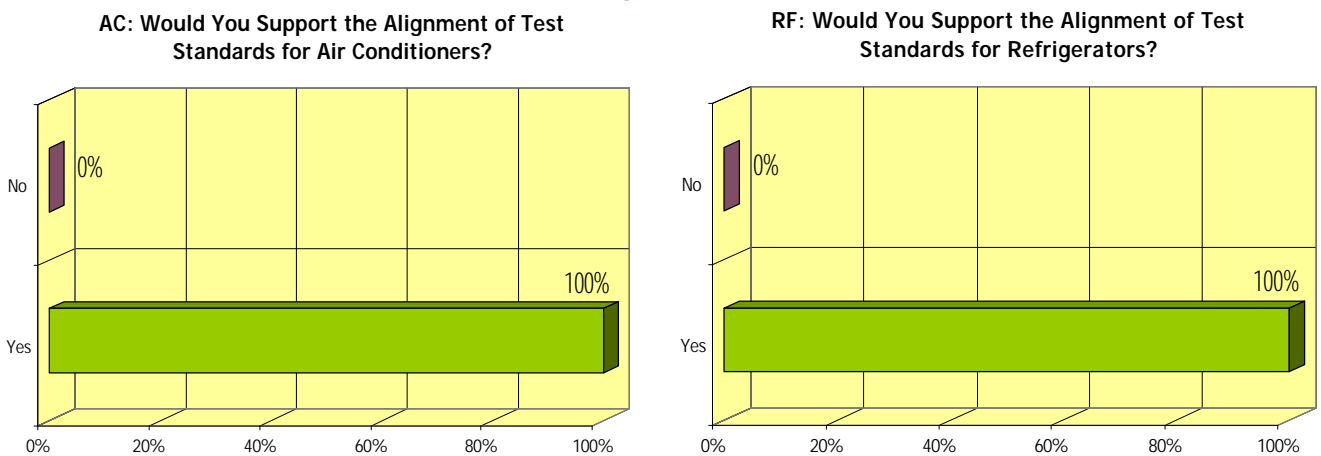
3.4.2 Regulator Views

Most of the regulators would favor the alignment of standards for both AC and RF; only 10% of the regulators do not support alignment of standards. Some regulators that responded negatively to this question reasoned that:
- ✔ The competence of manufacturers is different in different member countries
- ✔ [We should] leave it alone

Figure 26

AC: Would you support alignment of test standards for air conditioners?

RF: Would you support alignment of test standards for refrigerators?
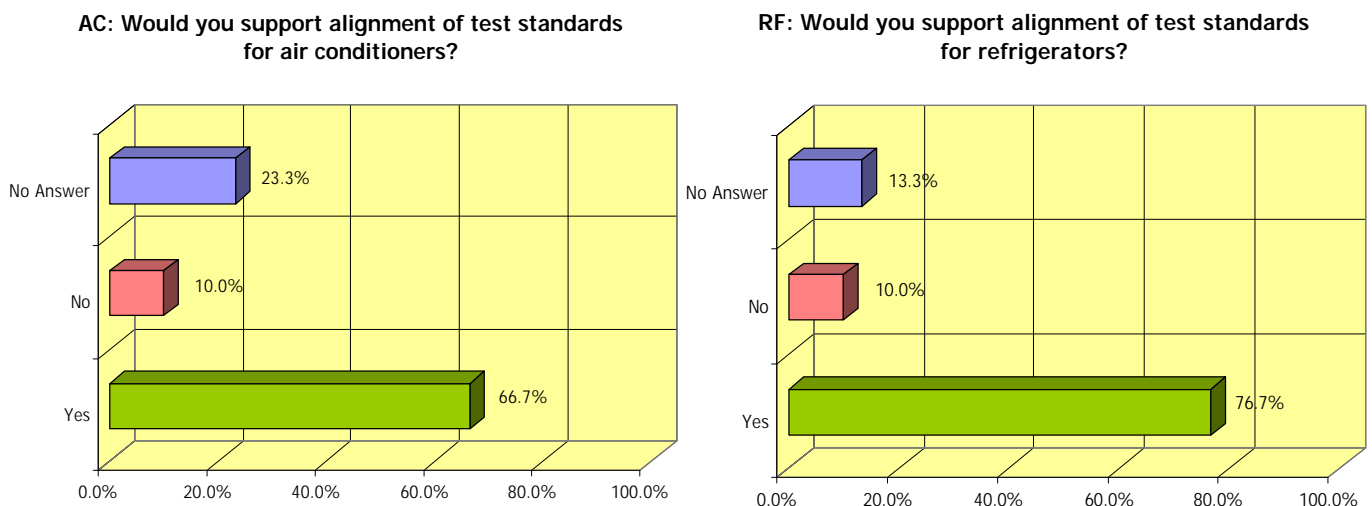
Regulators who support the alignment of standards mostly prefer the reference standard to be ISO for both AC and RF energy performance tests. The second most preferred reference standard is the IEC standard, which possibly indicates some confusion. The IEC standards for AC and RF deal with safety, while energy performance is covered by the ISO standards.

