Overview of Trade Flows of Energy-Using Products Between APEC Member Economies

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ASIA-PACIFIC ECONOMIC COOPERATION

Energy Working Group

November 1998

Coordinating Agency :

Export Council for Energy Efficiency

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Joachim Brennhausen, Osram-Taipei; David Cogan of the New Zealand Energy Efficiency and Conservation Authority; and Lloyd Harrington of Energy-Efficient Strategies, Australia.

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EXECUTIVE SUMMARY

■ Purpose of this study

The Energy Efficiency and Conservation Experts Group of the Asia-Pacific Economic Cooperation Forum (APEC) commissioned a study to examine trade flows of major energy-consuming products between APEC member economies. This report presents the findings of that study.

The study is intended to provide information to the APEC Steering Group on Energy Standards to assist in setting priorities for the program of work outlined by the Energy Ministers of the APEC member economies concerning cooperation related to energy efficiency standards and trade.

■ Methods of study

The study was conducted by collecting and analyzing data on energy efficiency and trade from a variety of sources. A key source of trade data was the UN Commodity Trade Statistics series, which includes trade data supplied by APEC member economies. (Trade statistics were collected separately from Chinese Taipei.) Other relevant information, such as production and sales data, was collected from authoritative sources, including reports, articles and personal interviews. Data on energy efficiency was obtained in the same way.

■ Findings on value of trade flows

Table 2.1 provides a summary of the value of trade flows in selected energy-using equipment in the APEC region. More detailed information on the flows is provided in subsequent tables addressing each type of equipment individually.

Among the equipment addressed by this study, the most valuable trade flows are flows of air conditioners and industrial motors. Trade among APEC economies in window and wall air conditioners and “other” air conditioners (including mini-split room air conditioners as well as ducted equipment) is worth about US$3,000-3,300 million per year. In general, trade in air conditioners other than window or wall units (that is, ductless split systems and ducted central air conditioners) is the more valuable trade flow, often by a factor of two or three.

Next most valuable is the trade in industrial motors. Trade flows of industrial motors among APEC economies is valued at about US$2,500-3,000 million per year. Trade in AC motors is larger by value than trade in DC motors and generators. AC motors account for about 60-65% of the total APEC regional motor trade.

Third most valuable is trade in household refrigeration equipment.[1] Trade among APEC economies in household refrigerators totals about US$1,000-1,100 million per year. Only about 10% or less of this sum is deep freezers; the vast majority are fridges or fridge-freezers.

Trade flows of lighting equipment are the least valuable of those examined in this report. Trade among APEC economies in discharge lamps, the trade category which includes fluorescent lamps, totals about US$400-600 million per year. Trade in ballasts for discharge lamps is valued at US$500-600 million per year. However, taken together, trade in fluorescent lamps and ballasts is about as large in value as trade in refrigerators.

Table 2.1: Overview of the value of APEC trade flows of selected equipment: 1994-1996
US$ millions

	1994*		1995		1996	
	Export	Import	Export	Import	Export	Import
Refrigerators						
Fridges and fridge-freezers	977.2	872.7	992.5	1,000.9	957.5	1,006.8
Freezers	126.8	99.4	79.2	113.6	70.4	122.1
Air conditioners						
Window/wall type	1,082.1	705.2	1346.7	828.1	1469.0	899.5
Other	1,972.5	2,542.0	*1,801.3*	*2,558.1*	*1,506.3*	*2,310.3*
Lighting						
Discharge lamps**	407.9	478.0	476.2	533.8	499.7	582.6
Ballasts for discharge lamps	312.3	470.4	526.3	593.0	649.1	648.3
Motors						
DC motors and generators	856.8	978.3	913.8	1,079.1	843.6	1,109.7
AC motors	1,118.8	1,633.5	1,484.8	1,898.5	1,824.3	2,131.3

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei Trade Statistics
*Data from Chinese Taipei not available for 1994.
** Data from Chinese Taipei on discharge lamps not available.

■ Findings on quantity of trade flows

The quantity of trade flows has been examined. Because data on the quantity of trade flows is variously reported as weight (in metric tons) or number or units, it was necessary to convert this data to a common basis, introducing considerable error.

Analysis shows that the largest flows by quantity of trade are motors and lighting equipment. This is to be expected since lighting equipment has a much lower unit cost than air conditioners

[1] For the purposes of this report, the term “refrigerator” will be used inclusively to refer to all household appliances providing cold storage. The various types will be differentiated as follows. The term “fridge” is used to refer to an appliance consisting of a single compartment for cold storage. “Fridge-freezer” refers to an appliance with at least two compartments, one for cold storage and one for freezing. The term “freezer” will be used to refer to an appliance consisting of a single compartment for freezing.

and refrigerators. Also, there are many small motors as well as large ones included in these trade statistics, so that the unit costs are relatively small.

Table 2.2: Overview of APEC trade flows by quantity, 1996
Thousands of units

	Exports		Imports	
Commodity	APEC-World	APEC-APEC	World-APEC	APEC-APEC
Window/wall air conditioners	7,763	5,277	3,770	3,334
Other air conditioners	7,388	4,946	3,928	3,701
AC motors	59,833	50,771	120,600	106,922
DC motors	143,300	134,491	192,167	182,197
Fridges and fridge-freezers	7,065	3,824	4,561	3,965
Deep freezers	614	225	706	510
Discharge lamps	3,217,775	2,738,840	1,371,607	768,026
Ballasts for discharge lamps	171,249	147,135	205,911	181,973

Source: Compiled and estimated UN Commodity Trade Statistics series and Chinese Taipei Trade Statistics

■ Findings on trade flows and energy efficiency

Data on the energy efficiency of traded equipment covered by this study is quite limited. In general, trade data and energy efficiency data are gathered and maintained separately. One way to broadly examine energy efficiency and trade is to look at imports of equipment into APEC economies with energy efficiency testing and/or performance requirements. Table 2.3 below summarizes data on the share of trade among APEC economies accounted for by imports to APEC economies with mandatory energy performance standards (MEPS) or mandatory labeling requirements. Both of these policy measures trigger the need for importers of covered equipment to have their products tested in order to verify compliance with MEPS or to verify information required for listing on mandatory energy efficiency labels.

The table also reports on the share of imports headed to APEC economies with voluntary labeling programs. Such policies do not require importers to have their products tested, but some do so in order to reap any marketing advantages from affixing an energy efficiency label to their products. Finally, the table indicates the share of imports going to APEC economies that do not currently have any MEPS or labeling schemes in effect, but are developing such programs for future implementation or considering whether to pursue similar policies. More detailed information on this analysis is presented in subsequent sections of this chapter dealing specifically with each type of equipment.

Table 2.3 shows that the share of total APEC imports headed for APEC economies with mandatory energy efficiency performance or labeling programs currently in effect ranges from about 80% for ballasts and 70% for air conditioners and industrial motors to about 60% for refrigerators and about 50% for fluorescent lamps. However, several APEC economies that

currently do not have mandatory or voluntary energy efficiency policies in place are considering instituting such measures. Analysis indicates that if all such possible programs were to be implemented, the share of APEC import trade subject to mandatory or voluntary energy efficiency testing could amount to 96% for air conditioners; 80% for motors, refrigerators, and ballasts; and 60% for lamps.

Table 2.3: Overview of APEC import flows by energy efficiency testing requirements

	Share of total trade		
	1994	1995	1996
Air conditioners			
Share of APEC-APEC import flows destined for economies with MEPS or mandatory labeling	.71	.74	.76
As above, plus voluntary labeling or targets	.95	.96	.96
As above, plus programs in development or under consideration	.95	.96	.96
AC Motors			
Share of APEC-APEC import flows destined for economies with MEPS or mandatory labeling	.68	.65	.70
As above, plus voluntary labeling or targets	.75	.72	.78
As above, plus programs in development or under consideration	.82	.80	.82
Fridges and fridge-freezers			
Share of APEC-APEC import flows destined for economies with MEPS or mandatory labeling	.63	.60	.63
As above, plus voluntary labeling or targets	.77	.71	.71
As above, plus programs in development or under consideration	.87	.87	.84
Discharge lamps			
Share of APEC-APEC import flows destined for economies with MEPS or mandatory labeling	.46	.50	.49
As above, plus voluntary labeling or targets	.55	.56	.54
As above, plus programs in development or under consideration	.57	.58	.56
Ballasts for discharge lamps			
Share of APEC-APEC import flows destined for economies with MEPS or mandatory labeling	.85	.85	.79
As above, plus programs in development or under consideration	.86	.85	.79

Source: Based on UN Commodity Trade Statistics and Chinese Taipei trade statistics

■ Implications of findings

The findings of this study have several implications for decision-making by APEC bodies concerning a program of work on harmonizing aspects of energy efficiency testing and verification within the region.

One possible criterion that APEC decision-makers may wish to take into account is the economic significance of regional trade in various kinds of energy-using equipment. This study has shown that air conditioning equipment and industrial motors are the most valuable trade flows among

the equipment designated for this study. Each accounts for more than US$3,000 million per year in trade within the APEC region.

Another key criterion is the relationship of trade flows to existing and planned programs of APEC member economies that establish energy efficiency testing or performance requirements for imports of equipment covered by this study. At present, a large volume of APEC regional trade occurs between economies with similar or even identical energy efficiency testing and/or performance requirements, such as trade between Canada, the US, and Mexico. However, several APEC member economies are contemplating the establishment of new energy efficiency labeling and/or performance requirements. This indicates that an increasing share of APEC regional trade in energy-using equipment will be subject to a patchwork of unrelated requirements.

Several APEC economies are considering developing or revising energy efficiency policies addressing air conditioners and refrigerators. Changes in such policies could cause a considerable shift in the regional APEC import market, and may indicate that these two appliances are important targets for priority attention.

The potential to save energy is a logical and important criterion for making decisions concerning APEC programming. The various end uses specified for this study each make up a significant but varying share of electricity demand in APEC economies. Data on the share of electricity demand attributable to *traded* versus domestically produced equipment is not available. However, the ratio of energy costs to purchase price is higher for industrial motors and fluorescent lighting equipment than for air conditioners or refrigerators.

1. INTRODUCTION

1.1 Purpose

The Energy Efficiency and Conservation Experts Group of the Asia-Pacific Economic Cooperation Forum (APEC) commissioned a study to examine trade flows of major energy-consuming products between APEC member economies. This report presents the findings of that study.

The study is intended to provide information to the APEC Steering Group on Energy Standards to assist in setting priorities for the program of work outlined by the Energy Ministers of the APEC member economies concerning cooperation related to energy efficiency standards and trade. In their declaration, the ministers laid out the following series of tasks:

- Developing firm proposals for establishing a base on which mutual acceptance of accreditation of energy efficiency testing facilities and the results of tests performed at these facilities can be achieved.
- Working toward the establishment of bases for the direct comparison of the outcomes of testing to different standard procedures so that the need to test to multiple standard procedures can be reduced or removed.
- Developing a general policy framework that would allow for the progressive development and implementation of harmonized standards on a bilateral or multilateral basis, and product-by-product, as technical details are established and mutually agreed upon.

Accordingly, the objective of this study is to:

- Examine and report on trade flows of household refrigerators, household air conditioners, fluorescent lighting equipment, and industrial motors; and
- Utilizing this information, and other appropriate information on ranges of energy efficiency of traded goods, characterize the regional appliance market and detail any implications of the analysis for key products under consideration.

1.2 Methods

Collecting information on trade flows of multiple products between 18 separate economies is a daunting task. The task is made more manageable by making use of the Commodity Trade Statistics series compiled by the United Nations. This series contains data from 17 of the 18 APEC member economies.[1] For the purposes of this study, UN data were supplemented by trade data collected directly from Chinese Taipei.

Until very recently, the United Nations Commodity Trade Statistics series was only available classified according to the Standard International Trade Classification system (SITC). For many

[1] Chinese Taipei does not report trade data to the United Nations; however, other economies report on transaction with Chinese Taipei.

commodities, this system is less detailed than the six-digit Harmonized System (HS). HS data is only available via the UN Commodity Trade Statistics series for one year, 1996. Therefore, SITC data (Revision 3) is used for most of this report, supplemented on occasion by HS data. However, statistics from Chinese Taipei are classified according to the Harmonized System, not the SITC.

The UN Commodity Trade Statistics series provides data on the value of trade, reported in US dollars. Data on the quantity of trade is variously reported as either weight (in metric tons) or number of units. Converting quantity data to a common basis introduces significant error, as conversion factors are liable to be quite inaccurate. Thus, this study concentrates on the value of trade, which can be directly added across the various member economies of APEC. Limited analysis of data on the quantity of trade has also been carried out.

The reader will note that the value of equivalent trade flows—for example, export of window air conditioners from A to B versus import of window air conditioners by B from A—are sometimes quite different. Some difference in the value of equivalent trade flows is due to systematic differences in the way trade flows are valued. The import value is generally higher than the export value due to the inclusion of customs, insurance, and freight in the former but not the latter. However, any systematic variance is usually swamped by other factors, including:

- misclassification of traded commodity. This includes simple error as well as deliberate misclassification to minimize tariffs or evade quotas;
- misreporting of the destination of exports. Again, this could be due to simple error, or a deliberate attempt to evade quotas, embargoes, etc; and,
- timing. An item exported in a given year may not be received until a later year.

In addition to data on trade flows, other relevant information, such as production and sales data, was collected from authoritative sources, including reports, articles and personal interviews. Data on energy efficiency was obtained in the same way.

1.3 Structure of the report

Chapter 2 provides an overview of trade flows and energy efficiency of designated equipment in the APEC region. The following four chapters report in detail on findings concerning energy efficiency and trade for specific appliances. Chapter 3 covers household refrigerators and freezers, and Chapter 4 addresses room air conditioners. Chapter 5 reports on fluorescent lighting equipment (lamps and ballasts), and Chapter 6 covers industrial motors. These chapters begin with an overview of the global and regional markets, followed by data on the market and trade flows of specific member economies. Finally, Chapter 7 provides comments on the implications of findings on energy efficiency and trade flows for decisions on APEC's program of work concerning regional harmonization of energy efficiency testing.

2. MARKET CHARACTERIZATION

This chapter will provide an overview of the market for selected energy-consuming equipment in the APEC region. It will characterize the market with respect to the following:

- size of trade flows, by value of equipment traded;
- size of trade flows, by number of appliances traded;
- leading exporters and importers; and
- share of imports destined for APEC economies with energy efficiency testing requirements versus economies without such requirements.

2.1 Overview of size of trade flows by type of equipment

The size of trade flows may be examined in terms of value or quantity. For a study like this one, examining trade flows of several commodities across 18 economies, data on the value of trade is more reliable than data on the quantity. This is because some economies report quantity of trade in terms of weight (usually kilograms or metric tons) and others as number of units of the commodity in question. Therefore, data from the UN Commodity Trade Statistics series (the principal source of trade data for this study) on the value of trade can be added directly, because such data is converted from local currency into a common currency (US dollars). In contrast, data on the quantity of trade is reported as a mix of weights and number of "sets", and must be converted by hand into common units. This conversion process is not only laborious, but also fairly arbitrary. A conversion factor for estimating the number of units represented by a flow reported by weight must be determined based on a limited amount of information, and is subject to considerable error.

■ Value of trade flows

Table 2.1 provides a summary of the value of trade flows in selected energy-using equipment in the APEC region. More detailed information on the flows is provided in subsequent tables addressing each type of equipment individually.

Among the equipment addressed by this study, the most valuable trade flows are flows of air conditioners and industrial motors. Trade among APEC economies in window and wall air conditioners and "other" air conditioners (including mini-split room air conditioners as well as ducted equipment) is worth about US$3,000-3,300 million per year. In general, trade in air conditioners other than window or wall units is the more valuable trade flow, often by a factor or two or three.

Next most valuable is the trade in industrial motors. Trade figures do not cover motors incorporated in other equipment, but only those shipped separately. Trade flows of industrial motors among APEC economies is valued at about US$2,500-3,000 million per year. Trade in AC motors is larger by value than trade in DC motors and generators. AC motors account for about 60-65% of the total APEC regional motor trade.

Third most valuable is trade in household refrigeration equipment.[1] Trade among APEC economies in household refrigerators totals about US$ 1,000-1,100 million per year. Only about 10% or less of this sum is deep freezers; the vast majority are fridges or fridge-freezers.

Trade flows of lighting equipment are the least valuable of those examined in this report. Trade among APEC economies in discharge lamps, the trade category which includes fluorescent lamps, totals about US$400-600 million per year. Trade in ballasts for discharge lamps is now valued at US$500-600 million per year. The increase in value of the ballast trade relative to the lamps trade may be due to trade in electronic ballasts, which are of higher value than wire-wound types. Normally, one would expect 2-3 lamps to be sold for each ballast, as ballasts last longer. Taken together, trade in fluorescent lamps and ballasts is about as large in value as trade in refrigerators.

Table 2.1: Overview of the value of APEC trade flows of selected equipment: 1994-1996
US$ millions

	1994*		1995		1996	
	Export	Import	Export	Import	Export	Import
Refrigerators						
Fridges and fridge-freezers	977.2	872.7	992.5	1,000.9	957.5	1,006.8
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Window/wall type	1,082.1	705.2	1346.7	828.1	1469.0	899.5
Other	1,972.5	2,542.0	*1,801.3*	*2,558.1*	*1,506.3*	*2,310.3*
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DC motors and generators	856.8	978.3	913.8	1,079.1	843.6	1,109.7
AC motors	1,118.8	1,633.5	1,484.8	1,898.5	1,824.3	2,131.3

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei Trade Statistics
*Data from Chinese Taipei not available for 1994.
** Data from Chinese Taipei on discharge lamps not available.

■ Quantity of trade

The quantity of trade flows has been examined, subject to the caveats described above. The largest flows by volume of trade are motors and lighting equipment. This is to be expected since lighting equipment has a much lower unit cost than air conditioners and refrigerators. Also, there

[1] For the purposes of this report, the term “refrigerator” will be used inclusively to refer to all household appliances providing cold storage. The various types will be differentiated as follows. The term “fridge” is used to refer to an appliance consisting of a single compartment for cold storage. “Fridge-freezer” refers to an appliance with at least two compartments, one for cold storage and one for freezing. The term “freezer” will be used to refer to an appliance consisting of a single compartment for freezing.

are many small motors as well as large ones included in these trade statistics, so that the unit costs are relatively small.

Table 2.2: Overview of APEC trade flows by quantity, 1996
Thousands of units

	Exports		Imports	
Commodity	APEC-World	APEC-APEC	World-APEC	APEC-APEC
Window/wall air conditioners	7,763	5,277	3,770	3,334
Other air conditioners	7,388	4,946	3,928	3,701
AC motors	59,833	50,771	120,600	106,922
DC motors	143,300	134,491	192,167	182,197
Fridges and fridge-freezers	7,065	3,824	4,561	3,965
Deep freezers	614	225	706	510
Discharge lamps	3,217,775	2,738,840	1,371,607	768,026
Ballasts for discharge lamps	171,249	147,135	205,911	181,973

Source: Compiled and estimated UN Commodity Trade Statistics series and Chinese Taipei Trade Statistics

2.2 Overview of trade flows and energy efficiency

Data on the energy efficiency of traded equipment covered by this study is quite limited. In general, trade data and energy efficiency data are gathered and maintained separately. Indeed, for many economies, there is very little data available on the general energy efficiency of selected equipment, much less specific data on the energy efficiency of equipment imported from a specific source.

In subsequent chapters of this report, a small amount of information obtained on the energy efficiency of traded equipment in specific economies is related. Meanwhile, one way to broadly examine energy efficiency and trade is to look at imports of equipment into APEC economies with energy efficiency testing and/or performance requirements. Table 2.3 below summarizes data on the share of trade among APEC economies accounted for by imports to APEC economies with mandatory energy performance standards (MEPS) or mandatory labeling requirements. Both of these policy measures trigger the need for importers of covered equipment to have their products tested in order to verify compliance with MEPS or to verify information required for listing on mandatory energy efficiency labels.