Figure 27

AC: Yes, to which standard?

RF: Yes, to which standard?
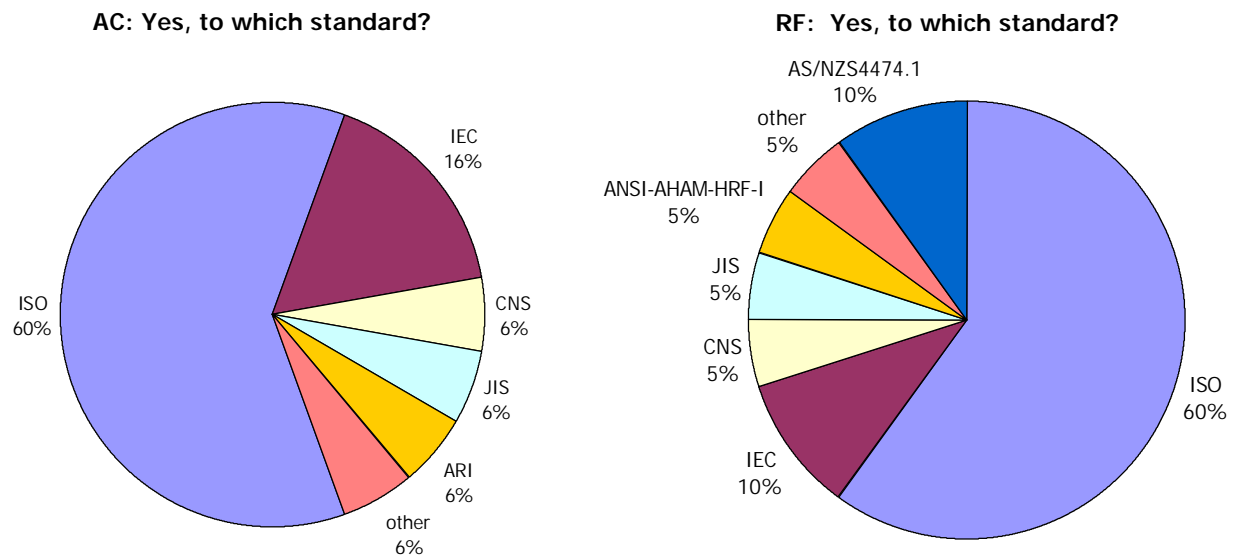
The other standards that were mentioned are CNS, JIS, ARI (for AC), AS/NZS (for RF), and ANSI-AHAM (for RF). However, we must note that these standards were mentioned by the regulators from economies that use the corresponding national standards. This observation reveals that there is still bias or preference towards one's own national standard; this bias could present a significant barrier to aligning test standards within APEC. If democracy prevails, the majority can still align test standards to one reference standard, the ISO standard, for energy performance testing of air conditioners and refrigerators. On the other hand, the preference for a local standard could indicate that there are perceived shortcomings in the ISO standard that need to be addressed before it is acceptable as the reference standard.

4 CONCLUSIONS

The Survey of Industry and Regulators for the APEC Studies on Algorithm Development for Energy Performance Testing was conducted during 1 October 2001 to 30 November 2001. During these two months given to complete this survey study, the survey team:

- ✔ Searched for and identified relevant AC & RF manufacturers/companies, policymakers, test officials, and experts
- ✔ Prepared comprehensive contact lists for:
    - ❖ AC manufacturers/companies
    - ❖ RF manufacturers/companies
    - ❖ AC&RF manufacturers/companies
    - ❖ Regulators
- ✔ Design three sets of survey instruments: AC, RF, and Regulator
- ✔ Distributed the questionnaires by fax, email, and post
- ✔ Collected the responses
- ✔ Entered the response data into separate databases for each of the three survey sets
- ✔ Analyzed the data and produced statistical and qualitative results
- ✔ Produced a Final Report to present the results

The survey study is completed and the results reported above. Below, the survey team concludes the findings of this survey study.

4.1 PRELIMINARY INDUSTRY SURVEY

Gathering data and contact information of AC & RF industry was not difficult; we rounded up more than 230 AC companies, 84 RF companies, and 76 AC&RF companies. However, the process of identifying whether they were relevant (a manufacturer, an exporter, and/or an importer) was costly and needed more time.

The Preliminary Industry Survey shows that the response rates for AC, RF, and AC&RF were all very low. From the 390 total companies found, only 22 replied (only about 14% response rate). Within these 22 responses, only 11 are relevant companies that are involved in international trade of *household* AC and RF products; therefore, even though some are distributors or importers.

The time constraint (about 1 week) had definitely reduced the value that we could gain from the preliminary survey. No following up could be made. We believe that if more time was available (at least 1 month), it should prove successful and could help filter out many of the irrelevant companies on the list. This, in turn, could help reduce the time and costs that would be incurred by conducting the main surveys.

4.2 RESPONSE RATES

Although the Preliminary Industry Survey helped to filter some of the irrelevant companies, the survey team still had to send the AC, RF, and AC&RF surveys to those who had not responded. As expected the response rates were low for all three survey sets. The low response rates for the Industry Survey

made the Regulator Survey response rate (30%) look quite good. The main problems in conducting this survey are:

- ✔ Low response rate
- ✔ Respondents are reluctant to provide answers as an individual
- ✔ Respondents are unsure of the actual purpose of the survey to APEC
- ✔ High cost of international fax and calls

We summarize some key observations based on the response statistics.

- ✔ The low response rate may be a result of various factors combined:
  - ❖ A survey sent with the APEC Secretariat's certification letter looks very official and substantiated; this official-look can be considered a two-edged sword.
  - ❖ Some companies can be very bureaucratic; answering the survey questionnaire may require approval from managerial level persons. This again may take a lot of time, or the response may never be approved for return.
  - ❖ Certainly, one of the main reasons is that the time allowed for companies to respond is too short. The time official allowed was only one week, but extended to three weeks.
  - ❖ Specifying an early deadline may not be a good idea; alternatively, specifying a deadline that is too far into the future could cause recipients to put off the task and forget about it when the deadline arrives.
  - ❖ Questionnaires may have been addressed to the wrong persons or persons who have left the company due to outdated information; and some were not addressed to anyone in particular.
  - ❖ There is a lack of personal relationship between the survey team and the companies' staff to be able to persuade a quick response.
- ✔ What could be done to alleviate the problems and avoid low response rates in the future?
  - ❖ Allow more time to filter the list of manufacturers/companies and regulators so that international long-distance charges can be reduced.
  - ❖ Allow more time for recipients to respond to the questionnaire (1 month or more).
  - ❖ Certification letters should explicitly and clearly assure confidentiality of data and be designed to be official, yet not too serious.
  - ❖ On the issue of specifying deadlines, the survey team suggests that a deadline is mentioned, however, it should be flexible. We added the phrase, "or as soon as possible" after specifying the deadline.
  - ❖ There is a need for incentives; some kind of "prize" should be given to the company or its staff who respond on time.
  - ❖ Identify the appropriate contact person who can answer the questions quickly and without conferring too much with superiors.
  - ❖ APEC and its consulting teams need to establish closer relationship with manufacturers, at least as we have with regulators. Many of the manufacturers have no knowledge about APEC. Consequently, even with a letter of certification from the APEC Secretariat, they have doubts about APEC and the purpose of this survey.

The low response rates for the surveys indicate a need for an integrated information system for energy standards and testing in APEC economies. As of November 2001, the APEC EWG has consigned funds to develop an internet-based energy standards information system. This information system would provide regulators, manufacturers, users, and researchers with updated contact information of key persons in each APEC economy; through this system, the representatives could exchange information and ideas, discuss, and even make decisions on issues related to energy standards. The system will be especially useful in times of urgency when issues on energy standards and testing arise.