The table also reports on the share of imports headed to APEC economies with voluntary labeling programs. Such policies do not require importers to have their products tested, but some do so in order to reap any marketing advantages from affixing an energy efficiency label to their products. Finally, the table indicates the share of imports going to APEC economies that do not currently have any MEPS or labeling schemes in effect, but are developing such programs for future implementation or considering whether to pursue similar policies. More detailed

information on this analysis is presented in subsequent sections of this chapter dealing specifically with each type of equipment.

Table 2.3 shows that the share of total APEC imports headed for APEC economies with mandatory energy efficiency performance or labeling programs currently in effect ranges from more than 70% for ballasts, air conditioners, and industrial motors to about 60% for refrigerators and about 50% for fluorescent lamps. However, several APEC economies that currently do not have mandatory or voluntary energy efficiency policies in place are considering instituting such measures. Analysis indicates that if all such possible programs were to be implemented, the share of APEC import trade subject to mandatory or voluntary energy efficiency testing could amount to 96% for air conditioners, 84% for motors and refrigerators, and 79% for fluorescent lamps and ballasts.

Table 2.3: Overview of APEC import flows by energy efficiency testing requirements

Share of total trade

	1994	1995	1996
Air conditioners			
Share of APEC-APEC import flows destined for economies with MEPS or mandatory labeling	.71	.74	.76
As above, plus voluntary labeling or targets	.95	.96	.96
As above, plus programs in development or under consideration	.95	.96	.96
AC Motors			
Share of APEC-APEC import flows destined for economies with MEPS or mandatory labeling	.68	.65	.70
As above, plus voluntary labeling or targets	.75	.72	.78
As above, plus programs in development or under consideration	.82	.80	.82
Fridges and fridge-freezers			
Share of APEC-APEC import flows destined for economies with MEPS or mandatory labeling	.63	.60	.63
As above, plus voluntary labeling or targets	.77	.71	.71
As above, plus programs in development or under consideration	.87	.87	.84
Discharge lamps			
Share of APEC-APEC import flows destined for economies with MEPS or mandatory labeling	.46	.50	.49
As above, plus voluntary labeling or targets	.55	.56	.54
As above, plus programs in development or under consideration	.57	.58	.56
Ballasts for discharge lamps			
Share of APEC-APEC import flows destined for economies with MEPS or mandatory labeling	.85	.85	.79
As above, plus programs in development or under consideration	.86	.85	.79

Source: Based on UN Commodity Trade Statistics and Chinese Taipei trade statistics

2.3 Trade flows of air conditioners in the APEC region

Chapter 4 provides a detailed look at available information at the market for air conditioning in each of the APEC member economies. The following section presents a summary of information on the regional trade flows.

Within the SITC code, window and wall air conditioner units are classified under one code, and all "other" air conditioning equipment under another. Within the latter code are lumped together ductless mini-split room air conditioners and ducted central air conditioning systems. Tables 2.4 and 2.5 present detailed data on export and import for window/wall air conditioners among APEC economies in 1996. Tables 2.5 and 2.6 present analogous data for "other" air conditioners.

■ Window and wall air conditioners

As indicated in Table 2.4, the total value of window/wall air conditioners imported into APEC economies is about US$1,000 million per year, of which about 90% come from other APEC economies. An estimated 3.8 million units per year were imported from the world, of which 3.3 million were imported from APEC. Leading importers are the United States, Singapore and Hong Kong, China, which together account for almost 75% of imports by value and/or quantity.

The total value of window/wall air conditioners exported by APEC economies is about US$1,200 million per year, of which about 60% are exported to other APEC economies. Worldwide exports total about 7.8 million units, of which about 5.3 million units are bound for other APEC economies. Leading exporters are Malaysia, Singapore, Thailand, and Korea, which together account for more than 80% of exports from one APEC economy to another.

■ Other air conditioners

As shown in Table 2.6, the value of air conditioners other than window or wall units imported by APEC economies totals approximately US$2,700 million per year, of which about 90% are imported from other APEC economies. An estimated 3.7 million units are imported annually by one APEC economy from another.[2] Leading importers are Hong Kong, China; Canada; and Singapore, which together account for more than 60% of total APEC imports by value.

Worldwide exports of air conditioners other than window or wall units are valued at about US$3,100 million per year, of which about 60% are exported to other APEC economies. An estimated 4.9 million units are exported annually from one APEC economy to another. Leading exporters are the United States, Japan, and Thailand, which together account for about 90% of exports.

[2] Note that Hong Kong, a major participant in trade of air conditioners, did not report any data on *quantity* of trade in air conditioners other than window/wall units.

Table 2.4: Imports of window/wall air conditioners (1996)																		
(000s of USD)																		
	Reporter Economy:																	
Partner:	AUS	BD	CDA	CHL	PRC	HKC	INA	JPN	ROK	MAS	MEX	NZ	PNG	RP	SIN	CT	*THA**	USA
World	49942		49331	5761	20204	195685	4044	43068	9375	14693	9793	4785		11329	194223	38998	*3696*	374531
Australia	-			46	9		114	12	91			442		4	45		*52*	
Brunei Darussalam		-																
Canada			-	11	3		2	11			12				6			1255
Chile				-														
China	216		3758	427	-	14422	559	106	14	84		2		1518	1140		*81*	5832
Hong Kong, China	9			142	34	-	13	50	11	3120		82		660	6862		*12*	107
Indonesia	2						-	8	3	3						323		153
Japan	1932		159		14512	13606	791	-	5249	5189	9	1421		287	17490	10992	*1226*	6193
Korea, Rep. of	6495		873	229	3308	10966	133	4	-	102	1168	564		4790	7737	10423	*294*	68028
Malaysia	7425		1476	594	98	43998	196	12741		-	14	796		2	76799	1167	*1025*	62008
Mexico	24		3068	14							-							34174
New Zealand	592					322						-			36			
Papua New Guinea													-					
Philippines						457			2					-	2			
Singapore	979		58	4	10	39311	261	64	4	1563	33	80		218	-	1	*160*	97840
Chinese Taipei	6531		349	90	239	35357	60	16534	104	80		294		1991	2562	-		707
Thailand	10502		103	93	439	24826	1249	13231	345	3479	4	903		1093	77784	3518	-	45399
United States	1501		39100	2044	1466	6407	164	191	1897	331	8348	169		676	716	11616	*222*	-
Total APEC imports:	36208	-	48944	3694	20118	189672	3542	42952	7720	13951	9588	4753	-	11239	191179	38040	*3072*	321696
APEC imports as % of total	0.73		0.99	0.64	1.00	0.97	0.88	1.00	0.82	0.95	0.98	0.99		0.99	0.98	0.98	*0.83*	0.86
Total APEC-APEC import flows:	946368																	
Worldwide import flows to APEC:	1029458																	

Note: Thailand data are for most recent available year (1995)

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics.

Table 2.5: Exports of window/wall air conditioners (1996)																		
(000s of USD)																		
	Reporter Economy:																	
Partner:	AUS	BD	CDA	CHL	PRC	HKC	INA	JPN	ROK	MAS	MEX	NZ	PNG	RP	SIN	CT	*THA**	USA
World	4610		3008	172	55819	32	536	19005	389345	663915	39961	808		886	265446	93869	*312077*	126405
Australia	-				44			1284	8980	18053	27	441			1209	6749	*23519*	2646
Brunei Darussalam		-							732	2472					7863		*16*	
Canada			-						2539	904		1				181	*654*	40625
Chile				-	64				1014	808	28						*155*	1799
China	9		7		-	32		414	6721	38719					2862		*190*	1346
Hong Kong, China	370		14		14520	-		1991	18710	110489				752	80940	9676	*49852*	7325
Indonesia	52				63		-	11	1644	27539						1352	*2*	123
Japan					4397			-	598	117056		1		77	161	17357	*63695*	182
Korea, Rep. Of	94				1282			264	-	140				1	25	324	*33*	94
Malaysia	623				254		2	54	3713	-					3473	32	*1428*	4
Mexico									1277	415	-					55	*220*	6469
New Zealand	810				3				970	1587		-			18	4	*745*	19
PNG	334								1171	230			-		168	288	*84*	11
Philippines	42				2632			168	8777	2527				-	67	996	*253*	1510
Singapore	652				366		1	4624	23488	77889					-	10036	*37444*	327
Chinese Taipei	1						485	31	12125	15853					14	-	*3436*	9422
Thailand	321				8			45	1325	7090					4456	65	-	353
United States	244		2300		3751			92	60779	44910	36948			56	88245	1089	*2190*	-
Total APEC exports:	3552	-	2321	-	27384	32	488	8978	154563	466681	37003	443	-	886	189501	48204	*183916*	72255
APEC exports as % of total	0.77		0.77	0.00	0.49	1.00	0.91	0.47	0.40	0.70	0.93	0.55		1.00	0.71	0.51	*0.59*	0.57
Total APEC-APEC export flows:	1196207																	
Worldwide export flows to APEC:	1975894																	

Note: Thailand data are for most recent available year (1995)
Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics.

Table 2.6: Imports of other air conditioners (1996)																		
(000s of USD)																		
	Reporter Economy:																	
Partner:	AUS	BD	CDA	CHL	PRC	HKC	INA	JPN	ROK	MAS	MEX	NZ	PNG	RP	SIN	CT	*THA**	USA
World	80710		334741	24145	184009	970316	43463	199854	14575	33225	103666	26557		33497	351269	79418	*37773*	200336
Australia	-		345	63	725	5725	1199	2	1652	917		9615		49	9676	1991	*4030*	2936
Brunei Darussalam		-													28			
Canada	138		-	300	290	591		289			1724			30		308	*55*	38767
Chile				-							4172							
China	642		7	54	-	80605	527	5094	694	142	12	142		887	2068		*1*	3354
Hong Kong, China	668			86	4370	-	72	256	6	922	179	67		1501	2101	2	*4*	88
Indonesia	627					34	-	3		1015	1	14		22			*1729*	
Japan	24220		6695	1498	82159	314970	8609	-	3201	5279	6399	10385		12630	113639	35830	*12401*	71722
Korea, Rep. of	4003		3045	470	13227	16145	729	837	-	228	283	799		3174	21074	379	*1129*	13901
Malaysia	12862		4	337	6840	138146	13223	81091	19	-	479	1106		4194	80968	14724	*7558*	1726
Mexico	84		1779	589					5	210	-				652	87		23920
New Zealand	3238				2000	1220	21					-			205			4
Papua New Guinea													-					
Philippines						53	81	2						-	1			
Singapore	1594			1	915	70851	939	1094	30	1335	68	64		1292	-	2	*126*	436
Chinese Taipei			367		6699		1113				1	151				-		
Thailand	17324		149	453	51	113891	1196	72949	5	1009	3047	979		584	64811	3888	-	12405
United States	6374		316137	15068	42505	103819	3630	25463	3727	3335	84200	653		4946	24778	10541	*3789*	-
Total APEC imports:	71774	-	328528	18919	159781	846050	31339	187080	9339	14392	100565	23975	-	29309	320001	67752	*30822*	169259
APEC imports as % of total	0.89		0.98	0.78	0.87	0.87	0.72	0.94	0.64	0.43	0.97	0.90		0.87	0.91	0.85	*0.82*	0.84
Total APEC-APEC import flows:	2408885																	
Worldwide import flows to APEC:	2717554																	

Note: Thailand data are for most recent available year (1995)

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics.

Table 2.7: Exports of other air conditioners (1996)																		
(000s of US$)																		
	Reporter Economy:																	
Partner:	AUS	BD	CDA	CHL	PRC	HKC	INA	JPN	ROK	MAS	MEX	NZ	PNG	RP	SIN	CT	*THA**	USA
World	27094		43398	282	109100	5090	4396	1089812	40537	194403	36743	6872		298	110708	101490	*384312*	915846
Australia	-		10		471	44		30618	1718	5164		3445			2247	6783	*2874*	7844
Brunei Darussalam	88	-						1273	15	173					7547		*133*	812
Canada			-					3545		174	7					435	*178*	318577
Chile	51		13	-	87	26		1323		117	1024					57	*52*	8495
China	828		44		-	3892	23	101309	5357	3365	165	226			3948	280	*121*	39116
Hong Kong, China	2841		414		41672	-		202667	4814	27569		1403		286	6531	40238	*64989*	30210
Indonesia	463				371	55	-	19471	2651	6149		134				406	*96*	1425
Japan	2		144		7573	85	2764	-	469	874	1	484		4	1328	5250	*126820*	25915
Korea, Rep. of	368		117		7	72		8495	-		5	38			5	208	*45*	22784
Malaysia	558				3523	108	116	6322	53	-		3			11959	680	*14949*	5708
Mexico								104	106	511	-				226		*935*	103989
New Zealand	3949				459	4		4932		469		-			174	178	*171*	886
Papua New Guinea	1297				44	13		382		413		17	-		195		*110*	
Philippines	683		37		4124	119		20425	2157	13371				-	1415	1599	*1285*	9382
Singapore	1886				873	192	40	90937	359	54629	648	440			-	4281	*45080*	15850
Chinese Taipei										1725					534	-	*4301*	
Thailand	3094		9		346	106	205	11071	155	4548		2			2044	670	-	16421
United States	971		39662	1	297	1		47749	98	8019	28650				2516	2447	*39020*	-
Total APEC exports:	17079	-	40450	1	59847	4717	3148	550623	17952	127270	30500	6192	-	290	40669	63512	*301159*	607414
APEC exports as % of total	0.63		0.93	0.00	0.55	0.93	0.72	0.51	0.44	0.65	0.83	0.90		0.97	0.37	0.63	*0.78*	0.66
Total APEC-APEC export flows:	1870823																	
Worldwide export flows to APEC:	3070381																	

Note: Thailand data are for most recent available year (1995)

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics.

Table 2.8: Trade flows of window/wall air conditioners by quantity					
Economy	Exports		Imports		Year
	To World	To APEC	From World	From APEC	
Australia	*11,767*	*9,514*	142,956	102,120	1996
Brunei Darussalam	-	-	-	-	-
Canada	8,691	7,130	204,126	201,647	1996
Chile	*272*	-	*16,151*	*10,605*	1996
China	196,720	105,856	46,542	46,518	1996
Hong Kong, China	110	100	631,011	491,876	1996
Indonesia	*2,914*	*13*	*23,269*	*22,450*	1996
Japan	99,269	64,809	144,181	90,198	1996
Korea	*1,297,735*	*583,939*	*20,238*	*14,683*	1996
Malaysia	3,430,578	2,728,295	161,400	147,524	1995
Mexico	*193,108*	*179,859*	*42,061*	*41,596*	1996
New Zealand	1,107	758	8,640	8,586	1996
Papua New Guinea	-	-	-	-	-
Philippines	8,076	8,074	19,941	19,612	1995
Singapore	681,129	501,329	666,260	653,991	1996
Chinese Taipei	283,560	*129,665*	104,881	*102,708*	1996
Thailand	1,220,755	763,876	24,222	24,025	1995
United States	327,500	194,052	1,514,111	1,355,621	1996
TOTAL:	**7,763,291**	**5,277,268**	**3,769,990**	**3,333,761**	

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics
Note: Italicized data are estimated rather than reported figures.

Table 2.9: Trade flows of other air conditioners by quantity					
Economy	**Exports to World**	**Exports to APEC**	**Imports from World**	**Imports from APEC**	**Year**
Australia	*10,355*	*6,357*	151,397	135,845	1996
Brunei Darussalam	-	-	-	-	-
Canada	41,051	29,706	1,114,728	1,097,039	1996
Chile	*39*	*0*	*5,216*	*4,115*	1996
China	292,058	146,814	83,250	79,744	1996
Hong Kong, China	-	-	-	-	1996
Indonesia	*395*	*100*	*18,449*	*15,403*	1996
Japan	2,053,519	1,090,578	980,924	963,569	1996
Korea	*11,031*	*5,587*	*2,675*	*1,666*	1996
Malaysia	193,868	90,676	23,068	13,108	1995
Mexico	*19,390*	*16,126*	*49,544*	*48,459*	1996
New Zealand	4,903	4,535	42,180	40,860	1996
Papua New Guinea	-	-	-	-	-
Philippines	*169*	*166*	*16,048*	*14,879*	1995
Singapore	229,514	76,660	682,336	636,426	1996
Chinese Taipei	319,525	*190,536*	114,746	*67,752*	1996
Thailand	2,008,364	1,707,803	46,951	46,000	1995
United States	2,203,442	1,580,191	596,097	536,179	1996
TOTAL:	**7,387,622**	**4,945,835**	**3,927,610**	**3,701,044**	

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics
Note: Italicized data are estimated rather than reported figures.

■ Energy efficiency and air conditioner trade flows

As indicated in table 2.10 below, several APEC economies have minimum energy performance standard and/or mandatory labeling programs. The United States, Canada, and Mexico have harmonized MEPS, and the United States has announced plans to strengthen its standards effective in 2000. The Philippines has a MEPS which is updated and strengthened on a regular basis. Korea has minimum performance standards, as well as target energy efficiency values. However, MEPS in some APEC economies are reportedly not rigorously enforced, such as the China and Singapore. Imports into APEC economies that have at least nominal mandatory performance and/or labeling programs for air conditioners accounted for 76% of all imports from APEC economies.

In addition, Hong Kong, China, a major participant in air conditioner trading in the APEC region, instituted a voluntary energy efficiency labeling program for air conditioners in 1996. Thailand and New Zealand also have voluntary energy efficiency labeling schemes. Japan has energy efficiency targets for air conditioners, which are negotiated with the air conditioner industry. These targets currently apply to the average of shipments, rather than specific air conditioner models. The value of imports of air conditioners into these economies—especially Hong Kong, China—is quite large. Hence, more than 95% of total APEC-APEC import flows are destined for economies with either mandatory or voluntary energy efficiency standards or labeling programs.

Table 2.10: APEC trade flows of window/wall air conditioners by energy efficiency performance and testing			
			US$ thousands
	1994	**1995**	**1996**
Value of global imports of window/wall air conditioners	1,316,877	1,369,592	1,556,463
Value of window/wall air conditioners imported into APEC economies from world	800,067	961,019	1,040,407
Value of window/wall aircon imported into APEC from APEC	705,172	828,123	899,492
Imports from APEC into APEC economies with MEPS			
United States	232051	286094	320988
Canada	12882	34701	48593
Mexico	19404	4209	9588
Korea	3205	3369	7720
Philippines	2795	3466	9248
China	47641	42318	20117
Singapore	146546	124945	188617
Chinese Taipei	-	73124	38040
With mandatory labeling			
Australia	33843	39120	36207
Subtotal mandatory	**498,367**	**611,346**	**679,118**
Percentage of total APEC-APEC trade	**71%**	**74%**	**76%**
With voluntary labeling			
Hong Kong, China	164320	162315	154315
New Zealand	1931	3590	4754
Thailand	2189	3072	-
With voluntary targets			
Japan	4783	16382	26416
Subtotal voluntary	**173,223**	**185,359**	**185,485**
Subtotal existing mandatory and voluntary	**671,590**	**796,705**	**864,603**
Percentage of total APEC-APEC trade	**95%**	**96%**	**96%**
With programs in development or under consideration			
Indonesia	578	2116	3241
Total existing and planned	**672,168**	**798,821**	**867,844**
Percentage of total APEC-APEC trade	**95%**	**96%**	**96%**

Source: Based on data from UN Commodity Trade Statistics and Chinese Taipei trade statistics

2.4 Trade flows of motors

Industrial motors are second only to air conditioning equipment in terms of the value of trade flows in the APEC region. Chapter 6 provides additional available market and energy efficiency information on motors in specific APEC economies.

The SITC code includes only two classifications for industrial motors, one for DC motors and generators and one for AC motors. (AC generators are classified separately, as are all motors with capacities of less than 37.5 watts.)