4.3 MEPS, LABELING, AND REPEAT TESTING REQUIREMENTS

The trend for energy performance requirements in APEC is moving towards a more restrictive environment. Most economies are already requiring labeling and more and more are implementing MEPS. Energy performance testing procedure is an important part of any labeling and MEPS program. However, the surveys found that these programs require energy performance of AC and RF units to be tested under many different international and national standards. The difference in test standard requirements has led essentially all relevant APEC economies to require products to be retested when they are imported from economies that use a different test standard.

The fact that repeat testing is unmistakably prevalent supports the need to develop a central basis in some certain form that APEC economies could agree upon that would help remove the need for repeat testing. Conversion algorithms, if proved successful, could be one of the possible forms that the economies could all agree to utilize in order to reduce the cost of trade.

4.4 VIEWS ON CONVERSION ALGORITHMS

Benefits of Conversion Algorithms

The majority of Industry respondents agree that a conversion algorithm would be beneficial to them in terms of cost, time, design, production, and equipment. Similarly, more than 80% regulators agree that conversion algorithms could help reduce both time and cost, and opens up trade.

Support for Conversion Algorithms

There was a good level of support for conversion algorithms from RF respondents. AC respondents showed an average level of support, with a minority stating that conversion algorithms would not be useful or applicable. A great majority (at least 90%) of regulators would support the regulations that would allow conversion algorithm to be used. They recognize that conversion algorithms could reduce waste, helps trade, and provide benefits to all; but still, many cautioned that a good reference standard would be necessary to gain their support.

Development of Conversion Algorithms

Majority of all respondents prefer that conversion algorithms be "simple but effective," rather than "complex but accurate." Most respondents do not have experience in developing these algorithms while those that do have not been 100% successful.

AC respondents suggested that most attention should be paid to ambient temperature, indoor dry & wet bulb temperature, compressor type, and refrigerant type for AC conversion algorithm development. RF respondents are most concerned with the ambient temperature, refrigerant type, test packs (load), duration & procedure of tests, adjusted volume & wall thickness, and compartment temperature. For air-conditioners, seasonal variation is important in those regions with seasonal climates. Therefore, a modeling-type algorithm would probably be useful. For refrigerating appliances, an algorithm is possibly less necessary and would be more complex.

The most significant barriers would be the difference in testing conditions and environment, different test methods and setup, and reaching a consensus on a reference standard. Regulators are also worried about the difficulty of developing a model that is fully applicable to all conditions. Standardizing

a reference test method is also important and the development should start from a small number of test standards. To overcome these barriers, the respondents most often stress the importance of cooperation among economies in working together to reach an agreement.

4.5 VIEWS ON THE ALIGNMENT OF STANDARDS

The results of both Industry and Regulator surveys showed extremely encouraging signs for the initiative to align test standards in the APEC region. All Industry respondents indicated they would support the alignment of standards, while there were about 70% of the regulators who expressed support. The most preferred standard to align to is the ISO standard for both AC and RF testing. However, because the ISO test standards still had some shortfalls, some still prefer to align to their own economy's test standards.

4.6 OVERALL SUPPOSITION

Overall, the survey was successful in gathering views of the Industry and Regulators in APEC economies. The results indicate clearly the need for more activities in APEC in terms of cooperative developments and projects, such as the development of conversion algorithms, which aim to reduce differences in energy performance testing requirements in APEC.

The following are the conclusions that sum up the survey study.

1) The concept of introducing algorithms received a very high degree of support from regulators, who before the survey represented the highest potential barrier.

2) Unexpectedly, there was also great support for the alignment of test standards, despite some possible dissatisfaction with the current international standards.

3) Development of conversion algorithms should continue, as it could be an intermediate solution to reduce trading costs from repeat testing until the alignment of standards is realized.

4) There is a need for continued coordination between regulators of the APEC member economies. Possibly this could be in the form of an EGEE&C self-funded project or a workstream of that expert group.

5) Fundamentally, there is a crucial need for a forum where representatives of APEC economies can continually exchange information and ideas on energy standards-related issues. An internet-based energy standards information system that the APEC EWG is developing could be just the solution to increase coordination between APEC economies.

APPENDIX I – APEC CERTIFICATION LETTER

ASIA-PACIFIC ECONOMIC COOPERATION
SECRETARIAT

Re : EWG 03/2000T

Dear members,

An APEC funded study is currently underway to examine the concept of using conversion algorithms in place of repeat testing of electrical equipment, and the extent to which they can be used to compare energy performance test results of refrigerators and air conditioners.

This project is one of a number of projects managed by the APEC EWG Expert Group on Energy Efficiency and Conservation (EGEEC) to strengthen cooperation on energy efficiency standards. The main objective of this project is to foster the development and use of conversion algorithms in comparing energy performance test results to avoiding expensive multiple testing of appliances to different test standards, when those appliances are subject to different energy performance requirements in various economies.

One part of the project is a survey to collect the views and opinions of manufacturers, policymakers, and regulators towards conversion algorithms, particularly their feasibility and applicability. The APEC Secretariat would like to request your kind cooperation in this study and would like to introduce to you the consultants who will be carrying out this APEC sponsored survey study.

Mr. Sood Ratanadilok Na Phuket. His contact information:
382/1 Soi 13, Ngamwongwan 25
Nonthaburi, Thailand 11000
Tel: +66 (1) 844 8439
Fax: +66 (2) 952 7865
Email: naphuket@yahoo.com
and
Mr. David Cogan (Project Overseer). His contact information:
Tel: +64 4 470 2231
Fax: +64 4 499 5330
Mobile: +64 21 462676
Email: david.cogan@eeca.govt.nz

Thank you for your cooperation.

Yours sincerely,

Dr. Helena Gaytan
Program Director

APPENDIX II – AC PRELIMINARY SURVEY

Studies on Algorithm Development for Energy
Performance Testing (EWG 03/2000T)

Study 4: Survey of Industry and Regulators

To:		From:	Sood Ratanadilok Na Phuket
			APEC EWG 03/2000T Survey Study
			382/1 Soi 13, Ngamwongwan 25
			Nonthaburi, Thailand 11000
Tel:		Tel:	+66 (1) 844 8439
Fax:		Fax:	+66 (2) 952 7865
		Email:	naphuket@yahoo.com
Date:		Page(s):	2
		Code:	

Dear Sir or Madam:

The survey team would like to request for your kind cooperation in this APEC study. Please refer to the letter from the APEC Secretariat (following this page) for the description of the study and its objectives. At this stage, we would like to confirm your company's contact information and find the right contact person. Please complete the following form and **fax or email back to us by Thursday, 11 October 2001**.

On behalf of APEC, we thank you in advance for your immediate response.

Sincerely,

Sood Ratanadilok Na Phuket
Project Manager, Study 4: Survey of Industry and Regulators

Note: More than one answer may be checked for each question.

1. Does your company produce **household** air conditioning appliances?

   ☐ Yes   ☐ No

2. Your company is:

   ☐ a manufacturer (of complete units)   If so, which brands: _____

   ☐ an OEM (parts manufacturer)   If so, which parts: _____
   and for which brands: _____

   ☐ a distributor (distribution and   If so, which brands: _____
   sales)

3. Do you export or import your products?

☐ Yes, export. If so, how: ☐ Yes, import.
    ☐ By our company
    ☐ Through an exporter   ☐ No, we only make/sell domestic products.

4. Please indicate who would be the most appropriate person for us to contact in your company regarding **energy performance testing and certification**.

His/her contact information:
(If not the same as above)

Name: _____
Position: _____
Tel: _____
Fax: _____
Email: _____
Address: _____
_____
_____

APPENDIX III – RF PRELIMINARY SURVEY

Studies on Algorithm Development for Energy Performance Testing (EWG 03/2000T)

Study 4: Survey of Industry and Regulators

To:		From:	Sood Ratanadilok Na Phuket
			APEC EWG 03/2000T Survey Study
			382/1 Soi 13, Ngamwongwan 25
			Nonthaburi, Thailand 11000
Tel:		Tel:	+66 (1) 844 8439
Fax:		Fax:	+66 (2) 952 7865
		Email:	naphuket@yahoo.com
Date:		Page(s):	2
		Code:	

Dear Sir or Madam:

The survey team would like to request for your kind cooperation in this APEC study. Please refer to the letter from the APEC Secretariat (following this page) for the description of the study and its objectives. At this stage, we would like to confirm your company's contact information and find the right contact person. Please complete the following form and **fax or email back to us by Thursday, 11 October 2001**.

On behalf of APEC, we thank you in advance for your immediate response.