The value of AC motor imports into APEC economies is about US$2,800 million per year, of which about 75% are imported from other APEC economies. This figure likely includes large quantities of small motors. Analysis of more detailed trade data (available for 1996 only) indicates that about one-quarter of this amount is fractional horsepower motors. Another 25% is integral horsepower, single-phase motors. About one-third is multi-phase motors up to 75 kW and the remaining 20% is multi-phase motors over 75kW. The total quantity of imports of all AC motors in the APEC region is an estimated 107 million annually. The import market for AC motors is dominated by the US; Malaysia; and Hong Kong, China. Together, these three economies account for about 70% of the regional APEC import trade in AC motors.

Exports of AC motors by APEC economies are valued at about US$2,200 million per year, of which almost 85% are exported to other APEC economies. More than 50 million AC motors are exported within the APEC market annually. Leading exporters are China, Singapore, and Mexico, which account for a combined 53% of the total APEC export market for AC motors.

The APEC regional market for DC motors and generators is larger by volume but smaller in value. The total value of DC motors and generators imported by APEC economies is about US$1,300 million per year, of which about 80% are imported from other APEC economies. This amounts to an estimated 182 million units imported by one APEC economy from another. Principal importers are Mexico, Malaysia, and the US, which together account for more than 85% of the total APEC import market.

Exports of DC motors and generators by APEC economies total US$1,120 million per year, of which 80% are shipped to other APEC economies. About 135 million units are exported from one APEC economy to another annually. Key exporting economies are Singapore, Thailand, and Canada, which together export about 100 million units per year to the APEC market.

Table 2.11: Imports of AC motors (1996)																		
(000s of USD)																		
	Reporter Economy:																	
Partner:	AUS	BD	CDA	CHL	PRC	HKC	INA	JPN	ROK	MAS	MEX	NZ	PNG	RP	SIN	CT	*THA**	USA
World	95361		139261	23896	98044	143091	64516	197912	246970	160435	108446	25747		43078	116101	45027	*82586*	1169324
Australia	-		64	25		104	1040	1520	2	1425	10	3088		85	1584	248	*1270*	134
Brunei Darussalam		-																
Canada	135		-	226	3455	12	21	929	2474	81	1656	116		153	177		*38*	88714
Chile				-						13								2
China	6285		207	712	-	60019	2369	51121	6022	7048	4152	850		3499	5229	402	*7194*	54072
Hong Kong, China	53		319	73	4994	-	170	532	16	6379	1483	98		1019	1324	2426	*568*	9450
Indonesia			58		118	284	-	591		291	1461			47		1514	*1242*	849
Japan	5306		2134	403	22277	12716	12494	-	134070	61083	5580	2952		2668	34817	21199	*12299*	107109
Korea, Rep. of	314		12	483	4070	1891	1120	16637	-	3416	2093	125		4349	675	58	*2856*	15316
Malaysia	1400			6	241	12774	750	130	644	-	31	285		1570	10291	3	*4920*	4955
Mexico	1		1907	9	6	31	748	525	7	18	-	25			152	58		613345
New Zealand	94		1	37			36			69		-			29	2		4
Papua New Guinea													-			11		
Philippines						27		117	1		16			-	4			
Singapore	705		1		1697	12091	9803	2840	3995	34205	437	66		3200	-	94	*11174*	217
Chinese Taipei	14239		900	341	10165	13101	8983	37744	3011	13737	3122	2182		7829	10457	-	*8918*	48774
Thailand	101			1	36	1174	304	8815	44	6647	6	198		775	1370	165	-	26
United States	10136		112536	6713	10151	4750	7698	20943	20519	11090	66717	6390		10644	16527	5828	*5122*	-
Total APEC imports:	38769	-	118139	9029	57210	118974	45536	142444	170805	145502	86764	16375	-	35838	82636	32008	*55601*	942967
APEC imports as % of total	0.41		0.85	0.38	0.58	0.83	0.71	0.72	0.69	0.91	0.80	0.64		0.83	0.71	0.71	0.67	0.81
Total APEC-APEC import flows:	2098597																	
Worldwide imports to APEC:	2759795																	

Note: Thailand data are for most recent available year (1995)

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics.

Table 2.12: Exports of AC motors (1996)																		
(000s of USD)																		
	Reporter Economy:																	
Partner:	AUS	BD	CDA	CHL	PRC	HKC	INA	JPN	ROK	MAS	MEX	NZ	PNG	RP	SIN	CT	*THA**	USA
World	4062		101331	314	184995	3215	70409	525335	112086	53770	443207	1262		19	92389	165621	*13766*	389390
Australia	-		199		4618	50		4908	170	1320		306			753	13267	*87*	3220
Brunei Darussalam		-			1			5		56					140	2		275
Canada			-		3937		4	2430	1944	1516	1284				1	5506		177921
Chile	24		421	-	1002			359	453		3					160		1597
China	1		237		-	2574	743	29065	8336	183					1380	160	*13*	2431
Hong Kong, China	27		20		26390	-	4	12465	670	363	3	1		3	8058	12048	*1719*	1676
Indonesia	75		268		2708	2	-	10023	2997	4488						7205	*11*	1881
Japan	1845		356		45795	4	7295	-	33796	1230	158	688			941	34003	*7741*	10743
Korea, Rep. of	12		367		2355		42	143215	-	1068					3729	2487		8114
Malaysia	643				4021		21	10866	3242	-		39			30725	1889	*448*	3289
Mexico			22		267			2411	1221		-					319		73163
New Zealand	938		29		180	28		2516	1	298		-			48	1404	*117*	2761
Papua New Guinea	61									11			-			217	*2*	
Philippines	27		2		4536		11	3094	5632	1844				-	3024	6445	*111*	2301
Singapore	204		99		5027		54047	17201	1193	6363	12	2		16	-	13262	*1530*	6571
Chinese Taipei	5		668		2021	506	114		648	7043					2580	-		4961
Thailand	2		2		5474	14	2597	39394	10728	14848					15494	5701	-	2103
United States	78		92897	18	28614	12	2278	111309	26203	4616	434697				11675	42808	*466*	-
Total APEC exports:	3942	-	95587	18	136946	3190	67156	389261	97234	45247	436157	1036	-	19	78548	146883	*12245*	303007
APEC exports as % of total	0.97		0.94	0.06	0.74	0.99	0.95	0.74	0.87	0.84	0.98	0.82		1.00	0.85	0.89	*0.89*	0.78
APEC-Wide export flows:	1816476																	
Worldwide exports to APEC:	2161171																	

Note: Thailand data are for most recent available year (1995)

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics.

Table 2.13: Imports of DC motors, generators (1996)																		
(000s of USD)																		
	Reporter Economy:																	
Partner:	AUS	BD	CDA	CHL	PRC	HKC	INA	JPN	ROK	MAS	MEX	NZ	PNG	RP	SIN	CT	*THA**	USA
World	51360		139261	5538	70195	6771	11939	73889	84842	113161	118263	3817		3236	79022	17181	*20496*	515397
Australia	-		64	2	73		384	407	85	636	7	163		1		1	*39*	159
Brunei Darussalam		-																
Canada	274		-	800	227		77	988	1491	4	520	10		16	30		*92*	137036
Chile				-							55							
China	559		207	22	-	3983	238	9277	5793	7613	793	48		289	2037	7	*327*	28538
Hong Kong, China	99		319	11	3755	-	66	677	78	3530	5	3		58	1095	11	*175*	3602
Indonesia			58		52		-	46	663	2640	1					4		5
Japan	10503		2134	97	41988	1232	2640	-	23391	39236	1922	437		898	32030	5134	*6064*	90922
Korea, Rep. of	65		12	7	2086	25	39	3219	-	2117	16	6		4	3816	1396	*48*	12175
Malaysia	7			1	1115		35	438	16196	-	62	3			1085		*1814*	1173
Mexico	21		1907	3	17		2	171			-	1			4			94430
New Zealand	29		1	10	1			2		51	13	-		11				97
Papua New Guinea													-					
Philippines					26			35	2120		18	2		-	23			201
Singapore	35		1	3	1978	108	2179	249	2452	23348	16	1		23	-	59	*1150*	412
Chinese Taipei	256		900	50	2891	689	1033	986	2625	7433	276	78		363	6146	-		2494
Thailand							118	861	6255	8215	14				10203	32	-	16862
United States	30733		112536	1688	4891	108	1348	35421	12084	11918	89451	1250		376	8898	2983	*1555*	-
Total APEC imports:	42581	-	118139	2694	59100	6145	8159	52777	73233	106741	93169	2002	-	2039	65367	9627	*11264*	388106
APEC imports as % of total imports:	0.83		0.85	0.49	0.84	0.91	0.68	0.71	0.86	0.94	0.79	0.52		0.63	0.83	0.56	*0.55*	0.75
TOTAL APEC-APEC import flows:	1041143																	
Worldwide imports to APEC:	1314368																	

Note: Thailand data are for most recent available year (1995)

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics.

Table 2.14: Exports of DC motors, generators (1996)																		
(000s of USD)																		
	Reporter Economy:																	
Partner:	AUS	BD	CDA	CHL	PRC	HKC	INA	JPN	ROK	MAS	MEX	NZ	PNG	RP	SIN	CT	*THA**	USA
World	6599		186368	56	18095	2942	15213	240917	41250	22044	155575	84		297	62954	3812	*74326*	290340
Australia	-		93		156	51		6927	5	3594		26		162	290	11	*6*	5071
Brunei Darussalam		-								5					857			
Canada	2		-		605			1216		1993	2828				14	1		116123
Chile	10		33	-	44			16			14				3			629
China			3998		-	43	26	7475	56	559				13	1315		*3572*	5177
Hong Kong, China	4542		48		826	-		3481	40	763	32	1			4116	549		1365
Indonesia	262		5		953		-	7004	97	123						707	*18*	1447
Japan	2		481		938	72	46	-	1879		333	3		1	813	131	*38313*	7853
Korea, Rep. Of	90		2209		753		17	30846	-	1487	993				694	15	*91*	5676
Malaysia	38				399		58	11669		-					36821	248	*331*	730
Mexico			6					622	347		-				15			50732
New Zealand	801				4			192				-			60	1		362
Papua New Guinea													-		14			
Philippines	9				723			5166	17	34				-	1011	488	*7*	2614
Singapore	116		201		309		14990	10090	420	6903	45	1			-	212	*8389*	2790
Chinese Taipei	8		50		120	196		17920	40	243				59	744	-		3536
Thailand	5		185		418			8879	196	4322		8			3806	363	-	313
United States	211		138608	14	6984	2298		74817	37647	951	149470			4	2213	831	*5392*	-
Total APEC exports:	6096	-	145917	14	13232	2660	15137	186320	40744	20977	153715	39	-	239	52786	3557	*56119*	204418
APEC exports as % of total exports:	0.92		0.78	0.25	0.73	0.90	0.995	0.77	0.99	0.95	0.99	0.46		0.80	0.84	0.93	*0.76*	0.70
Total APEC-APEC export flows:	901970																	
Worldwide exports to APEC:	1120872																	
Note: Thailand data are for most recent available year (1995)																		

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics.

Table 2.15: Trade flows of AC motors by quantity					
Economy	**Exports to World**	**Exports to APEC**	**Imports from World**	**Imports from APEC**	**Year**
Australia	*80,248*	*77,741*	2,233,610	797,900	1996
Brunei Darussalam	-	-	-	-	
Canada	526,122	425,868	3,290,867	3,042,655	1996
Chile	*6,515*	*87*	*402,756*	*140,393*	1996
China	13,206,097	11,214,472	6,932,097	4,807,594	1996
Hong Kong, China	348,244	273,422	13,171,551	12,501,707	1996
Indonesia	*651,032*	*605,173*	*1,287,226*	*942,390*	1996
Japan	*5,096,890*	*3,706,647*	*4,296,310*	*2,331,184*	1996
Korea	*3,199,625*	*2,839,961*	*2,149,614*	*1,566,685*	1996
Malaysia	3,147,169	2,683,766	26,949,350	25,569,211	1995
Mexico	*7,609,723*	*7,352,284*	*2,883,319*	*2,450,255*	1996
New Zealand	1,134	874	585,028	464,328	1996
Papua New Guinea	-	-	-	-	
Philippines	76	1	1,455,286	100,348	1995
Singapore	9,475,931	8,952,233	5,305,154	4,805,474	1996
Chinese Taipei	6,310,488	5,117,771	1,428,626	1,375,922	1996
Thailand	5,549,756	4,185,974	6,654,938	6,276,655	1995
United States	4,623,932	3,334,774	41,574,797	39,749,663	1996
TOTAL:	**59,832,981**	**50,771,048**	**120,600,529**	**106,922,364**	

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics
Note: Italicized data are estimated rather than reported figures.

Table 2.16: Trade flows of DC motors and generators by quantity					
Reporter	**Exports to World**	**Exports to APEC**	**Imports from World**	**Imports from APEC**	**Year**
Australia	*56,243*	*39,568*	744,310	686,513	1996
Brunei Darussalam	-	-	-	-	
Canada	32,235,621	30,848,028	3,479,233	2,960,657	1996
Chile	*1,404*	*22*	*78,267*	*40,510*	1996
China	913,192	773,740	4,365,816	4,328,947	1996
Hong Kong, China	66,720	22,771	2,641,300	2,578,614	1996
Indonesia	*59,804*	*45,700*	*224,197*	*154,355*	1996
Japan	*2,425,133*	*1,687,952*	*714,935*	*544,049*	1996
Korea	*694,865*	*680,227*	*624,396*	*565,139*	1996
Malaysia	26,327,372	26,048,657	60,400,235	56,501,948	1995
Mexico	*3,374,236*	*2,604,928*	*67,425,349*	*66,778,710*	1996
New Zealand	362	281	55,186	35,978	1996
Papua New Guinea	-	-	-	-	
Philippines	*4,116*	*982*	*3,329*	*2,187*	1996
Singapore	36,034,377	35,255,735	9,568,649	8,195,909	1996
Chinese Taipei	773,740	279,225	82,856	74,375	1996
Thailand	36,558,598	32,947,838	1,321,255	1,265,658	1995
United States	3,773,906	3,255,563	40,438,247	37,484,332	1996
TOTAL:	**143,299,688**	**134,491,215**	**192,167,561**	**182,197,881**	

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics
Note: Italicized data are estimated rather than reported figures.

■ Energy efficiency and motors trade flows

A relatively small number of APEC economies have established energy efficiency performance or labeling requirements for industrial motors. The US, Canada, and Mexico have established minimum performance standards for motors, which are quite similar to one another. It has been reported that Chinese Taipei has MEPS for industrial motors, although information on the nature of these requirements was not available for this report. Malaysia also has established MEPS for industrial motors, although these are not very stringent. Imports of AC motors and generators into these economies now accounts for about 70% of the regional APEC import market.

Korea has an endorsement program for high-efficiency motors. In addition, several APEC economies are considering the establishment of energy efficiency performance or labeling requirements for industrial motors. Imports into APEC economies with either existing programs or programs under consideration accounts for about 80% of the total APEC market.

Table 2.17: APEC trade flows of AC motors by energy efficiency testing requirements

US$ thousands

	1994	**1995**	**1996**
Value of global imports of AC motors	4,817,763	5,757,421	5,725,476
Value of AC motors imported into APEC economies from the world	2,205,434	2,581,335	2,961,835
Value of AC motors imported into APEC from APEC	1,633,521	1,898,500	2,131,298
Imports from APEC into APEC economies with MEPS			
United States	733055	830521	894193
Canada	171352	210602	215420
Mexico	116582	75035	86762
Malaysia	92265	90749	263527
Chinese Taipei	-	36260	32000
Subtotal mandatory	**1,113,254**	**1,243,167**	**1,491,902**
Percentage of total APEC-APEC trade	**68%**	**65%**	**70%**
With endorsement labeling			
Korea	116643	132147	170070
Subtotal mandatory and voluntary	**1,229,897**	**1,375,314**	**1,661,972**
Percentage of total APEC-APEC trade	**75%**	**72%**	**78%**
With program under consideration			
Australia	31296	32406	31025
New Zealand	11018	10825	15270
Thailand	29263	55601	-
Indonesia	42068	36247	44788
Subtotal under consideration	**113,645**	**135,079**	**91,083**
Total existing and planned	**1,343,542**	**1,510,393**	**1,753,055**
Percentage of total APEC-APEC trade	**82%**	**80%**	**82%**

Source: Based on data from UN Commodity Trade Statistics and Chinese Taipei trade statistics

2.5 Trade flows of refrigerators

Trade flows of refrigerators within the APEC region are less valuable than flows of air conditioners or industrial motors. Nevertheless, this regional market has considerable economic significance. SITC trade statistics classify fridges and fridge-freezers together, while deep freezers are classified in a separate category.

■ Fridges and fridge-freezers

Imports of fridges and fridge-freezers by APEC economies are valued at US$1,200 million per year, of which almost 85% are imported from other APEC economies. This amounts to a total APEC import market of about 4.0 million units. The US dominates the import market, accounting for nearly 40% of imports. Canada and Japan account for a further 22% of the market.

APEC economies export fridges and fridge-freezers valued at more than US$1,900 million per year, of which about 60% are exported to other APEC economies. The volume of exports is about 3.8 million units annually. Leading exporters are Korea, Mexico, Thailand, the US, and China. Together, these five economies make up 90% of the market.

Trade flows in deep freezers are quite a bit smaller. By value and by volume, the APEC regional trade in deep freezers is only about 10% as large as the trade in fridges and fridge-freezers.

APEC imports of freezers are valued at about US$190 million, of which 65% are imported from other APEC economies. The market totals about 500,000 units annually. Freezer imports are dominated by the US, which accounts for 70% of all APEC imports.

Exports of freezers by APEC economies total US$180 million per year, of which almost 75% are exported to other APEC economies. The volume of exports is about 200,000 units annually. The US dominates exports as well, making up nearly 50% of the market.

Table 2.18: Imports of Fridges and Fridge-freezers (1996)																		
(000s of USD)																		
	Reporter Economy:																	
Partner:	AUS	BD	CDA	CHL	PRC	HKC	INA	JPN	ROK	MAS	MEX	NZ	PNG	RP	SIN	CT	*THA**	USA
World	64328		209612	28002	24038	79295	9986	119658	71182	60259	23960	16185		11932	78131	76529	*10693*	322193
Australia	-		1		10	2777	584	74	2	1146		***35***			1561		*334*	5
Brunei Darussalam		-																
Canada			-	3	26	2		5	47		12						*10*	18831
Chile				-			10											
China	76		3764	219	-	6107	55	6834	53	2759	16	267		9	271		*72*	23223
Hong Kong, China	68			66	302	-	41	2	6					104	267	1385	*4*	
Indonesia					2	307	-	5140	5	2236	1			225		327		
Japan	3684		402	82	13752	18368	755	-	493	1908	24	216		1890	11648	1440	*1245*	6744
Korea, Rep. Of	14073		1866	14895	1043	19546	594	37969	-	33708	1039	2094		3256	23415	35558	*3529*	4391
Malaysia				2		59	7	2	1	-					1319	2	*1*	
Mexico			5477	6419	8			649	4		-					66		158011
New Zealand	3126				7	3724	10			1584		-			1785	268	*45*	
Papua New Guinea													-					
Philippines				1					25			9		-			*54*	
Singapore	5				30	2833	240	68	4	270	1	7		980	-		*101*	4
Chinese Taipei	55				178				219							-		
Thailand	2951			497	6692	21759	2133	51869	4	9383	16	526		2532	25438	21897	-	
United States	6351		191346	3698	948	1898	1664	10395	68066	5129	22303	1436		2432	8759	14436	*3633*	-
Total APEC imports:	30389	-	202856	25882	22998	77380	6093	113007	68929	58123	23412	4590	-	11428	74463	75379	*9028*	211209
APEC imports as % of total imports:	0.47		0.97	0.92	0.96	0.98	0.61	0.94	0.97	0.96	0.98	0.28		0.96	0.95	0.98	*0.84*	0.66
TOTAL APEC-APEC import flows:	1015166																	
Worldwide imports to APEC:	1205983																	

Note: Thailand data are for most recent available year (1995)

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics.