Sincerely,

Sood Ratanadilok Na Phuket
Project Manager, Study 4: Survey of Industry and Regulators

Note: More than one answer may be checked for each question.

1. Does your company produce **household** refrigeration appliances?

   ☐ Yes   ☐ No

2. Your company is:

   ☐ a manufacturer (of complete units)   If so, which brands: _____

   ☐ an OEM (parts manufacturer)   If so, which parts: _____

   and for which brands: _____

   ☐ a distributor (distribution and sales)   If so, which brands: _____

3. Do you export or import your products?

☐ Yes, export. If so, how: ☐ Yes, import.
     ☐ By our company
     ☐ Through an exporter   ☐ No, we only make/sell domestic products.

4. Please indicate who would be the most appropriate person for us to contact in your company regarding **energy performance testing and certification**.

His/her contact information:
(If not the same as above)

Name:	
Position:	
Tel:	
Fax:	
Email:	
Address:	

APPENDIX IV – AC SURVEY QUESTIONNAIRE

		Studies on Algorithm Development for Energy Performance Testing (EWG 03/2000T)	
		Study 4: Survey of Industry and Regulators	

To:		From:	Sood Ratanadilok Na Phuket
			APEC EWG 03/2000T Survey Study
			382/1 Soi 13, Ngamwongwan 25
			Nonthaburi, Thailand 11000
		Tel:	+66 (1) 844 8439
		Fax:	+66 (2) 952 7865
Tel:		Email:	naphuket@yahoo.com
Fax:		Page(s):	2
Date:		Code:	

This survey is carried out on behalf of the APEC Energy Working Group to obtain your views, opinions, and suggestions on issues regarding the use of conversion algorithms for translating energy performance results between test standards. **The information you provide will be strictly confidential.** No individual data will be published or accessible to any other party than the Study Team and the APEC Energy Working Group; further, the data will strictly be used only within the scope of this study. **Please return this survey to the above fax or email by Wednesday, 24 October 2001** or as soon as possible. Thank you in advance for your immediate response to this survey.

Survey of Air Conditioner Manufacturers

*All questions are regarding to air conditioner (AC) units for **household use** only.*

1. What is your product range? Please give the size range in BTU, ton, or kW (state which) for each type of air conditioning appliance (specify type: split-system, window, etc.)

    _____

    _____

2. Does your economy impose minimum energy performance standard (MEPS) on household ACs?

    ☐ Yes ......which test standard is required to measure energy performance? _____

    ☐ No ......but under consideration and will be implemented in (year) _____

    ☐ No

3. To what energy performance test standard(s) does your company perform tests?

    ☐ Test standard(s): _____

    ☐ No ......comment: _____

4. Does the test standard that your company use accurately consider the impact of barometric pressure on the psychrometric calculations to determine cooling capacity?

    ☐ Yes ☐ No

    ......Is the barometric pressure measured? ☐ Yes ☐ No

5. Do you export your AC units?

☐ Yes......to which APEC economies? ....

☐ No ......do you plan to export in the future?
    ☐ Yes, when? ....
    ☐ No (Go to Question 9)

6. Do you encounter repeated testing when exporting to other economies?

☐ Yes......in which economies? ....
    What is the reason?   ☐ Incomparable MEPS requirement
                          ☐ Different test standard
                          ☐ Other: ....

☐ No

7. Would a conversion algorithm benefit the trade of your company's products?

☐ Yes......in terms of: ☐ Cost   ☐ Time   ☐ Equipment
                      ☐ Production   ☐ Design
                      ☐ Other benefits: ....

☐ No ......comment: ....

8. If a conversion algorithm can satisfactorily translate results between different test standards, would you support the regulations that will allow the use of this algorithm?

☐ Yes

☐ No ......comment: ....

9. Should these algorithms be "simple but effective" or "cumbersome but accurate"?

☐ Simple but effective   ☐ Complex but accurate

10. Have you had any experience in developing a conversion algorithm to translate results between test standards?

☐ Yes......was it successful? ....

☐ No

11. In the development of conversion algorithms, can you prioritise the <u>five</u> most important variables that should be addressed? Please rank from 1 to 5, where 1 is the most important.

____	Ambient temperature	____	Indoor dry bulb temperature
____	Refrigerant type	____	Indoor wet bulb temperature
____	Compressor type	____	ambient wet bulb temperature
____	Expansion device type	____	Test condition tolerances
____	Other:		

12. What do you see as the most significant barriers in translating results between test standards?

....