Table 2.19: Exports of Fridges and Fridge-Freezers (1996)																		
(000s of USD)																		
	Reporter Economy:																	
Partner:	AUS	BD	CDA	CHL	PRC	HKC	INA	JPN	ROK	MAS	MEX	NZ	PNG	RP	SIN	CT	*THA**	USA
World	21765		20740	8012	75791		15489	53107	475563	4403	227837	22360		822	88752	7628	*245624*	658915
Australia	-				905		21	57	23365	18	2	9893			115		*8669*	15317
Brunei Darussalam	16	-			20			10		1472					2681	55	*125*	51
Canada	7		-	1	3063			5	1764		4801	3				1	*79*	199683
Chile			20	-	96		47	6	16733		5339						*921*	2256
China	110				-			9483	722	8	21				7888		*15077*	912
Hong Kong, China	2637				5451	-	329	17339	17391	82	4	3318			2042	145	*26149*	2237
Indonesia	961				2569		-	1480	13794	116		10					*2407*	1181
Japan	220				7946		4644	-	36280	199	2			2	3579	1495	*75982*	16658
Korea, Rep. Of					288		1	159	-	36	3822				50337	1	*52*	56922
Malaysia	1402				1774		1318	130	26940	-		1102			1697	6	*7108*	1385
Mexico					20				1971		-							19345
New Zealand	10135				334			151	1320			-				1	*34*	1036
Papua New Guinea	834						11		918			362	-		9		*70*	
Philippines	17		44		229		327	120	5007	8		36		-	2	101	*1835*	3789
Singapore	2180				372		931	9619	20397	694	18	1819			-	243	*24418*	6125
Chinese Taipei									33815							-		
Thailand	638				727		289	198	5871	82	2	105			13	18	-	4067
United States	20		20088		20960			182	3944	141	182806	1		1	40	1474	*239*	-
Total APEC exports:	19177	-	20152	1	44754	0	7918	38939	210232	2856	196817	16649	-	3	68403	3540	*163165*	330964
APEC exports as % of total exports:	0.88		0.97	0.00	0.59	-	0.51	0.73	0.44	0.65	0.86	0.74		0.00	0.77	0.46	*0.66*	0.50
TOTAL APEC-APEC export flows:	1123570																	
Worldwide exports to APEC:	1926808																	

Note: Thailand data are for most recent available year (1995)

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics.

Table 2.20: Imports of Freezers (1996)																		
(000s of USD)																		
	Reporter Economy:																	
Partner:	AUS	BD	CDA	CHL	PRC	HKC	INA	JPN	ROK	MAS	MEX	NZ	PNG	RP	SIN	CT	*THA**	USA
World	11127		1046	7987	5113	2506	1622	58540	4028	4407	4319	1848		921	4485	2440	*3963*	74266
Australia	-			6	10	27	34	64		9		***?***			119		*45*	
Brunei Darussalam		-																
Canada			-	34		7		226	1		490					116		60793
Chile				-														
China				4	-	883	2	1231	95	73	6			1	231		*92*	
Hong Kong, China					113	-								5	127		*1*	39
Indonesia					4		-										*42*	
Japan	118		592		811	196	15	-	360	19	9	13		14	589	101	*356*	1717
Korea, Rep. Of					27		196	5507	-	174		1			49		*162*	
Malaysia	1									-					534			
Mexico			9	260				374			-					5		7585
New Zealand	5992				1	6	9			540		-		269		26		
Papua New Guinea													-					
Philippines					6									-		25	*41*	
Singapore					55	56	32	13						28	-	19	*215*	
Chinese Taipei			5		73											-		
Thailand					340			5935		85					68		-	
United States	383			937	1706	827	57	12717	1404	1968	3380	120		62	227	747	*206*	-
Total APEC imports:	6494	-	606	1241	3146	2002	345	26067	1860	2868	3885	134	-	379	1944	1039	*1160*	70134
APEC imports as % of total imports:	0.58		0.58	0.16	0.62	0.80	0.21	0.45	0.46	0.65	0.90	0.07		0.41	0.43	0.43	*0.29*	0.94
TOTAL APEC-APEC import flows:	123304																	
Worldwide imports to APEC:	188618																	

Note: Thailand data are for most recent available year (1995)

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics.

Table 2.21: Exports of Freezers (1996)																		
(000s of USD)																		
	Reporter Economy:																	
Partner:	AUS	BD	CDA	CHL	PRC	HKC	INA	JPN	ROK	MAS	MEX	NZ	PNG	RP	SIN	CT	*THA**	USA
World	3562		60926	469	3273	38	98	9631	4881	3677	7650	15644		2	2693	2	*5596*	63682
Australia	-				3			414	4	164	3	8097			3			199
Brunei Darussalam	104	-			89					227					1163		*42*	
Canada			-					581										18114
Chile				-				28			381							146
China					-	20	14	595	202	8					73			124
Hong Kong, China	45				1296	-		1104	35	16		101			22	1	*20*	1133
Indonesia	3				136		-	65	105	102		9						64
Japan	2				55			-	2160			4123		1			*3976*	7881
Korea, Rep. Of					99			339	-									1715
Malaysia	83							32	35	-		327			376			95
Mexico											-							2533
New Zealand	1629							60			2	-						119
Papua New Guinea	418											298	-		2			
Philippines								77		13		237		-	22			118
Singapore	54				125			261	104	778		129			-		*881*	321
Chinese Taipei																-		
Thailand					9			272		48		6			94		-	1187
United States	5		60926	2				2353			6756	1						-
Total APEC exports:	2343	-	60926	2	1812	20	14	6181	2645	1356	7142	13328	-	1	1755	1	*4919*	33749
APEC exports as % of total exports:	0.66		1.00	0.00	0.55	0.53	0.14	0.64	0.54	0.37	0.93	0.85			0.65	0.50	*0.88*	0.53
TOTAL APEC-APEC export flows:	136194																	
Worldwide exports to APEC:	181824																	

Note: Thailand data are for most recent available year (1995)

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics.

Table 2.22: APEC trade flows of fridges and fridge-freezers by quantity					
Economy	**Exports to world**	**Exports to APEC**	**Imports from World**	**Imports from APEC**	**Year**
Australia	*78,419*	*68,611*	222,230	107,744	1996
Brunei Darussalam	-	-	-	-	
Canada	73,958	71,195	526,958	505,323	1996
Chile	*31,945*	*15*	*88,233*	*81,210*	1996
China	1,021,015	602,441	67,366	64,855	1996
Hong Kong, China	-	-	278,197	271,911	1996
Indonesia	*68,403*	*33,060*	*28,237*	*23,648*	1996
Japan	*257,179*	*125,095*	*397,490*	*386,846*	1996
Korea	*1,940,522*	*841,946*	*161,993*	*157,628*	1996
Malaysia	11,061	5,844	117,087	115,562	1995
Mexico	*927,720*	*738,305*	*130,392*	*128,634*	1996
New Zealand	71,245	53,922	42,310	16,430	1996
Papua New Guinea	-	-	-	-	1996
Philippines	3,541	253	38,112	35,679	1995
Singapore	109,057	28,410	233,230	223,792	1996
Chinese Taipei	31,431	23,754	286,742	263,827	1996
Thailand	1,231,247	617,880	30,331	23,990	1995
United States	1,207,867	613,266	1,911,948	1,557,483	1996
TOTAL:	**7,064,609**	**3,823,997**	**4,560,856**	**3,964,562**	

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics
Note: Italicized data are estimated rather than reported figures.

Table 2.23: Trade flows of freezers by quantity					
Economy	**Exports to World**	**Exports to APEC**	**Imports from World**	**Imports from APEC**	**Year**
Australia	*12,864*	*8,676*	37,060	22,870	1996
Brunei Darussalam	-	-	-	-	
Canada	296,834	-	2,343	898	1996
Chile	*889*	*7*	*18,246*	*1,669*	1996
China	13,739	8,285	3,680	2,319	1996
Hong Kong, China	37	24	6,976	5,470	1996
Indonesia	*256*	*66*	*2,007*	*1,029*	1996
Japan	*10,510*	*6,618*	*147,787*	*65,213*	1996
Korea	*13,740*	*6,656*	*5,586*	*1,655*	1996
Malaysia	2,925	1,382	13,079	9,529	1995
Mexico	*21,669*	*19,484*	*20,800*	*19,508*	1996
New Zealand	51,846	43,993	4,965	46	1996
Papua New Guinea	-	-	-	-	
Philippines	*5*	*3*	*423*	*314*	1996
Singapore	7,819	5,392	19,008	10,500	1996
Chinese Taipei	6	2	7,356	6,856	1996
Thailand	19,304	17,003	32,558	3,524	1995
United States	161,113	107,044	384,004	359,070	1996
TOTAL:	**613,555**	**224,636**	**705,877**	**510,470**	

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics
Note: Italicized data are estimated rather than reported figures.

■ Energy efficiency and refrigerator trade flows

A large number of APEC economies have or are contemplating mandatory energy efficiency performance or labeling schemes for household refrigerators. The US, Canada, and Mexico have minimum energy performance standards, which are harmonized. Korea has a minimum efficiency requirement, as well as target energy efficiency values. Chinese Taipei is reported to have a minimum efficiency standard, although information on it was not available for this report. China has a minimum energy performance standard, which is reportedly not well enforced. In addition, Australia has a mandatory energy efficiency labeling scheme for refrigerators (and will establish a MEPS as of October 1999). Together, imports of refrigerators by these economies make up more than 60% of the APEC market.

Besides these mandatory requirements, several economies have voluntary labeling schemes. Other economies are considering establishing energy efficiency standards and/or labeling programs, including Japan and Hong Kong, China, which are major participants in regional refrigerator trade. Imports of refrigerators into economies with existing programs or considering programs amounts to about 85% of APEC regional trade.

Table 2.24: APEC trade flows of refrigerators by energy efficiency testing requirements US$ thousands			
	1994	**1995**	**1996**
Value of global imports of fridges and fridge-freezers	3,506,839	3,902,173	3,520,101
Value of fridges and fridge-freezers imported into APEC from world	1,035,661	1,166,756	1,194,203
Value of fridges and fridge-freezers imported into APEC from APEC	872,724	1,000,924	1,006,768
Imports from APEC into APEC economies with MEPS			
United States	152188	185360	211209
Canada	199075	180590	202857
Mexico	103639	17524	23411
Korea	46586	64508	68927
China	20934	36171	22998
Chinese Taipei	-	84395	75443
With mandatory labeling			
Australia	26852	33981	30388
Subtotal mandatory	**549,274**	**602,529**	**635,233**
Percentage of total APEC-APEC trade	**63%**	**60%**	**63%**
With voluntary labeling			
Hong Kong, China	103193	87164	77378
Thailand	6535	9027	-
New Zealand	12083	13230	4590
Subtotal voluntary	**121,811**	**109,421**	**81,968**
Subtotal existing mandatory and voluntary	**671,085**	**711,950**	**717,201**
Percentage of total APEC-APEC trade	**77%**	**71%**	**71%**
With programs in development or under consideration			
Japan	83210	140534	113575
Philippines	4264	12397	11429
Indonesia	2604	5532	6094
Subtotal planned	**90,078**	**158,463**	**131,098**
Total existing and planned	**761,163**	**870,413**	**848,299**
Percentage of total APEC-APEC trade	**87%**	**87%**	**84%**

Source: Based on data from UN Commodity Trade Statistics and Chinese Taipei trade statistics

Trade flows of lighting equipment

Of the equipment specified for this study, trade flows of lighting equipment are the smallest by value, but the largest by volume.

SITC trade statistics place all discharge lamps in one classification. These statistics are indicative of, but larger than, trade flows of fluorescent lamps lamps only. The harmonized system of trade statistics classification contains a separate category for fluorescent lamps, and this data was used where feasible. Ballasts for all discharge lamps are classified together in both the SITC and Harmonized System.

■ Lamps

Imports of fluorescent lamps by APEC economies are valued at about US$550,000 per year, of which more than 60% are imported from other APEC economies. The US dominates this market, accounting for more than 35% of total APEC imports. Canada and Hong Kong, China together make up another 25%.

Exports of fluorescent lamps by APEC economies total more than US$440 million annually. Almost 70% of these exports were destined for other APEC economies. The US, Japan, and Canada are the principal APEC exporters, making up more than 50% of the total market.

Data on the volume of trade currently is available only for discharge lamps generally. This data is indicative of the volume of trade in fluorescent lamps specifically, but overstates the actual volume. The volume of APEC regional export trade in discharge lamps is an estimated 270 million units annually.

■ Ballasts

APEC economies import ballasts for discharge lamps valued at about US$760,000 per year. More than 85% of these imports come from other APEC economies. The volume of APEC regional import trade in ballasts is an estimated 182 million units. Leading importers are the US, China, and Mexico, which together account for 75% of the total APEC import market.

Exports of ballasts by APEC economies total US$728,000 per year, of which 90% are exported to other APEC economies. This amounts to an estimated 147 million units exported annually within the APEC market. Principal exporters are Mexico and China, which together take more than 75% of the regional export market.

Table 2.25: Imports of Fluorescent Lamps (1996)																		
(000s of USD)																		
	Reporter Economy:																	
Partner:	AUS	BD	CDA	CHL	PRC	HKC	INA	JPN	ROK	MAS	MEX	NZ	PNG	RP	SIN	*CT*	*THA**	USA
World	19698		45821	1773	15783	54521	14997	19740	9709	42764	18420	4750		5233	19215	*42392*	*25554*	213872
Australia	-				16	1966	343			93		718		196	444	*95*	*88*	6
Brunei Darussalam		-																
Canada	10		-	4						8	2	7			3	*4*	*21*	40367
Chile				-														1977
China	1948		159	97	-	8503	6396	727	616	541	6	153		450	905	*1225*	*665*	2038
Hong Kong, China	96		12	17	3767	-	211	2001	5	80		8		1108	387	*416*	*39*	342
Indonesia	684			14	57	5651	-		193	102		5		823		*550*	*225*	923
Japan	3098		1352	22	4915	5458	472	-	799	2497	26	290		116	5212	*28038*	*6107*	22328
Korea, Rep. Of	94		203	3	812	1947	15	1293	-	2579		8		31	649	*1471*	*52*	3809
Malaysia	29				24		1	3		-	6	1			26		*366*	
Mexico			2130	7							-					*1311*		55070
New Zealand	5											-						
Papua New Guinea							4						-					
Philippines					1	968		381		166				-		*39*		7
Singapore	66				82	486	256	7977	22	1288		3		635	-	*0*	*751*	1939
Chinese Taipei			152	28	582		96					5				-		
Thailand	907		25	54	583	17460	10	58	933	777		246		1227	1456	*211*	-	902
United States	1004		37562	508	540	931	391	1175	2347	93	9852	215		3	2174	*2892*	*1970*	-
Total APEC imports:	7941		41595	754	11379	43370	8195	13615	4915	8224	9892	1659	0	4589	11256	*36253*	*10284*	129708
APEC imports as % of total imports:	0.40		0.91	0.43	0.72	0.80	0.55	0.69	0.51	0.19	0.54	0.35		0.88	0.59	*0.86*	*0.40*	0.61
TOTAL APEC-APEC import flows:	343629																	
Worldwide imports to APEC:	554242																	

Note: Thailand data are for most recent available year (1995) and are for all discharge lamps. Chinese Taipei data are for 1994.

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics.

Table 2.26: Exports of Fluorescent Lamps (1996)																		
(000s of USD)																		
	Reporter Economy:																	
Partner:	AUS	BD	CDA	CHL	PRC	HKC	INA	JPN	ROK	MAS	MEX	NZ	PNG	RP	SIN	CT	*THA**	USA
World	664		41564	5164	52285	2052	21531	85084	14883	579	27837	40		202	38005	*9439*	*37516*	106351
Australia	-				613		881	3036	121						94	*527*	*880*	498
Brunei Darussalam		-						2		53					480			
Canada			-		274			811	17		31					*91*	*2032*	39406
Chile	2			-	167	17	37	11	21							*15*	*101*	313
China	3				-	1867		2285	1242	96					24		*47*	
Hong Kong, China	254				20043	-	1678	5189	2456	70		1			131	*1723*	*12133*	1075
Indonesia	37				3203		-	3426						13		*40*	*164*	122
Japan	5				543	16		-	654					1	7607	*19*	*399*	1753
Korea, Rep. Of					2929		311	1731	-					9	38	*93*	*550*	2869
Malaysia	43				290		157	2645	25	-					23911	*430*	*1194*	7
Mexico								395	41		-							18089
New Zealand	7						26	256				-			2		*39*	22
Papua New Guinea	47									91			-		4		*21*	13
Philippines					701	23	955	438	17					-	789	*428*	*891*	100
Singapore	140				1719		1372	5797	444	80				15	-	*297*	*874*	1913
Chinese Taipei							86									-		
Thailand	40				831		396	2165	10					165	217	*309*	-	268
United States			41042	1622	1796		969	22773	4571		26244				1878	*1016*	*6516*	-
Total APEC exports:	578	-	41042	1622	33109	1923	6868	50960	9619	390	26275	1	-	203	35175	*4989*	*25841*	66448
APEC exports as % of total exports:	0.87		0.99	0.31	0.63	0.94	0.32	0.60	0.65	0.67	0.94	0.03		1.00	0.93	0.53	*0.69*	0.62
TOTAL APEC-APEC export flows:	305043																	
Worldwide exports to APEC:	443196																	

Note: Thailand data are for most recent available year (1995) and are for all discharge lamps. Chinese Taipei data are for 1994.

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics.

Table 2.27: Imports of Discharge Lamp Ballasts (1996)																		
(000s of USD)																		
	Reporter Economy:																	
Partner:	AUS	BD	CDA	CHL	PRC	HKC	INA	JPN	ROK	MAS	MEX	NZ	PNG	RP	SIN	CT	*THA**	USA
World	4700		65037	2673	12567	53133	7751	10857	4024	7951	42584	3256		7395	24372	7623	*8839*	499247
Australia	-		2	246	720	9085	410	250	2084	2686		1884		208	7241	2867	*1050*	5
Brunei Darussalam		-																
Canada	2		-				3		1		198				1		*7*	15111
Chile				-														
China	7		3457	362	-	38845	900	1561	13	71	4	23		255	504	400	*107*	95080
Hong Kong, China	2		37	15	1581	-	89	238	8	490		3		1192	694	6	*120*	3278
Indonesia					15	56	-	2052									*5*	107
Japan	48		93		2195	121	2491	-	647	564	23			136	259	197	*3219*	1390
Korea, Rep. Of	3		361		110		178	1072	-	552	17	23		20	10		*829*	25947
Malaysia	50		892		7	85	7			-	2	30		2	6298	1	*515*	65
Mexico			16634	42	18	58		115			-					35		295634
New Zealand	25						53					-			12			
Papua New Guinea							30						-					
Philippines			2		5						4			-			*2*	
Singapore	231		49		125	748	299	3		939	15			17	-	2	*13*	762
Chinese Taipei	19		3543		2023		140				1260	2				-		
Thailand	20				62		433			55	7			835	174		-	
United States	679		38031	736	240	1213	340	2138	548	309	40819	319		616	197	258	*412*	-
Total APEC imports:	1086		63101	1401	7101	50211	5373	7429	3301	5666	42349	2284	0	3281	15390	3766	*6279*	437379
APEC imports as % of total imports:	0.23		0.97	0.52	0.57	0.95	0.69	0.68	0.82	0.71	0.99	0.70		0.44	0.63	0.49	*0.71*	0.88
TOTAL APEC-APEC import flows:	655397																	
Worldwide imports to APEC:	762009																	

Note: Thailand data are for most recent available year (1995)

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics.

Table 2.28: Exports of Discharge Ballasts (1996)																		
(000s of USD)																		
	Reporter Economy:																	
Partner:	AUS	BD	CDA	CHL	PRC	HKC	INA	JPN	ROK	MAS	MEX	NZ	PNG	RP	SIN	CT	*THA**	USA
World	18793		17751	50	141740	1721	6775	20577	30822	6739	334131	194		7474	4484	40881	*3911*	92451
Australia	-		5			104		4	74			142			248		*2*	409
Brunei		-			1										319			
Canada			-		1279		50	92	252	1460	4281				171	211		39513
Chile	228			-	809			23			39						*44*	83
China	157				-	540	1	3324	97	400					135	3	*51*	267
HKC	4778		149		8079	-	170	502	2	56				318	819	174	*1*	988
Indonesia	45				613		-	4228	5					2		11	*254*	10
Japan					2006		3486	-	3605	169					2	2775	*7*	811
Korea, Rep. Of	1329				2339			930	-									468
Malaysia	321				357			446	43	-					1474	173	*91*	16
Mexico					2645			54			-					1829		32178
New Zealand	2066									6		-			1			24
PNG	6									23		1	-		7			
Philippines	180				734			731	24					-	14	43	*180*	94
Singapore	4494		47		785	29	232	291		3956					-		*292*	148
Chinese Taipei																-	*54*	
Thailand	636				11	24	29	2933	712						255		-	241
United States	15		16869		99289	648	50	908	25058	190	328764				3	33702	*33*	-
Total APEC exports:	14255	0	17070	-	118947	1345	4018	14466	29872	6260	333084	143	-	320	3448	38921	*1009*	75250
APEC exports as % of total exports:	0.76		0.96	0.00	0.84	0.78	0.59	0.70	0.97	0.93	1.00	0.74		0.04	0.77	0.95	*0.26*	0.81
TOTAL APEC-APEC export flows:	658408																	
Worldwide exports to APEC:	728494																	

Note: Thailand data are for most recent available year (1995)

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics.

Table 2.29: Trade in discharge lamps by quantity					
Economy	**Exports to World**	**Exports to APEC**	**Imports from World**	**Imports from APEC**	**Year**
Australia	*261,556*	*237,981*	18,388,566	10,879,949	1996
Brunei Darussalam	-	-	-	-	
Canada	37,705,118	37,420,917	42,006,705	38,867,376	1996
Chile	*1,130,458*	*289,147*	*564,709*	*297,916*	1996
China	279,550,514	239,056,466	78,222,802	59,100,583	1996
Hong Kong, China	12,884,500	10,352,660	349,165,072	301,151,747	1996
Indonesia	*8,239,001*	*1,864,962*	*3,004,768*	*2,239,964*	1996
Japan	*2,149,532,166*	*1,771,101,890*	*592,783,612*	*87,045,841*	1996
Korea	*1,404,516*	*994,750*	*1,622,812*	*1,053,293*	1996
Malaysia	3,268,661	3,164,707	26,138,752	12,736,859	1995
Mexico	*6,787,287*	*6,441,897*	*15,696,471*	*15,073,280*	1996
New Zealand	8,530	2,452	3,369,055	1,413,982	1996
Papua New Guinea	-	-	-	-	
Philippines	890,978	739,728	6,460,897	4,527,026	1995
Singapore	31,275,506	23,748,701	65,405,319	46,540,650	1996
Chinese Taipei	16,498,974	7,542,390	18,533,213	12,885,750	1996
Thailand	613,463,290	595,851,073	22,101,477	76,624,327	1995
United States	54,874,209	40,030,616	128,143,220	97,587,839	1996
TOTAL:	**3,217,775,263**	**2,738,840,336**	**1,371,607,451**	**768,026,382**	

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics
Note: Italicized data are estimated rather than reported figures.

Table 2.30: Trade in ballasts for discharge lamps by quantity					
Economy	**Exports to World**	**Exports to APEC**	**Imports from World**	**Imports from APEC**	**Year**
Australia	*7,311,947*	*5,267,039*	782,188	73,689	1996
Brunei Darussalam	-	-	-	-	
Canada	887,631	869,853	6,687,624	6,606,581	1996
Chile	*11,700*	*15*	*639,644*	*378,374*	1996
China	49,845,235	37,860,623	39,614,022	34,340,841	1996
Hong Kong, China	769,941	635,067	21,571,506	19,615,912	1996
Indonesia	*1,437,796*	*1,290,070*	*5,564,532*	*4,292,092*	1996
Japan	*3,826,876*	*2,057,716*	*1,323,323*	*1,259,809*	1996
Korea	*4,143,496*	*3,944,789*	*993,895*	*901,824*	1996
Malaysia	979,977	488,070	1,562,141	1,474,469	1995
Mexico	*74,698,536*	*74,231,248*	*28,511,291*	*28,430,194*	1996
New Zealand	-	-	-	-	
Papua New Guinea	-	-	-	-	
Philippines	*293,373*	*181,330*	*2,463,235*	*1,439,612*	1996
Singapore	1,905,977	1,142,318	9,349,330	5,693,974	1996
Chinese Taipei	3,755,134	3,586,695	3,876,053	1,930,726	1996
Thailand	3,341,404	1,150,047	1,128,718	887,133	1995
United States	18,039,636	14,430,160	81,843,724	74,647,967	1996
TOTAL:	**171,248,659**	**147,135,039**	**205,911,225**	**181,973,198**	

Source: Compiled from UN Commodity Trade Statistics and Chinese Taipei trade statistics
Note: Italicized data are estimated rather than reported figures.

■ Energy efficiency and trade flows of lighting equipment

Fewer APEC economies have energy efficiency performance or testing requirements for lighting equipment than for air conditioning or refrigeration equipment. The US, Canada, and Korea have mandatory energy efficiency requirements for both fluorescent lamps and ballasts. Chinese Taipei reportedly has energy requirement for ballasts. Imports of lighting equipment into APEC economies with mandatory energy efficiency performance requirements accounts for about 50% of total regional trade in discharge lamps and 80% of regional trade flows of ballasts.

Japan has voluntary targets for the energy efficiency of fluorescent lamps. In addition, several APEC economies are considering establishing energy efficiency requirements for fluorescent lamps and/or ballasts. Mexico is developing a MEPS for compact fluorescent lamps, and China is reportedly considering such a move as well. New Zealand is considering instituting energy performance requirements for both fluorescent lamps and ballasts, while Australia is examining a possible requirement for ballasts only. APEC economies with either existing energy efficiency requirements or examining possible programs together account for 80% of total APEC regional import trade in both fluorescent lamps and ballasts.

Table 2.31: APEC trade flows of ballasts for discharge lamps by energy efficiency performance and testing requirements

US$ thousands

	1994	**1995**	**1996**
Value of global imports of ballasts for discharge lamps	903,483	1,137,226	1,243,453
Value of ballasts imported into APEC economies from the world	504,140	700,028	745,546
Value of ballasts imported into APEC from APEC	470,392	588,220	645,356
Imports from APEC into APEC economies with MEPS			
U.S.	341045	417944	437379
Canada	57281	71624	63100
Korea	3542	2886	3301
Chinese Taipei	-	6333	3766
Subtotal mandatory	**401,868**	**498,787**	**507,546**
Percentage of total APEC-APEC trade	**85%**	**85%**	**79%**
With programs under development or consideration			
Australia	190	320	408
New Zealand	2521	491	2285
Subtotal planned	**2711**	**811**	**2693**
Total existing and planned	**404,579**	**499,598**	**510,239**
Percentage of total APEC-APEC trade	**86%**	**85%**	**79%**

Source: Based on data from UN Commodity Trade Statistics and Chinese Taipei trade statistics

Table 2.32: APEC trade flows of discharge lamps by energy efficiency performance and testing requirements			
			US$ thousands
	1994	**1995**	**1996**
Value of global imports of discharge lamps	2,014,011	2,327,638	2,327,966
Value of discharge lamps imported into APEC economies from the world	709,973	818,193	918,239
Value of discharge lamps imported into APEC from APEC	478,032	533,763	582,598
Imports from APEC into APEC economies with MEPS			
United States	132449	164699	177269
Canada	64230	68397	66762
Korea	23523	36020	40895
Subtotal mandatory	**220,202**	**269,116**	**284,926**
Percentage of total APEC-APEC trade	**46%**	**50%**	**49%**
With voluntary targets			
Japan	44212	29893	32261
Subtotal mandatory and voluntary	**264,414**	**299,009**	**317,187**
Percentage of total APEC-APEC trade	**55%**	**56%**	**54%**
With programs under development or consideration			
New Zealand	3405	3313	3204
Mexico (CFLs only)	4394	3756	4780
China (CFLs only)	1322	1281	1715
Hong Kong, China (CFLs only)	7972	10104	10116
Subtotal planned	**9,121**	**8,350**	**9,699**
Total existing or planned	**273,535**	**307,359**	**326,886**
Percentage of total APEC-APEC trade	**57%**	**58%**	**56%**

Source: Based on data from UN Commodity Trade Statistics and Chinese Taipei trade statistics

3. TRADE FLOWS AND ENERGY EFFICIENCY OF HOUSEHOLD REFRIGERATORS IN THE APEC REGIONAL MARKET

3.1 Overview of the Global and Regional Market[1]

An estimated 73 million refrigerators are manufactured and sold each year around the world. Global annual sales were valued at US$27 billion in 1992. Western Europe was the largest market in 1992, accounting for 30.4% of worldwide sales. Southeast Asia (26.0%) recently replaced North America (24.7%) as the second largest regional market. The value of the global market grew by 14% in real terms between 1988 and 1992, and growth of 20% is predicted from 1992 to 2000.

Historically, there has been little interregional trade in refrigerators. Almost all the models sold within each region have been produced there. Industry experts do not expect major shifts in this pattern, however there are some important developments occurring. There is a general trend toward industry consolidation and globalization, with several companies developing into transglobal concerns. The five largest manufacturers on a worldwide basis are Electrolux, Whirlpool, General Electric, Matsushita, and Bosch-Siemens. Because "white goods" are relatively "low tech," manufacturers are increasingly moving production toward low-cost production centers. China in particular has increased production at an extraordinary rate.

However, consumer preferences are regionally distinct, and most manufacturers produce separate models for and within each region. Despite the persistence of regional differences, components are increasingly sourced on an interregional basis, and technology cooperation occurs between as well as within global regions.

The term "refrigerator" can be used to refer to various types of household appliances providing cold storage. For the purposes of this report, the term "refrigerator" will be used inclusively to refer to all household appliances providing cold storage. The various types will be differentiated as follows. The term "fridge" is used to refer to an appliance consisting of a single compartment for cold storage. "Fridge-freezer" refers to an appliance with at least two compartments, one for cold storage and one for freezing. The term "freezer" will be used to refer to an appliance consisting of a single compartment for freezing.

SITC data combines household fridges and fridge-freezers within one classification (775.21). HS data classifies household fridge-freezers (841810) separately from fridges (841821). The SITC has one code for deep freezers (775.22), while the HS distinguishes between chest freezers (841830) and upright freezers (841840).

According to SITC data, in 1996 APEC economies exported fridges and fridge-freezers valued at a total of US$1.7 billion. This was a decline of 3% over 1995 exports, which followed an 11% increase between 1994 and 1995. Of the US$1.7 billion total, about 57% were exports of fridges and fridge-freezers from one APEC economies to another.

[1] The following section draws heavily from Waide and Lebot, 1995.

Imports of fridges and fridge-freezers by APEC economies were valued at US$1.1 billion in 1996. Annual growth in total imports was 3% from 1995 to 1996 and 4% from 1994 to 1995. Of the US$1.1 billion total, 83% were imports into one APEC economy from another.

Table 3.1: Trade flows of fridges and fridge-freezers in the APEC region, 1994-1996
Millions of US$

	1994*	1995	1996
Total global exports	3,799.5	4,495.6	4,090.5
APEC exports to world	1,561.8	1,734.3	1,681.2
APEC exports to APEC only	977.2	992.5	957.5
Total global imports	3,506.8	3,902.2	3,520.1
APEC imports from world	1,035.7	1,167.9	1,195.3
APEC imports from APEC only	872.7	1,000.9	1,006.8

Source: Calculated from UN Commodity Trade Statistics and Chinese Taipei Trade Statistics. Note that 1996 statistics for global trade are incomplete.
*Data from Chinese Taipei not available for 1994.

The trade in freezers is only about 10% as large as the trade in fridges and fridge-freezers. In 1996, APEC economies exported freezers valued at a total of US$176 million. About 40% of this amount is export between APEC economies. Total imports of freezers by APEC economies were valued at US$182 million in 1996, of which 66% was imports from other APEC economies.

Table 3.2: Trade flows of freezers in APEC region, 1994-1996
Millions of US$

	1994*	1995	1996
Total global exports	1,185.2	1,280.5	1,181.7
APEC exports to world	166.9	176.6	176.2
APEC exports to APEC only	126.8	79.2	70.4
Total global imports	1,008.8	1,160.9	1,052.2
APEC imports from world	158.6	164.9	184.6
APEC imports from APEC only	99.4	113.6	122.1

Source: Calculated from UN Commodity Trade Statistics and Chinese Taipei Trade Statistics. Note that 1996 global statistics are incomplete.
*Data from Chinese Taipei not available

Refrigerators typically consume around 20% of household electricity, although this figure varies between about 10% and 30% in different regions of the world. Ongoing refrigerator energy efficiency initiatives are being conducted in several APEC member economies, including the United States, Canada, Australia, People's Republic of China, New Zealand, South Korea, Mexico, and Thailand.

3.2 Australia

In Australia, refrigerator models tend to be smaller than those purchased in North America, but larger than the models commonly found in Europe.

Table 3.3: Market Share of Refrigerators by Size Range for Australia and New Zealand

Storage Capacity (liters)	Share of Sales (%)	
	New Zealand	Australia
<200	18	15
201-300	18	16
301-400	56	29
401-500	6	26
>500	2	14

Source: Waide and Lebot 1995

In 1997, 502,000 fridges and fridge-freezers and 80,000 deep freezers were sold in Australia. The major manufacturer is Email, whose Kelvinator and Westinghouse brands accounted for 52% of sales in 1992. Other leading brands include Hoover (16% of the market) and Fisher & Paykel (6% of the market, with about one-third of these coming from its New Zealand base and the remainder from production in Australia).

Australian exports of fridges and fridge-freezers are valued at about US$20 million per year, of which approximately 80% are shipped to APEC economies, principally New Zealand; Hong Kong, China; and Singapore. Imports of fridges and fridge-freezers rose from US$45 million in 1994 to US$64 million in 1996. The share of imports originating in other APEC economies is about 60%. Leading sources are the US, New Zealand, Korea, and Thailand.

Table 3.4: Australian trade flows of fridges and fridge-freezers, 1994-1996

Millions of US$

	1994	1995	1996
Exports to world	22.0	18.4	21.8
Exports to APEC only	15.9	14.9	19.2
Imports from world	45.5	52.0	64.3
Imports from APEC only	26.8	34.0	30.4

Source: UN Commodity Trade Statistics

Exports of freezers are valued at US$3.5-4.0 million per year, of which exports to APEC make up 50-60%. New Zealand is the leading destination for freezers exported to APEC. Imports of freezers total US$8-10 million. APEC accounts for an increasing share of imported freezers, rising from 40% in 1994 to 58% in 1996. New Zealand supplies the largest share of freezers imported from APEC.

Table 3.5: Australian trade flows of freezers, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	3.6	3.9	3.6
Exports to APEC only	1.8	2.5	2.3
Imports from world	10.0	7.7	11.1
Imports from APEC only	4.0	4.2	6.5

Source: UN Commodity Trade Statistics

Since 1986, a state-level program has been in place requiring Australian refrigerators to carry an energy label. This label provides information on total annual energy consumption, and also ranks the efficiency of the refrigerator according to a six-star system, with six stars being the most energy-efficient. For the purposes of energy efficiency testing, Australian refrigerators are divided into seven classes: single-door fridges (Class 2), single-door fridge-freezers with ice-makers (Class 2) or freezers (Class 3), two-door manual-defrost fridge-freezers (Class 4); two-door frost-free fridge-freezers (Class 5), upright or chest freezers (Class 6) and frost-free freezers (Class 7).

Between 1987 and 1990, energy efficiency increased at an annual rate of 3.5% (Waide and Lebot 1995). In more recent years, the average EER of refrigerators increased from 3.56 in 1993 to 3.88 in 1997. Average EER of freezers increased from 4.17 in 1993 to 4.28 in 1997 (Harrington 1998).

Australia will institute minimum energy performance standards for household refrigerators as of October 1, 1999.

Table 3.6: Distribution of Star Ratings for Australian Refrigerators: 1993-1997							
Year	1 Star	2 Star	3 Star	4 Star	5 Star	6 Star	Average
1993	9.0%	12.5%	25.0%	40.2%	13.3%	0.0%	3.56
1994	4.7%	14.2%	26.9%	38.9%	15.2%	0.0%	3.62
1995	2.0%	10.2%	29.6%	43.0%	15.3%	0.0%	3.71
1996	5.8%	9.9%	25.3%	42.6%	16.4%	0.0%	3.69
1997	4.0%	10.7%	21.3%	38.0%	26.1%	0.0%	3.88

Source: Harrington 1998

Table 3.7: Distribution of Star Ratings for Australian Freezers: 1993-1997							
Year	1 Star	2 Star	3 Star	4 Star	5 Star	6 Star	Average
1993	5.5%	6.2%	18.3%	38.3%	31.6%	0.0%	4.17
1994	5.5%	7.8%	16.8%	39.2%	30.8%	0.0%	4.14
1995	0.0%	8.4%	10.0%	47.8%	32.6%	1.3%	4.40
1996	0.0%	8.1%	12.0%	45.0%	32.0%	2.9%	4.41
1997	0.0%	7.9%	24.5%	50.0%	15.5%	2.1%	4.28

Source: Harrington 1998

The estimated sales-weighted average electricity consumption of new appliances sold in 1995 was 755 kWh per year for refrigerators and 585 kWh per year for freezers (Wilkenfeld 1996). There is a fairly wide range of energy efficiency among refrigerators on the Australian market. The table below shows the relationship of the most and least energy-efficient models on the market to the sales-weighted average energy efficiency. The "energy efficiency index" (EEI) is the ratio of the sales-weighted average energy-intensity (kWh/adjusted liter of capacity) and the energy intensity of the most and least energy-efficient models on the market. The wide range of efficiencies has been attributed to the fact that although energy labeling initially removed the poorest performers from the market, at this point, the program is having minimal impact on the bottom end of the market. Instead it is driving the market toward higher efficiency at the top end.

Table 3.8: Energy Efficiency Indices for Refrigerator Classes, 1995							
Model	Class 1 (single door, fridge only)	Class 2 (single door, all fridge with ice-maker)	Class 3 (single door, all fridge with freezer)	Class 4 (2 door, cyclic, fridge-freezer)	Class 5 (2 door, frost-free fridge-freezer)	Class 5 2/3 (2 door, side by side, frost-free fridge-freezer)	Refrigerators SW Average
Most efficient	1.30	1.28	1.30	1.46	1.45	1.22	1.41
SW Average	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Least efficient	0.42	0.65	0.67	0.61	0.59	0.89	0.60

Source: Wilkenfeld 1996

Table 3.9: Energy Efficiency Indices for Freezer Classes, 1995				
Model	Class 6 (Freezer – chest or upright)	Class 6 1	Class 7 (Frost-free upright freezer)	Freezers SW Average
Most efficient	1.77	1.85	1.29	1.70
SW Average	1.00	1.00	1.00	1.00
Least efficient	0.53	0.67	0.78	0.65

Source: Wilkenfeld 1996

The Netenergy Web site provides information on the energy efficiency of refrigerator models available on the Australian market. The site also provides information on where each model is

manufactured, making it possible to compare the energy efficiency of refrigerators according to where they were manufactured. The results summarized in the table below indicate that refrigerator models manufactured in Australia, New Zealand, Thailand, and the US tend to be more energy-efficient than models produced in Korea, China, and non-APEC economies.