....

13. Please suggest ways in which the conversion algorithm could be developed to meet the needs of manufacturers such as yourself:

....

....

14. Would you support the alignment (harmonization) of test standards for air conditioners?

☐ Yes......to which reference standard and why? ....

....

☐ No ......comment: ....

....

APPENDIX V – RF SURVEY QUESTIONNAIRE

<table>
<tr><td>To:</td><td></td><td>From:</td><td>Sood Ratanadilok Na Phuket
APEC EWG 03/2000T Survey Study
382/1 Soi 13, Ngamwongwan 25
Nonthaburi, Thailand 11000</td></tr>
<tr><td></td><td></td><td>Tel:</td><td>+66 (1) 844 8439</td></tr>
<tr><td></td><td></td><td>Fax:</td><td>+66 (2) 952 7865</td></tr>
<tr><td>Tel:</td><td></td><td>Email:</td><td>naphuket@yahoo.com</td></tr>
<tr><td>Fax:</td><td></td><td>Page(s):</td><td>2</td></tr>
<tr><td>Date:</td><td></td><td>Code:</td><td></td></tr>
</table>

This survey is carried out on behalf of the APEC Energy Working Group to obtain your views, opinions, and suggestions on issues regarding the use of conversion algorithms for translating energy performance results between test standards. **The information you provide will be strictly confidential.** No individual data will be published or accessible to any other party than the Study Team and the APEC Energy Working Group; further, the data will strictly be used only within the scope of this study. **Please return this survey to the above fax or email by Wednesday, 24 October 2001** or as soon as possible. Thank you in advance for your immediate response to this survey.

Survey of Refrigerator Manufacturers

*All questions are regarding to refrigerator (RF) units for **household use** only.*

1. What is your product range? Please give the size range in litres or cu ft (state which) for each type of refrigeration appliance (specify type: refrigerators, freezers, refrigerator freezers, etc.)

   _____

   _____

2. Does your economy impose minimum energy performance standard (MEPS) on household RFs?

   ☐ Yes ......which test standard is required to measure energy performance? _____

   ☐ No ......but under consideration and will be implemented in (year) _____

   ☐ No

3. To what energy performance test standard(s) does your company perform tests?

   ☐ Test standard(s): _____

   ☐ No ......comment: _____

4. Are there any special features in any of your models that may reduce energy consumption in actual use but not under test conditions? If yes, please give brief details

☐ Yes......comment: ....
....

☐ No

5. Do you export your RF units?

☐ Yes......to which APEC economies? ....
☐ No ......do you plan to export in the future? ....
    ☐ Yes, when? ....
    ☐ No (Go to Question 9)

6. Do you encounter repeated testing when exporting to other economies?

☐ Yes......in which economies? ....
    What is the reason?   ☐ Incomparable MEPS requirement
                             ☐ Different test standard
                             ☐ Other: ....

☐ No

7. Would a conversion algorithm benefit the trade of your company's products?

☐ Yes......in terms of: ☐ Cost   ☐ Time   ☐ Equipment
                            ☐ Production   ☐ Design
                            ☐ Other benefits: ....

☐ No ......comment: ....

8. If a conversion algorithm can satisfactorily translate results between different test standards, would you support the regulations that will allow the use of this algorithm?

☐ Yes
☐ No ......comment: ....

9. Should these algorithms be "simple but effective" or "complex but accurate"?

☐ Simple but effective   ☐ Complex but accurate

10. Have you had any experience in developing a conversion algorithm to translate results between test standards?

☐ Yes......was it successful? ....
☐ No

11. In the development of conversion algorithms, can you prioritise the <u>five</u> most important variables that should be addressed? Please rank from 1 to 5, where 1 is the most important.

____ Ambient temperature   ____ Food loads / test packs
____ Compartment temperature   ____ Door openings
____ Refrigerant type   ____ Test measurement duration and procedure
____ Adjusted volume & wall thickness   ____ Advanced features and defrost mechanism
____ Other: ....

12. What do you see as the most significant barriers in translating results between test standards?

   ....

   ....

13. Please suggest ways in which the conversion algorithm could be developed to meet the needs of manufacturers such as yourself:

   ....

   ....

14. Would you support the alignment (harmonization) of test standards for refrigerators?

☐ Yes......to which reference standard and why?   ....