Table 3.10: Energy efficiency ratings of refrigerators sold in the Australia market by place of manufacture

Class	Average star rating (# models)	Australia-made models only	N.Z.-made models	Korea-made models	China-made models	US-made model	Thailand-made models	Non-APEC models
1	2.78 (18)	3.17 (12)	3.5 (2)	1 (2)	-	-	-	1.5 (2)
2	1.86 (29)	3.14 (7)	3.00 (1)	1.33 (12)	1.28 (7)	-	-	2.00 (2)
3	N/Av (2)	N/Av (1)	-	-	-	-	-	N/Av (1)
4	3.54 (41)	3.85 (33)	3.67 (3)	1.0 (2)	-	-	-	1.67 (3)
5	3.86 (104)	4.07 (38)	-	3.33 (33)	-	4.07 (29)	4.50 (4)	-

Source: Netenergy 1998

3.3 Canada

The Canadian refrigerator market is almost completely unified with the United States market. Manufacturers and products are virtually the same, although brand names can vary. Refrigerators bought by Canadians, along with those in the United States, tend to be larger than the refrigerators found in other regions.

In 1992, 554,000 fridges and fridge-freezers and 245,000 freezers were sold in Canada, with a total value of CAN$472 million. Most refrigerator sales were for fridge-freezers with volumes of 16.5-19.4 cubic feet. Chest freezers are more common than upright freezers. Leading brands in the Canadian market are Frigidaire (owned by Electrolux) with a 38% market share, and Camco (owned by General Electric) with 32%.

Canadian exports of fridges and fridge-freezers are valued at US$20 million, of which 99% are shipped to the US. Canada imports fridges and fridge-freezers worth about US$210 million, of which more than 95% are imported from APEC economies, principally the US and China.

Table 3.11: Canadian trade flows of fridges and fridge-freezers, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	4.6	18.7	20.7
Exports to APEC only	4.4	18.5	20.2
Imports from world	210.4	189.2	209.6
Imports from APEC only	199.1	180.6	202.8

Source: UN Commodity Trade Statistics

Canadian freezers exports reached US$61 million in 1996. Imports of freezers are negligible, at about US$1 million per year.

Table 3.12: Canadian trade flows of freezers, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	50.2	53.5	60.9
Exports to APEC only	50.0	53.5	60.9
Imports from world	0.7	0.9	1.0
Imports from APEC only	0.4	0.5	0.6

Source: UN Commodity Trade Statistics

Under the Federal Energy Efficiency Act of 1993, mandatory minimum energy efficiency standards for refrigerators became effective in Canada in 1995. Canada adopted the US standards for refrigerators and freezers. Canadian and US regulations specify 17 different refrigerator product categories, each having its own minimum energy efficiency level. The categories take into account geometric considerations (size and location of compartments), functional attributes (type of cooling service provided) and method of defrosting.

As a result of establishing energy performance standards, the energy consumption of a typical Canadian refrigerator (17 cubic-feet/480-liter fridge-freezer with automatic defrost) declined from almost 1,400 kWh per year in 1988 to 630 kWh per month in 1994 (Waide and Lebot 1995).

3.4 Chile

As of 1992, 55% of Chilean households had a refrigerator, with urban households (61%) far more likely to own one than rural households (29%). Demand for refrigerators has been growing 12%-15% per year in recent years. There are two local manufacturers, Sindelen and CTI, which produce the Fensa and Mademsa brand names. Until 1990, the market was held almost exclusively by these companies. Today, Sindelen and CTI retain a 58% market share for household refrigerators (Vidal 1997).

The Chilean refrigerator market currently appears to be in transition. Through the mid- 1990s, manual-defrost models dominated the market, but now frost-free models are gaining ground. Korean brands arrived in 1990, and are making inroads in the Chilean market. Frost-free technology was first introduced by US, but was too expensive for many Chilean consumers. Korean models use the same frost-free technology, but are more affordable due to lower production costs, which has closed the price gap between manual-defrost and frost-free models. Samsung leads the frost-free market, with a 34% share.

Local manufacturers are now introducing new models featuring frost-free technology. These are expected to be cheaper than Korean models due to lower freight and other costs. Sindelen signed a 1995 agreement with the US firm Frigidaire to provide frost-free technology for their Chilean-made refrigerators. By 1997, CTI had already introduced frost-free models, using technology purchased from the Japanese firm, Matsushita. CTI is said to be planning to increase its production from 200,000 to 400,000 units, with 250,000 units bound for the domestic market and the remainder to be sold to neighboring (non-APEC) economies.

Chilean exports of fridges and fridge-freezers reached US$8.0 million by 1996, of which only a negligible amount was exported to APEC economies. Imports of fridges and fridge-freezers have grown to US$28 million per year, of which over 90% come from APEC economies. Korea and the US are the principal suppliers.

Table 3.13: Chilean trade flows of fridges and fridge-freezers, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	4.2	5.4	8.0
Exports to APEC only	-	-	<0.1
Imports from world	15.0	28.1	28.0
Imports from APEC only	9.7	21.2	25.9

Source: UN Commodity Trade Statistics

Chile exports less than US$1 million worth of freezers per year, of which fewer still are bound for APEC economies. Imports of freezers total about US$8 million per year, of which about 15% originated in APEC economies, mostly the US and Japan.

Table 3.14: Chilean trade flows of freezers, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	<0.1	0.2	0.5
Exports to APEC only	<0.1	-	<0.1
Imports from world	8.7	8.4	8.0
Imports from APEC only	0.5	0.8	1.2

Source: UN Commodity Trade Statistics

The Chilean National Energy Commission reportedly considers the development of appliance energy performance standards to be a priority in the next few years. As of 1995, Chilean-made refrigerators models were less energy-efficient than imported models. Of the 10 least energy-efficient models sold in Chile, seven were manufactured locally. Electricity consumption by these least-efficient models ranged from 0.53 watts/liter to 0.86 watts per liter (Lord 1995).

3.5 China

According to a recent Gallup poll, two-thirds of urban Chinese households own a refrigerator. This is a very rapid increase from recent years. In 1981, fewer than 1% of urban households owned a refrigerator, and the figure was only 35% as recently as 1993. Currently, in the nine largest cities, refrigerator ownership has risen to more than 90%. Saturation has reached 100%+ in the three largest cities of Beijing, Guangzhou, and Shanghai. Nationwide, about 25% of households have a refrigerator.

Refrigerator models sold in China are quite small, generally manual-defrost models with a volume of about 200 liters. In 1994, frost-free models accounted for only 10% of the market (Nadel 1995).

China has recently become the second largest refrigerator manufacturer in the world. Production rose from 56,000 units in 1981 to 4.63 million in 1990. Refrigerator shipments totaled 9.86 million units in 1997, a 3.4% increase over 1996 (Appliance 1998a). Domestic demand is expected to increase 5-8% in 1998. Production has become fairly constant in recent years, as the domestic market has become largely a replacement market. Many urban households have refrigerators that are approaching 10 years of age and will soon need to be replaced. Demand in rural areas is not rising rapidly, as refrigerator acquisition is not a first priority for many households. Among respondents to a recent Gallup poll, 21% said they planned to purchase a refrigerator in the coming 1-2 years.

The structure of the Chinese refrigerator industry has been changing in recent years. Formerly, there were numerous producers, most of them state-owned enterprises. The industry is now undergoing a process of consolidation, with many of the smaller firms closing down. In 1997, the six largest manufacturers accounted for more than 80% of demand (Appliance 1998a). During the 1980s, refrigerator production lines were imported from Italy, Germany, and Japan. Many of these lines are now being upgraded, and most of the large producers are engaged in technology cooperation with one or more foreign partners (Nadel 1995).

Quality has been an important issue in the Chinese refrigerator market. The industry's output has been steadily improving, and several manufacturers have obtained ISO 9000 certification. However, the average Chinese refrigerator is not up to international quality levels. Many producers have been investing in technological improvement, including CFC-free technology. The desire to increase exports has been driving quality improvements, and Chinese consumers are also very concerned about quality. Urban respondents to a Gallup poll indicated that, by a margin of 78% to 10%, they prefer high quality goods, even if they are more expensive.

Joint-ownership agreements were prohibited until recently, although overseas partnerships on a license or contractual basis have been permitted for a longer period. The Chinese government initially asked for a very high proportion of JV production to be exported, but this policy has been relaxed as the initial export targets proved to be unreachable (Leng 1998). Refrigerator joint ventures (JVs) entering operation in 1997 included Chunlan with LG and Little Swan with Matsushita. A refrigerator JV between Rongshida and Maytag is said to be going into operation soon. A freezer JV between Kelong and Sanyo also began operations in 1997 (Appliance 1998a). Other companies with refrigerator JVs in China include Samsung, National/Panasonic, Technic, and Sharp (Leng 1998). A JV between Whirlpool and Snowflake has closed down.

Chinese manufacturers are also establishing JVs abroad. In 1997, Xinfei opened a refrigerator joint venture in Indonesia, and Haier Group opened joint ventures producing a variety of white goods in Indonesia, Malaysia, Philippines, and Yugoslavia.

Exports of Chinese refrigerators are rising sharply. In 1997, 1.3 million units with a value of US$107 million were exported, an increase of 26% and 37%, respectively, over 1996 levels. Exports are projected to increase 12% in 1998 (Appliance 1998a). Europe is the primary

overseas market for Chinese refrigerators, while exports also go to East and Southeast Asia, and small refrigerators are exported to the United States. (Leng 1998). Chinese producers are increasingly exporting their own brands, instead of products made under foreign brands' nameplates (Appliance 1998a).

Refrigerator imports fell in 1996. Chinese consumers show a marked preference for domestic brands. Imports of fridges and fridge-freezers were valued at US$24 million in 1996, and a further US$5 million worth of freezers were imported. About 95% of fridge and fridge-freezer imports came from APEC economies, primarily from Japan, the United States and Mexico. About 70% of imported freezers were sourced from APEC economies, mostly the US and Japan.

Table 3.15: China trade flows of fridges and fridge-freezers, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	39.1	67.9	75.8
Exports to APEC only	21.0	39.2	44.8
Imports from world	21.6	38.2	24.0
Imports from APEC only	20.9	36.2	23.0

Source: UN Commodity Trade Statistics

Table 3.16: China trade flows of freezers, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	1.4	1.6	3.3
Exports to APEC only	1.0	1.0	1.8
Imports from world	7.2	5.2	5.1
Imports from APEC only	4.9	3.6	3.1

Source: UN Commodity Trade Statistics

The relatively new designs used by the Chinese refrigerator industry means that models are more energy-efficient than in many developing countries. Also, China has minimum energy efficiency standards for refrigerators that have eliminated the most inefficient models from the market. The current performance standard requires that refrigerators with a volume between 189 and 209 liters consume no more than 1.3 kWh per 24 hours (475 kWh per year) when tested at an ambient temperature of 27°C (Nadel 1995).

Compressors for Chinese refrigerators are mostly manufactured domestically using foreign designs. One or two local manufacturers make high-efficiency compressors, but in very small numbers, due to low demand.

Chinese consumers are relatively indifferent to energy efficiency, due to low electricity prices and the fact that many households do not pay for electricity. Refrigerators account for 30-40% of household electricity demand in China, however their constant use makes the impact of

refrigerator energy efficiency on electricity bills fairly opaque to consumers (Wang and Xu 1998).

With support from the Global Environment Facility (GEF), China is currently developing an energy efficiency labeling program for refrigerators. The State Technology Supervision Bureau (STSB) will determine how and when the program will be implemented. Modeled on European energy efficiency labeling, the Chinese refrigerator labeling program will likely rate models according to 5-7 energy efficiency classes. The "A" class is expected to represent a 40-50% increase in energy efficiency relative to the current Chinese energy efficiency standard, with about 5% of models qualifying for an "A" class designation. About 30% of models are expected to fall into the "B" class, and the majority (about 60%) are expected to be "C" class (Leng 1998). The design of the label itself will be tailored to meet the needs of the Chinese market.

The GEF program also includes a manufacturer incentive program, expected to amount to about US$2 million. A large share of this sum will be awarded to the factory producing the most energy-efficient models on a sales-weighted basis. Lesser amounts will be awarded to runners-up. GEF funds will also support consumer education on the benefits of energy-efficient refrigerators (Leng 1998).

3.6 Hong Kong, China

Hong Kong, China does not export fridges and fridge-freezers, and only a negligible amount of freezers. However, Hong Kong, China is a key trading center engaging in significant re-export of white goods shipped from third countries.

Imports of fridges and fridge-freezers declined from US$105 million in 1994 to US$79 in 1996. More than 95% came from other APEC economies, primarily Thailand, Japan, and South Korea. Imports of freezers rose to US$2.5 million in 1996, 80% of which came from APEC economies, mostly the US and Japan.

Re-exports have fluctuated around a value of US$30 million for fridges and fridge-freezers, and US$1.5 million for freezers. From 40-60% of re-exported fridges and fridge-freezers and about 90% of freezers were shipped to APEC economies, primarily China.

Table 3.17: Hong Kong, China trade flows of fridges and fridge-freezers, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	-	-	-
Exports to APEC only	-	-	-
Imports from world	105.0	89.9	79.3
Imports from APEC only	103.2	87.2	77.4
Reexports to world	27.9	36.0	16.3
Reexports to APEC only	11.1	22.6	7.4

Source: UN Commodity Trade Statistics

Table 3.18: Hong Kong, China trade flows of freezers, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	0.2	0.1	<0.1
Exports to APEC only	-	-	<0.1
Imports from world	1.7	2.8	2.5
Imports from APEC only	1.1	1.9	2.0
Reexports to world	1.5	1.0	1.9
Reexports to APEC only	1.3	0.9	1.7

Source: UN Commodity Trade Statistics

Hong Kong, China currently is operating a voluntary energy efficiency labeling program for household refrigerators.

3.7 Indonesia

Data on the saturation of refrigerators in Indonesia are somewhat scarce. A survey of Java's 9.5 million electricity customers showed that 40% own a refrigerator. This percentage is lower on other islands. The majority of sales are for small (140-170 liters), single-door refrigerators. In Indonesia, refrigerators account for 23% of household electricity consumption (Opheim and du Pont 1995).

Indonesian production of refrigerators increased 44% per year between 1987 and 1992., reaching 237,000 units in 1992. A 1992 market survey found 13 companies registered to assemble refrigerators in Indonesia. These companies had a production capacity of more than 500,000 units per year as of 1992. These local makers mostly supply the market with small and medium-sized units. Larger units are usually imported.

Several overseas makers have established JVs with local companies to produce refrigerators in Indonesia. National, Samsung, and Sanyo are the largest. Others include Sharp, Toshiba, and Mitsubishi. As of 1997, several Chinese makers were also setting up JVs in Indonesia. Sanyo produces compressors locally for its refrigerator production in Indonesia. Compressors used by other makers are imported.

Indonesian exports of fridges and fridge-freezers reached US$15.5 million in 1996, of which half were bound for APEC economies. Key markets were Japan and Malaysia

Imports rose from US$3.3 million in 1994 to US$10.0 million in 1996. Imports from APEC economies accounted for 61% of the market in 1996, with Thailand, the US, and Japan as the principal suppliers.

Table 3.19: Indonesian trade flows of fridges and fridge-freezers, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	12.4	11.8	15.5
Exports to APEC only	4.5	3.9	7.9
Imports from world	3.3	6.3	10.0
Imports from APEC only	2.6	0.9	6.1

Source: UN Commodity Trade Statistics

Table 3.20: Indonesian trade flows of freezers, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	<0.1	<0.1	0.1
Exports to APEC only	-	<0.1	<0.1
Imports from world	0.4	1.7	1.6
Imports from APEC only	0.3	1.6	0.3

Source: UN Commodity Trade Statistics

No data on the energy efficiency of Indonesian refrigerators was located for this report.

3.8 Japan

About 99% of Japanese households own a fridge-freezer. There are about 121 fridge-freezers per 100 households (JEMA 1997). Japanese refrigerators are generally smaller than equivalent models in other markets but have the most complex designs, usually featuring multiple compartments operating at different temperatures. Recently, however, Japanese consumers have begun to purchase larger refrigerators. Models with volumes between 350 and 400 liters are becoming the norm. Demand for units larger than 400 liters rose from 900,000 units in 1992 to 1.4 million in 1997 (JARN, 1998b).

On a national basis, Japan is the world's second largest refrigerator market. The market is dominated by three manufacturers—Matsushita, Hitachi, and Toshiba—which together account for almost 76% of sales (Waide and Lebot 1995). Sales growth of refrigerators has been slow in recent years. Shipments in 1997 reached 5.4 million units, but are expected to fall to 5 million units per year in 1998 (JARN, 1998b). Almost 96% of sales were for combined fridge-freezers (Waide and Lebot 1995).

Production of fridge-freezers has been relatively steady at between 4.5 million and 5.1 million for several years. Production of freezers increased to 258, 000 units in 1996, a 25% rise over the previous year. The Japanese refrigerator market is currently in transition, as manufacturers switch refrigerants, from R14a to R22. As a result of this phase-out, new refrigerator models will be introduced at the end of 1998.

Exports have been declining sharply in recent years as Japanese manufacturers have established overseas production capacity in such countries as Thailand and China. Exports of fridge-freezers

fell from 1.9 million units in 1985 to 442,000 units in 1990 to 261,000 units in 1995. Exports of freezers declined from 13,000 units in 1985 to 3,000 units in 1990 and 1995 (JEMA 1997). Three-quarters of refrigerator exports were bound for other Asian countries, 10% to the Middle East and the rest to Europe and the US (Saito 1998).

Only about 1% of refrigerators sold in Japan in 1992 was imported, due in part to the unique design of Japanese refrigerators (Waide and Lebot 1995). Imports have increased in recent years, attributable to reverse imports of goods produced by Japan makers at overseas production facilities in Thailand and elsewhere. There has also been an increase in imports of foreign brands, especially from Korea. Imports of fridge-freezers increased from 8,000 units in 85 to 340,000 units in 1990 and 693 000 units in 1995. About 43% of refrigerators were imported from Korea and 32% from Thailand. Imports of freezers increased from 1,000 units in 1985 to 26,000 units in 1990 to 172,000 units in 1995.

Table 3.21: Japanese trade flows of fridges and fridge-freezers, 1994-1996

Millions of US$

	1994	1995	1996
Exports to world	111.9	66.5	53.1
Exports to APEC only	84.3	50.5	38.9
Imports from world	88.8	147.2	119.7
Imports from APEC only	83.2	140.5	113.6

Source: UN Commodity Trade Statistics

Table 3.22: Japanese trade flows of freezers, 1994-1996

Millions of US$

	1994	1995	1996
Exports to world	7.5	9.5	9.6
Exports to APEC only	4.0	5.3	6.2
Imports from world	29.5	45.2	58.5
Imports from APEC only	8.4	21.5	26.1

Source: UN Commodity Trade Statistics

For the purposes of energy efficiency testing, Japanese refrigerators are divided into 4 product classes: units with self-defrosting systems with freezer at the top; units with reinforced circulation systems with freezer at the top; units with freezer on the side; and refrigerator without freezer compartment. Historically, the Japanese Industrial Standard (JIS) used a significantly lower ambient temperature than other test protocols. This meant that measured energy consumption tended to be much lower than consumption as measured by ISO or other testing protocols. For instance, comparative testing of 12 Japanese refrigerators according to the US test protocol increased measured energy consumption by an average of 43% relative to the former JIS. Since 1993, the Japanese energy test has been modified to include the ISO test, which is reported to raise measured energy consumption by an average of 30% (Waide and Lebot 1995).

Japan regulates the average energy efficiency of refrigerator shipments, rather than setting a minimum performance standard on a per unit basis. Energy efficiency targets for refrigerators were first set in 1979, mandating a 20% improvement in energy efficiency by 1983. This target was largely achieved. A study by Japan's New Energy Development Organization, a branch of MITI, indicated that the energy consumption of a typical 2-door, 170-liter fridge-freezer decreased from almost 1,000 kWh per year in the early 1970s to 320 kWh per year in the early 1980s. Since 1984, however, average energy performance has not improved further (Waide and Lebot 1995).

The Energy Conservation Center of Japan (ECCJ) produces a booklet listing the energy efficiency attributes of dozens of models of various appliances, including refrigerators. This data is summarized in the table below, showing the range of energy efficiency levels of refrigerators currently on the Japanese market.

Table 3.23: Energy Efficiency Range Of Refrigerators Sold in Japan

	Size class of refrigerator, by volume in liters				
	101-200	201-300	301-350	351-400	401-450
Total number of models	17	15	18	29	29
Models consuming <400 kWh/yr	-	-	1	4	1
401-500	3	2	-	4	15
501-600	12	11	9	10	5
601-700	2	2	8	7	1
701-800	-	-	-	3	4
801+	-	-	-	1	3

Source: Compiled from information supplied by ECCJ

The Japanese Energy Conservation Law was revised in 1998. The law requires resetting the energy efficiency target for refrigerators, but the level has not yet been determined. It is thought that the Japanese government will adopt a "top-runner" scheme, in which all models on the market 5 years from now will be required to be as energy-efficient as the most efficient model currently available. The top-runner program is still in discussion within the Japanese government, and targets are expected to be officially registered in April 1999. The government has proposed a 30% improvement in energy efficiency to be achieved by the top-runner program. The Japanese Electrical Manufacturers Association (JEMA) has proposed a 13% increase in energy efficiency per one product unit, relative to 1995 levels, by 2010.

3.9 Korea, Republic of

Korea has a very high saturation of refrigerators, with 120 units per 100 households. Replacement accounts for 80% of demand. Koreans are increasingly buying large refrigerators, as more women are employed outside the home and seek the convenience of having room to

store cold food. In 1996, 42% of sales were for units with capacity over 500 liters, up 9% over 1995 (Lee 1997).

Sales of fridge-freezers totaled 538,000 million won in 1997, a 20% decline from 1996. Local manufacturers Daewoo, LG, and Samsung supply 70% of the market (Waide and Lebot 1995). About 1.8 million units were sold in 1996; due to the economic crisis, sales are expected to decline to 1 million units (B.M. Lee 1998).

Table 3.24: Domestic Sales of Refrigerators in Korea, 1995-1997 (million won)

	1995	1996	1997
Fridge-freezers	700,009	651,240	537,765
Fridge only	61,625	57,084	76,080
Chest freezers	3,508	382	1,902
Upright freezers	6,596	4,020	3,804

Source: Korean Ministry of Commerce, Industry and Energy 1998

Production of fridges and fridge-freezers rose steadily from 1995 to 1997, while production of freezers has been more erratic.

Table 3.25: Production of Refrigerators in Korea, 1995-1997 (million won)

	1995	1996	1997
Fridge-freezers	945,958	976,860	988,539
Fridge only	113,282	114,168	152,160
Chest freezers	30,493	3,537	20,922
Upright freezers	11,993	8,040	7,600

Source: Korean Ministry of Commerce, Industry and Energy 1998

Korean refrigerator manufacturers have established JVs in several Asian countries. Samsung has a JV in China producing small refrigerators, which are exported to Korea and to Southeast Asia, as well as supplying the Chinese market. Samsung also has a JV in Thailand, but its production is not shipped to Korea.

The total number of refrigerators exported from Korea is estimated at 1.5 million units per year (B.M. Lee 1998). In the case of Samsung, most of its exports are small units with volumes of 300 liters or less. However, the company aims to shift 30% of its exports by 2001 into exports of large, energy-efficient models. Exports of fridges and fridge-freezers were valued at US$476 million in 1996, of which 44% were destined for APEC economies. Japan and Chinese Taipei were the largest export markets.

The Korean government opened the market to imports of household appliances in 1989. In 1996, the import market for refrigerators was valued at US$71 million, an increase of 7% from 1995. Growth in 1994 and 1995 was 76% and 39%, respectively. This initial slowing of growth in 1996 appears to be due to development of large-capacity units by local manufacturers. Foreign-made goods experienced a more dramatic turndown in sales following the onset of the economic crisis

in late 1997. In 1996, US models accounted for 95% of imports, or about 10% of the total market, mostly for models larger than 600 liters (Lee 1997).

Table 3.26: Korean trade flows of fridges and fridge-freezers, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	363.2	386.3	475.6
Exports to APEC only	176.1	189.0	210.2
Imports from world	48.0	66.6	71.2
Imports from APEC only	46.6	64.5	68.9

Source: UN Commodity Trade Statistics

Exports of freezers have fluctuated in recent years, with about US$5 million exported in 1996, of which about 50% were bound for APEC economies, mostly Japan. Imports of freezers rose to US$4 million in1996, of about 50% originated in APEC economies, primarily the US.

Table 3.27: Korean trade flows of freezers, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	4.7	6.8	4.9
Exports to APEC only	2.2	5.5	2.6
Imports from world	3.2	3.5	4.0
Imports from APEC only	1.7	1.3	1.9

Source: UN Commodity Trade Statistics

In 1992, the Korean Ministry of Commerce, Industry and Energy (MOCIE) established minimum energy efficiency standards and a mandatory energy labeling program for various consumer products. The first standards became effective in 1993, and were designed to reduce energy consumption by up to 7% (Duffy 1996). A second set went into effect in 1995; these revised standards were designed to save 15% of fridge energy use and 20% of fridge-freezer energy consumption relative to 1992 models.

The labels affixed to products bear a numerical designation representing the level of energy efficiency, as well as information on energy consumption. The efficiency is determined according to the relevant test procedure contained within the Korean Industrial Standards, which are based loosely on Japanese test procedures. The rating scheme for fridges and fridge-freezers was initially established in 1992, and first updated in 1996. A second update may possibly take place in 1999.

The scheme recognizes three products classes—fridges, fridge-freezers with an adjusted volume of less than 500 liters, and fridge-freezers of adjusted volume of 500 liters or more. The highest grade is Grade 1, assigned to models that consume no more than 100% of the target value for energy consumption for the relevant product class. Models consuming more than 100% but less than 120% of the target value are placed in Grade 2; up to 140% is Grade 3; up to 150% is Grade

4; and more than 150% is Grade 5. The number of refrigerator models in Grade 1 rose from 6% in 1992 to 58% in 1997. Most of units with volumes between 400 and 600 liters are in the #1 energy efficiency class. Most of the units below 300 liters are in energy efficiency classes 2 and 3 (S.G. Lee 1998).

Table 3.28: Distribution of Korean Refrigerators Models by Energy Efficiency Grade, 1992-1997

Year	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Total
1992	6	48	39	5	8	106
1997	98	44	26	-	-	168

Source: KEMCO 1998

3.10 Malaysia

Malaysian exports of fridges and fridge-freezers have increased steadily from US$2 million in 1994 to US$4.4 million in 1996. About 64% of exports in 1996 were shipped to APEC economies, mostly Brunei. Imports rose rapidly from US$25.9 million in 1994 to US$60.3 million in 1996. More than 95% of 1996 imports came from APEC economies, mostly Korea and Thailand.

Table 3.29: Malaysian trade flows of fridges and fridge-freezers, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	2.2	3.0	4.4
Exports to APEC only	1.6	2.0	2.8
Imports from world	25.9	33.2	60.3
Imports from APEC only	23.9	32.2	58.1

Source: UN Commodity Trade Statistics

Exports of freezers reached US$3.7 million, of which about 40% were shipped to APEC economies, mostly Singapore. Imports grew to US$4.4 million in 1996, of which 66% came from APEC economies, mostly Korea and the US.

Table 3.30: Malaysian trade flows of freezers, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	0.8	0.7	3.7
Exports to APEC only	0.3	0.4	1.6
Imports from world	1.7	1.7	4.4
Imports from APEC only	0.9	1.0	2.9

Source: UN Commodity Trade Statistics

3.11 Mexico

In 1992, an estimated 70% of Mexican households owned a refrigerator. According to ANFAD, the typical Mexican refrigerator was a single-door, manual-defrost model with a volume of 9.6 cubic feet, and an annual energy consumption of 740 kWh (Landa).

About 650,000 refrigerators and 96,000 freezers are sold per year In Mexico (Appliance 1998c). There are two principal manufacturers, which produced about 1 million units in 1992.

Mexican exports of fridges and fridge-freezers reached US$228 million by 1996, of which 86% were shipped to APEC economies, mostly the US. Mexican imports of fridges and fridge-freezers plummeted in 1995, due to the economic crisis. By 1996, imports had increased slightly to US$24 million, of which 97% originated in APEC economies, mostly the US and to a lesser degree Korea.

Table 3.31: Mexican trade flows of fridges and fridge-freezers, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	130.2	169.0	227.8
Exports to APEC only	119.8	138.8	196.8
Imports from world	105.6	17.7	24.0
Imports from APEC only	103.6	17.5	23.4

Source: UN Commodity Trade Statistics

Exports of freezers have fluctuated, declining to US$7.6million, of which more than 90% were bound for APEC economies, primarily the US. Imports of freezers declined sharply with the economic situation in 1995. In 1996, imports were valued at US$4.3 million, of which 90% came from APEC economies, mostly the US.

Table 3.32: Mexican trade flows of freezers, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	10.7	18.9	7.6
Exports to APEC only	9.3	13.2	7.1
Imports from world	14.3	4.6	4.3
Imports from APEC only	12.4	4.2	3.9

Source: UN Commodity Trade Statistics

Mexico has a minimum energy efficiency standard and mandatory energy labeling for fridges and fridge-freezers. These performance standards and associated test procedures are very similar to those used in the US. They were first issued in 1995 and updated in 1997 (CONAE 1998).

Refrigerators made in Mexico in early 1990s had compressors with EERs of 2.6 for small units and up to 3.6 for large units (Landa).

3.12 New Zealand.

The New Zealand refrigerator market is very similar to that of Australia. The market is served by the same manufacturers, however refrigerators sold in New Zealand are considerably smaller than those in Australia. Auckland-based Fisher & Paykel takes about 70% of the market, a much larger share than in Australia. Australian manufacturers Email and Hoover account for about 20% of the market.

New Zealand exports about US$22 million worth of fridges and fridge-freezers per year. Three-quarters of these are destined for APEC economies, mostly Australia and Hong Kong, China. Imports of fridges and fridge-freezers rose to US$16 million in 1996. Key sources are Australia, Korea, and the US.

Table 3.33: New Zealand trade flows of fridges and fridge-freezers, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	25.1	22.0	22.4
Exports to APEC only	20.2	16.5	16.6
Imports from world	12.9	14.0	16.2
Imports from APEC only	12.1	13.2	4.6

Source: UN Commodity Trade Statistics

New Zealand's freezer exports total about US$15-6 million, of which 85% were sent to APEC economies, mostly Japan and Australia. Imports of freezers increased to US$1.8 million in 1996. Australia is the leading source.

Table 3.34: New Zealand trade flows of freezers, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	16.3	14.7	15.6
Exports to APEC only	14.6	12.4	13.3
Imports from world	1.2	1.7	1.8
Imports from APEC only	1.1	1.6	1.8

Source: UN Commodity Trade Statistics

The average New Zealand household uses 840 kWh per year for refrigeration. In 1988, New Zealand harmonized its refrigerator categorization and energy efficiency testing protocols with Australia. It has also adopted the Australian energy label on a voluntary basis.

3.13 Papua New Guinea

The refrigerator markets of the island states of the South Pacific, such as PNG, tend to be very similar to the Australian market. They are served by the same manufacturers offering the same products.

PNG has not reported trade data to the UN for the period 1994 to 1996. Other APEC economies reported that they exported to PNG fridges and fridge-freezers valued at US$1.5 million in 1995, mostly from Australia, and to a lesser extent from Korea and New Zealand.

3.14 Philippines

As of 1995, 41% of Filipino households owned a refrigerator. Sales have grown rapidly in recent years, nearly doubling from 320,000 units in 1993 to 600,000 units in 1997. Leading Filipino manufacturers are Concepcion Industries and PHILACOR (Philippines Appliance Corporation), along with JV companies established with Japanese makers Matsushita, Sharp, and Sanyo.

Table 3.35: Philippines Sales Data for Refrigerators, 1993-1997

	1993	1994	1995	1996	1997
Fridge-freezers (1-door)	241,571	300,035	383,599	457,697	484,583
Fridge-freezers (2-door)	52,253	57,531	67,053	75,362	65,084
Frost-free fridge-freezers	-	-	-	14,860	23,736
Others	-	23	24	300	364
Freezers	27,738	17,055	37,419	37,024	29,483
TOTAL	321,202	374,644	488,095	585,243	603,250

Source: IIEC, AHAM

Exports of refrigerators have been steadily declining, from a peak of 26,300 units in 1992 to about 3,500 units in 1995. The value of exported fridges and fridge-freezers declined from US$5.4 million in 1994 to US$800,000 in 1996, of which less than 10% were shipped to APEC economies.

Industry data indicate that 33,500 units were imported in 1995, a 146% increase from 1994. Imports now total about US$12 million per year. More than 95% of these come from APEC economies, primarily from the US as well as from Thailand and Korea.

Table 3.36: Philippines trade flows of fridges and fridge-freezers, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	5.4	1.1	0.8
Exports to APEC only	4.3	0.1	<0.1
Imports from world	4.3	13.1	11.9
Imports from APEC only	4.3	12.4	11.4

Source: UN Commodity Trade Statistics

Filipino freezer exports are negligible. Imports rose to US$900,000 in 1996, about half of which came from APEC sources, primarily New Zealand.

Table 3.37: Philippines trade flows of freezers, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	-	-	<0.1
Exports to APEC only	-	-	<0.1
Imports from world	0.1	0.1	0.9
Imports from APEC only	0.1	0.1	0.4

Source: UN Commodity Trade Statistics

According to a 1995 survey, the average electricity consumption of refrigerators in the Philippines is about 535 kWh per year. Negotiations are ongoing between the Fuels and Appliance Testing Laboratory of the Philippines Department of Energy and appliance manufacturers concerning establishment of an energy efficiency performance testing and labeling program for refrigerators, similar to the program already in effect for air conditioners in the Philippines.

3.15 Singapore

Leading refrigerator brands in the Singaporean market are Matsushita, Mitsubishi, and Sanyo. Singapore's exports of fridges and fridge-freezers rose from US$58 million in 194 to US$89 million in 1996. About 80% of these exports were headed to APEC markets, mostly Korea. Imports are steady at about US$80 million, of which more than 95% originated from APEC economies, mostly Thailand, Japan, and Korea.

Table 3.38: Singapore trade flows of fridges and fridge-freezers, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	58.2	80.5	88.8
Exports to APEC only	37.7	56.8	68.4
Imports from world	80.0	80.5	78.1
Imports from APEC only	77.1	77.1	74.5

Source: UN Commodity Trade Statistics

Singapore exports about US$3 million worth of freezers, of which about two-thirds are destined for APEC economies, primarily Brunei and Malaysia. Freezer imports are valued at about US$4 million, of which about 40% came from APEC economies, mostly Thailand and China.

Table 3.39: Singapore trade flows of freezers, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	2.4	2.9	2.7
Exports to APEC only	1.6	1.8	1.8
Imports from world	4.4	3.8	4.5
Imports from APEC only	1.9	1.7	1.9

Source: UN Commodity Trade Statistics

3.16 Chinese Taipei

In 1996, refrigerator sales in Chinese Taipei were valued at US$687 million. The market is expected to grow at an annual rate of 5% over the next 3 years. Approximately 75-80% of sales are for replacement purposes. Households tend to replace their refrigerators with larger models (Yen 1997).

Production of household refrigerators in Chinese Taipei has fluctuated in recent years, ranging from a high of 522,000 in 1995 to 432,000 in 1997. Over 70% of local production was accounted for by six firms: Tatung, Taiwan Matsushita, Sanyo, Taiwan Kolin, Teco, and Sampo.

Table 3.40: Production of Household Refrigerators in Chinese Taipei			
Year	Production (sets)	Shipments	
		Sets	Value (NT$ million)
1994	471,108	519,380	8,327
1995	522,539	539,285	8,386
1996	465,806	517,411	8,442
1997	432,283	485,743	7,568

Source: Chinese Taipei statistics

Exports of fridges and fridge-freezers from Chinese Taipei rose from US$5.9 million in 1995 to US$18.3 million in 1997. The proportion exported to APEC economies reached 76% in 1997, with Hong Kong, China as the leading destination. Imports have fluctuated from US$75-85 million, with 95% coming from APEC economies. Thailand, Korea, and the US are leading suppliers.

Table 3.41: Chinese Taipei trade flows of fridges and fridge-freezers, 1994-1996
Millions of US$

	1995		1996		1997	
	Fridge-freezers	Fridges	Fridge-freezers	Fridges	Fridge-freezers	Fridges
Exports to world	0.2	5.9	0.1	7.5	0.2	18.3
Exports to APEC only	0.1	2.8	0.1	3.5	0.1	13.9
Imports from world	0.1	85.4	0.4	76.1	0.1	79.7
Imports from APEC only	0.1	84.3	0.4	75.1	<0.1	77.0

Source: Chinese Taipei Trade Statistics

Table 3.42: Chinese Taipei trade flows of freezers, 1994-1996
Millions of US$

	1995		1996		1997	
	Chest freezers	Upright freezers	Chest freezers	Upright freezers	Chest freezers	Upright freezers
Exports to world	-	-	<0.1	<0.1	-	<0.1
Exports to APEC only	-	-	-	<0.1	-	-
Imports from world	1.3	0.5	1.9	0.5	2.1	0.5
Imports from APEC only	0.8	0.4	0.5	0.5	0.4	0.4

Source: Chinese Taipei Trade Statistics

It has been reported that Chinese Taipei has minimum energy performance standards for household refrigerators and freezers. However, no information on these requirements could be obtained for this report.

3.17 Thailand

About 90% of households in metropolitan Bangkok own a refrigerator. Outside the capital, the figure is 50%. Most Thai refrigerators are small by US or European standards, but the trend is toward larger models. There are probably more than 5 million refrigerators in use.

Thai refrigerator sales are dominated by JVs with Japanese companies, including Sanyo, Toshiba, National, and Mitsubishi. Hitachi also manufactures in Thailand, mostly for export (du Pont 1996). Electrolux recently established production facilities.

Production of refrigerators in Thailand reached 1.2 million units by 1993. This represents an average annual growth rate of 18% between 1988 and 1993.

Exports of fridges and fridge-freezers reached US$245 million in 1995, of which 66% were headed for APEC economies, principally Japan as well as Singapore and Hong Kong, China. Imports of fridges and fridge-freezers rose to US$11 million, of which 84% came from APEC economies, primarily the US and Korea. (Thailand has not yet reported 1996 trade data to the UN.)

Table 3.43: Thailand trade flows of fridges and fridge-freezers, 1994-1996

Millions of US$

	1994	1995	1996
Exports to world	155.2	245.6	N. Av.
Exports to APEC only	124.3	163.2	N. Av.
Imports from world	7.6	10.7	N. Av.
Imports from APEC only	6.5	9.0	N. Av.

Source: UN Commodity Trade Statistics

Thai exports of freezers are valued at about US$5-6 million, of which 88% are shipped to APEC economies, mostly Japan. In 1995, freezer imports declined to US$4 million, of which 29% were sourced from APEC economies, mostly Japan, Singapore, and the US.

Table 3.44: Thailand trade flows of freezers, 1994-1996

Millions of US$

	1994	1995	1996
Exports to world	6.0	5.6	N. Av.
Exports to APEC only	5.6	4.9	N. Av.
Imports from world	7.4	4.0	N. Av.
Imports from APEC only	0.5	1.2	N. Av.