   ....

☐ No ......comment: ....

   ....

APPENDIX VI – REGULATOR SURVEY QUESTIONNAIRE

Studies on Algorithm Development for Energy Performance Testing (EWG 03/2000T)
Study 4: Survey of Industry and Regulators

To:		From:	Sood Ratanadilok Na Phuket
			APEC EWG 03/2000T Survey Study
			382/1 Soi 13, Ngamwongwan 25
			Nonthaburi, Thailand 11000
		Tel:	+66 (1) 844 8439
		Fax:	+66 (2) 952 7865
Tel:		Email:	naphuket@yahoo.com
Fax:		Page(s):	3
Date:		Code:	

Dear Sir or Madam:

The Survey Team would like to request for your kind cooperation in this APEC study. Please refer to the letter from the APEC Secretariat (scanned image on the left) for the description of the study and its objectives.

The information you provide will be strictly confidential. No individual data will be published or accessible to any other party than the Study Team and the APEC Energy Working Group; further, the data will strictly be used only within the scope of this study.

Please return this survey to the above fax or email by Thursday, 25 October 2001 or as soon as possible.

Thank you in advance for your immediate response.

Sincerely,

Sood Ratanadilok Na Phuket
Project Manager – Study 4

Survey of Regulators

*All questions regard to refrigerator (RF) and air conditioner (AC) units for **household use** only.*

Air Conditioner	**Refrigerator**

1. Does your economy impose minimum energy performance standard (MEPS) on:

☐ Yes......test standard:	☐ Yes..... test standard:
......size range:	..... size range:
☐ No ......under consideration for year:	☐ No ..... under consideration for year:
......test standard:	..... test standard:
......size range:	..... size range:
☐ No	☐ No

2. Aside from MEPS requirements, does your economy require energy performance testing for labeling, or other information-related reasons?

☐ Yes......test standard:	☐ Yes..... test standard:
......size range:	..... size range:
☐ No	☐ No

If you answered "No" to both Questions 1 & 2, please skip to Question 5

3. For an imported unit that has been tested and certified in a foreign country under a different test standard than the one used in your economy, do your regulations require it to be re-tested?

☐ Yes	☐ Yes
☐ No (skip to Question 5)	☐ No (skip to Question 5)
Comment:	Comment:

4. In your opinion, how does repeated testing affect foreign manufacturers importing into your economy? Please comment beside the choices.

☐ Positively	☐ Positively
☐ Negatively	☐ Negatively
☐ No effect	☐ No effect
☐ Don't know	☐ Don't know

5. How does repeated testing affect local manufacturers exporting to other economies?

☐ Positively	☐ Positively
☐ Negatively	☐ Negatively
☐ No effect	☐ No effect
☐ Don't know	☐ Don't know

6. Would a conversion algorithm benefit the trade of AC and RF units?

☐ Yes......in terms of:	☐ Yes..... in terms of:
☐ No ......comment:	☐ No ..... comment:

Air Conditioner	Refrigerator

7. If a conversion algorithm can satisfactorily translate results between different test standards, would you support the regulations that will allow the use of this algorithm? Please comment.

☐ Yes		☐ Yes	
☐ No		☐ No	

8. Should these algorithms be "simple but effective" or "cumbersome but accurate"?

☐ Simple but effective	☐ Simple but effective
☐ Cumbersome but accurate	☐ Cumbersome but accurate

9. Have you or has your agency had any experience in developing conversion algorithms to translate results between test standards for AC and RF energy performance testing?

☐ Yes......successful?	☐ Yes..... successful?
☐ No	☐ No

10. What do you see as the most significant problems/barriers in translating results between test standards?

11. Please suggest ways in which the conversion algorithm could be best developed:

12. Would you support the alignment (harmonization) of test standards for air conditioners & refrigerators?

☐ Yes .....to which reference standard and why?	☐ Yes .... to which reference standard and why?
☐ No ......comment:	☐ No ..... comment:

13. For AC only: Is it important that MEPS predict the seasonal energy and efficiency for your local economy? Are the nominal values determined in ISO5151 *not* sufficient for ranking the relative performance of various AC products?

☐ Yes......comment:

☐ No ......comment:

Thank you very much. Please return pages 2 & 3 by Thursday, 25 October 2001 to:
Email: naphuket@yahoo.com
Fax: +66 2 952 7865