Source: UN Commodity Trade Statistics

As of 1995, most Thai manufacturers still used inefficient compressor designs, and insulation thicknesses were below optimal level, according to IIEC. The typical Thai refrigerator model had 30 millimeters of cabinet insulation and a compressor with an EER of about 3.1. The average Thai refrigerator uses about 500 kWh per year. Sanyo has developed a prototype with an improved compressor and additional insulation, which would cut energy consumption to about 300 kWh per year.

The Thai electricity generating authority officially established an energy efficiency labeling program for refrigerators in February 1995. It is a voluntary program, thus manufacturers usually affix labels only to efficient models. The Thai labeling program features a 5-star rating system, with 5 stars awarded to the most energy-efficient models. Since the inception of the program, the share of energy-efficient refrigerators on the Thai market has increased dramatically. Recently, the Thai government has been considering establishing a minimum energy performance standard for refrigerators.

3.18 United States

More than 99% of households own a full-size fridge or fridge-freezer, and 42% own a deep-freezer. Refrigerators in North America are larger than those sold elsewhere. The most common volume is about 17.5 cubic feet (500 liters); the largest sizes are more than 30 cubic feet (860 liters). In 1993, 11.2 million units were sold, with a value of almost US$4,000 million. Full-size refrigerators accounted for 72% of sales; compact refrigerators for 9%; chest freezers for 8%; and upright freezers for 6% (Waide and Lebot 1995).

Five brands—GE, Whirlpool, Electrolux (Frigidaire), Maytag (Admiral) and Raytheon (Admiral)—account for 99% of the market for full-size fridges and fridge-freezers. Leading brands of compact units are Sanyo, GE/Mabe, and Haier. The main freezer brands are Electrolux (Frigidaire) and W.C. Wood. 1996 shipments totaled 9 million units for full-size fridges and fridge-freezers, 1.1 million compact units, and 1.7 million units for deep freezers. Experts estimate that the 1998 replacement market consists of 6 million full-size fridges and fridge-freezers, 800,000 compact units, and 1.5 million deep freezers (Appliance 1997a)

The fastest growing segments of the US refrigerator market are freezer sales and compact refrigerator sales. Between 1988 and 1992, sales of chest freezers increased by 50% and sales of compact refrigerators rose by 88%, while sales of full-size refrigerators and refrigerator-freezers grew by only 5% (Waide and Lebot 1995).

US exports of fridges and fridge-freezers climbed to US$632 million in 1996, of which 50% were shipped to APEC economies. Exported units were principally destined for Canada, and to a lesser extent to Korea. (However, exports to Korea fell by 90% in December 1997.) Imports rose from US$260 million in 1994 to US$322 million in 1996. About 65% of imports originate in APEC economies, mostly Mexico as well as China and Canada.

Table 3.45: US trade flows of fridges and fridge-freezers, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	627.9	631.9	658.9
Exports to APEC only	363.0	296.3	328.0
Imports from world	260.2	295.6	322.2
Imports from APEC only	152.2	185.4	211.2

Source: UN Commodity Trade Statistics

Exports of freezers are valued at about US$63 million per year. About half of these are shipped to APEC economies, primarily Canada. Imports of freezers rose to US$74 million in 1996, of which 95% came from APEC economies, mostly from Canada and Mexico.

Table 3.46: US trade flows of freezers, 1994-1996			Millions of US$
	1994	1995	1996
Exports to world	62.9	58.1	63.7
Exports to APEC only	36.3	32.2	33.8
Imports from world	67.5	71.7	74.3
Imports from APEC only	61.2	67.2	70.1

Source: UN Commodity Trade Statistics

US minimum energy efficiency standards were introduced in 1990 and 1993, as mandated by the National Appliance Energy Conservation Act of 1987. Revised standards will take effect July 1, 2000.

The US Association of Home Appliance Manufacturers (AHAM) has reported shipment-weighted information on energy efficiency of US appliances on its Web site. This data indicates that energy consumption by US fridge-freezers fell 28% from 1990 to 1996. Freezer energy consumption declined 23% during the same period.

Table 3.47: Energy Efficiency Trends in US Refrigerators, 1990-1996				
	1990 adj. vol. (cubic feet)	1990 energy consumption (kWh/year)	1996 adj. vol. (cubic feet)	1996 energy consumption (kWh/year)
All fridge-freezers	20.45	916	20.31	660
Fridge-freezers, manual defrost	5.01	378	3.71	322
Fridge-freezers, partial auto defrost	14.59	708	6.34	407
Fridge-freezers, auto defrost, Top-mount freezer	20.62	884	20.58	654
Fridge-freezers, auto defrost, side-by-side and bottom-mount freezer	27.24	1279	27.9	843
All freezers	23.31	600	20.92	461
Chest freezers, manual defrost	20.20	471	17.20	345
Upright freezers, manual defrost	26.32	679	23.98	512
Upright freezers, auto defrost	29.36	1030	29.95	834

Source: AHAM

4. TRADE FLOWS AND ENERGY EFFICIENCY OF HOUSEHOLD AIR CONDITIONERS IN THE APEC REGIONAL MARKET

4.1 Overview of the Global and Regional Market

This report deals with two types of room air conditioners (RACs) widely used by households in the APEC region. Window room air conditioners are sold primarily in the US and other economies with a preference for US goods, including Australia; Chinese Taipei; Hong Kong, China; and the Philippines. Ductless split RACs were first commercialized in Japan, and are popular in East Asia, including China, Korea, Malaysia, and Thailand.

World shipments of RACs in 1997 totaled 24 million units. Another 10 million units of packaged air conditioning units (PACs), ducted units used for light commercial service and whole houses, were shipped that year (JARN, 1998c). The world market for RACs is now 1.5 times larger than a decade ago. The principal contributor to this growth is the great expansion in demand from East Asia, especially China. RAC demand in China was almost non-existent ten years ago, and now tops 5 million units per year.

The global air conditioner market peaked in 1996. World production of RACs was 26.9 million units in 1996, up 11% from 1995 (JRAIA 1998). Demand for RACs declined by 8% in 1997, following an 8% increase the previous year. Factors contributing to the downturn are thought to be the unseasonable weather in two key markets—the US and Japan—as well as the economic slump in Japan. Projections for 98 are mixed, with some observers forecasting a small increase, and others predicting continued decline due to the recession in Asia.

Table 4.1: World Demand for Room Air Conditioners, 1994-1998 (000s of units)

	1994	1995	1996	1997 est.	1998 proj.
Japan	7,091	7,749	8,002	6,904	7,249
Southeast Asia (excl. Japan)	6,782	7,822	8,852	8,554	8,819
North America	3,941	4,089	4,613	3,904	4,182
Central and South America	818	850	947	950	1,027
Oceania	188	207	231	252	274
Europe	959	1,204	1,235	1,179	1,286
Middle East	1,287	1,207	1,206	1,226	1,245
Africa	354	380	388	402	416
World total	21,420	23,508	25,474	23,371	24,498

Source: JRAIA

Table 4.2: World Production of Room Air Conditioners, 1994-1996			
	1994	1995	1996
Japan	7,913	7,823	7,685
Southeast Asia (excl. Japan)	8,504	11,250	13,028
North America	3,069	2,969	3,519
Central and South America	661	662	1,089
Oceania	35	39	38
Europe	529	617	643
Middle East	784	825	824
Africa	107	109	109
World total	21,602	24,294	26,935

Source: JRAIA

SITC has two principal categories for air conditioning units, one for window and wall units, and one for "other." This "other" category includes both ductless split systems and packaged systems.

Table 4.3: Trade flows of wall air conditioners in the APEC region, 1994-1996			
			(millions of US$)
	1994*	1995	1996
Total global exports	2,440.8	2,320.8	2,664.4
APEC exports to world	1,581.5	2,121.0	2,327.8
APEC exports to APEC only	1,082.1	1,346.7	1,469.0
Total global imports	1,316.9	1,369.6	1,556.5
APEC imports from world	800.1	961.0	1,040.4
APEC imports from APEC only	705.2	828.1	899.50

Source: UN Commodity Trade Statistics and Chinese Taipei trade statistics. Note that 1996 global statistics are incomplete.

* Does not include data from Chinese Taipei

Table 4.4: Trade flows of air conditioners other than window/wall units in the APEC region, 1994-1996

Millions of US$

	1994	1995	1996
Total global exports	4,395.1	4,936.1	4,790.4
APEC exports to world	2,855.9	2,898.9	2,583.6
APEC exports to APEC only	1,972.5	1,801.3	1,506.3
Total global imports	4,658.4	5,605.2	5,337.8
APEC Imports from world	2,742.7	2,823.7	2,600.4
APEC imports from APEC only	2,542.0	2,558.1	2,310.6

Source: UN Commodity Trade Statistics. Note that 1996 global statistics are incomplete.

4.2 Australia

A 1994 survey found that there were 261 air conditioners per 1,000 Australian households (Wilkenfeld 1996). About 36% of these units are cooling only and the remainder are reverse cycle. In 1995, 50,000 cooling-only air-conditioner units were sold in Australia. An additional 90,000 units of reverse-cycle units were sold.

Australian exports of window and wall air conditioners rose from US$2.1 million in 94 to US$4.6 million in 96. The share of exports headed to APEC economies ranged from 69% to 77% during this period. Exports were destined principally for New Zealand, Singapore, and PNG.

The value of Australian imports of window and wall air conditioner units has ranged from US$40-60 million in recent years. About 70-80% of these imports originated in APEC economies, primarily Thailand, South Korea, Malaysia, Japan, and Chinese Taipei.

Table 4.5: Australian trade flows of window/wall air conditioners, 1994-1996

Millions of US$

	1994	1995	1996
Exports to world	2.1	3.2	4.6
Exports to APEC only	1.6	2.2	3.6
Imports from world	41.7	58.3	49.9
Imports from APEC only	33.8	39.1	36.2

Source: UN Commodity Trade Statistics

Air conditioners sold in Australia are required to carry a label containing energy efficiency information. Australia has no plans to introduce a minimum performance standard for air conditioners. The sales-weighted average consumption of new air conditioner units sold in Australia in 1995 was estimated to be 1025 kWh per year for cooling-only units, and 820 kWh per year for the cooling cycle of reverse-cycle units (Wilkenfeld1996). The Netenergy Web site contains information about the energy efficiency of air conditioner models currently on the Australian market, which has been compiled in the table below.

Table 4.6: Energy efficiency ratings of Australian air conditioners by place of manufacture						
	1-1.99 kW	2.-2.99 kW	3-3.99 kW	4-4.99 kW	5-5.99 kW	6-6.99 kW
Total number of models:	15	54	33	22	35	29
Average rating of all models:	3.13	3.81	4.06	3.41	3.43	2.79
Average rating (# models) of Australia-made models	3.5 (4)	3.0 (4)	-	4.8 (5)	3.4 (5)	-
Korea-made:	3.33 (3)	4.46 (13)	4.86 (7)	2.0(3)	4.0 (7)	3.38 (8)
Japan-made:	4.0 (2)	4.25 (4)	3.25 (4)	2.67 (3)	2.8 (5)	3.0 (1)
Thailand made:	4.0 (1)	3.83 (6)	4.0 (4)	2.5 (2)	3.4 (5)	3.0 (6)
Japan/Thailand made:	-	3.0 (1)	-	3.0 (1)	-	3.5 (2)
Malaysia-made:	2.0 (2)	3.5 (8)	3.33 (6)	3.5 (2)	4.2 (5)	2.17 (6)
Chinese Taipei-made:	1.0 (1)	3.67 (9)	4.20 (5)	3.75 (4)	3.67 (3)	2.0 (2)
Singapore-made:	-	4.0 (1)	3.67 (3)	-	2.5 (2)	-
USA-made:	4.0 (1)	-	-	-	4.0 (1)	3.0 (1)
Mexico-made:	-	5.5 (2)	-	-	-	-
Non-APEC made:	2.0 (1)	2.83 (6)	3.25 (4)	3.5 (2)	3.0 (3)	2.67 (3)

Source: Compiled from information on the Netenergy web site, August 1998.

4.3 Canada

The Heating, Refrigeration and Air Conditioning Institute of Canada reports that 1997 shipments of residential air conditioning units totaled 130,805, a decline of 2% relative to 1996.

The Canadian air conditioner industry has been in transition in recent years, due to the 1988-1992 and the import liberalizing effects of NAFTA. As a result, several multinational companies have stopped manufacturing air conditioners in Canada. Other companies have undergone consolidation. Major companies currently producing air conditioning equipment in Canada are Carrier, Trane, and York International. The major Canadian manufacturer is Ontario-based Inter-City Products.

Canada's only significant trading partner in the air conditioning industry is the United States. The US and Canadian industries are highly integrated. Canadian air conditioner exports are on the increase, as some firms import components from the US and export assembled products back to US. In addition, some European firms are opening plants in Canada in order to access the US market.

Exports of window/wall units increased from US$2.6 million in 1994 to US$3.0 million in 1996. About 65-75% of this amount was exported to APEC economies, the vast majority to the US.

The Canadian air conditioner market is dominated by imports. Imports accounted for 91% of sales in 1994. US companies supply about 90% of imports.

Imports of window/wall units have increased substantially in recent years, from US$13.6 million in 1994 to US$35.5 million in 1995 to US$49.3 million in 1996. More than 95% of imports come from APEC economies, mostly from the US, and to a lesser extent from China, Mexico, and South Korea.

Table 4.7: Canadian trade flows of window/wall air conditioners, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	2.6	2.8	3.0
Exports to APEC only	1.8	1.8	2.3
Imports from world	13.6	35.5	49.3
Imports from APEC only	12.9	34.7	48.6

Source: UN Commodity Trade Statistics

Canada established minimum energy efficiency standards for air conditioners in 1995. These standards are harmonized with those of the US. In addition, air conditioners sold in Canada are required to bear an energy efficiency label.

4.4 Chile

Chilean air conditioner exports are negligible, and none are shipped to APEC economies.

Imports of window/wall units were US$5.8 million in 1996, a decline from US$6.2 million in 1995. About 65% of this amount was sourced from APEC economies. The US supplies about 35% of the market, with Malaysia supplying another 10%.

Table 4.8: Chilean trade flows of window/wall air conditioners, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	0.1	<0.1	0.1
Exports to APEC only	-	-	-
Imports from world	4.0	6.2	5.8
Imports from APEC only	2.7	4.0	3.6

Source: UN Commodity Trade Statistics

4.5 China

According to the first Gallup poll in China (1997), 6% of Chinese households nationwide have an air conditioner. Among urban households, 13% have an air conditioner. Saturations are highest in the major cities; for example, in Shanghai, 63% of households have an air conditioner.

Window RACs have a 27% market share. Split system RACs and PACs take the rest (JARN 1998c). Split systems are considered more prestigious by Chinese consumers, and are gaining market share (Appliance, September 1997).

Chinese demand for air conditioners increased by more than 40-fold between 1990 and 1997. Shipments totaled 8.5 million units in 1997, an increase of 25% over 1996. Demand is expected to be about 20% higher in 1998 (Wang and Xu, 1998). According to the 1997 Gallup poll in China, 8% of households nationwide plan to buy an air conditioner in the next two years. Households in the smaller, secondary cities are a key market (Appliance, September 97).

China's air conditioner production capacity was almost nil in 1990, but has since expanded to the point that some say that China has now surpassed Japan and the US (each with an annual production capacity of about 10 million units) to become the world's largest production center (JARN 1998c). According to the Chinese Household Electrical Appliances Association (CHEAA), air conditioner production in 1997 was 8.5 million units, a 25% increase over 1995. CHEAA predicts a 15% increase in production in 1998.

There are numerous (100-300) producers of air conditioners in China, however the six largest manufacturers supply 68% of the domestic market (Appliance 1998c). The key makers are Chunlan, Gree, Haier, Meidi (MD), Kelon, and Huabao. Chunlan is the oldest and the largest, with an overall capacity of 2 million units. Gree is another very large maker, also with a 2 million unit capacity. Haier is a well known appliance maker that has recently entered the RAC market, with an emphasis on exports. Haier has a reputation for high quality and has earned ISO 9001 certification (JARN 1998c). Meidi (MD) claims best performance for its RACs. It also has ISO 9001 certification and plans to export worldwide (JARN 1998c).

Chinese air conditioner makers are engaged in numerous joint ventures with overseas producers. JARN places the current number of Japanese JVs at 11, with all major Japanese makers involved in JV production in China. Meidi and Toshiba are JV partners, and Haier and MHI are involved in a JV manufacturing split systems. Sanyo has 24 manufacturing facilities in China: 22 are JVs and 2 are wholly-owned foreign enterprises (Appliance, September 1997).

According to JARN, the US firms Carrier, Fedders, Whirlpool, and Trane are involved in JVs in China. Carrier has five JVs making a comprehensive line of air conditioning equipment. Trane has two JVs, one of which makes split systems and window units (the other makes industrial chillers). Fedders has an export-oriented JV making residential air conditioners (Appliance, September 1997). In addition, one Korean maker (LG) and one Malaysian (O.Y.L.) maker have production facilities in China (JARN 1998c).

Chinese air conditioner exports totaled 811,000 units in 1997, valued at US$67.2 million. This represents an increase of 26% and 15%, respectively (Appliance, 1998c). JARN has reported that exports would have reached 1 million units if the Asian currency and economic crisis had not intervened (JARN 1998c). According to CHEAA, Gree and Haier are the main exporters.

UN Commodity Trade Statistics show that Chinese exports of window and wall air conditioner units more than doubled from US$23.4 million in 1994 to US$55.8 million in 1996. In the last two years, 40-50% of exports have been destined for APEC markets. More than 27% of exports went to Hong Kong, China; other smaller markets are Japan, the US, the Philippines, and South Korea.

China has been importing fewer air conditioners in recent years. Imports fell from US$47.8 million in 1994 to US$20.2 million in 1996, virtually all of which were sourced from APEC economies. About 70% of imports came from Japan; smaller amounts were shipped from Korea and the US.

Table 4.9: Chinese trade flows of window/wall air conditioners, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	23.4	35.4	55.8
Exports to APEC only	17.4	13.6	27.4
Imports from world	47.8	42.6	20.2
Imports from APEC only	47.6	42.3	20.1

Source: UN Commodity Trade Statistics

China's current minimum efficiency standards for air conditioners have been in effect since 1989. Electricity capacity problems are driving the government to move to upgrade these standards in the near future.

Table 4.10: Chinese Efficiency Standards for Room Air Conditioners		
	Minimum COP	
Cooling Capacity (Watts)	Window Units	Split Systems
Less than 2500	2.20	2.30
2501 – 4499	2.26	2.37
4500 and over	2.32	2.44

Source: Nadel 1995

China passed an energy conservation law in 1997 mandating energy efficiency labeling of air conditioners. However, this law does not identify unambiguously which agency is responsible for implementing such a program (Judd 1998). China is expected to take a statistical approach to revising its energy performance standards for air conditioners, aimed at removing the bottom 30% of the market with respect to energy efficiency (Judd 1998). Observers believe that the government may set a near-term energy performance standard for air conditioners, and then update it after 2 years. To support the standards development process, a household survey of air conditioning energy use is being conducted in 3 cities—Beijing, Shanghai, and Guangzhou. The survey involves automated data collection from 50 households per city over a period of 3 months.

According to CHEAA, Chinese consumers are much more sensitive to the energy efficiency of air conditioners than refrigerators. Electricity bills often double when air conditioner is in use. Also, much of the housing stock is poorly wired, so consumers want air conditioners that can cool a room quickly and efficiently without causing an electrical failure. Chinese manufacturers are using foreign expertise to increase air conditioner energy efficiency. Using expertise from Sharp, Kelon has made the most dramatic improvement in energy efficiency. According to CHEAA, Kelon is marketing one model with a COP of 3.3, and the average COP of all its models is 3.2. (National/Huabao also has a model with COP 3.3.) The industry average is a COP of 2.7, with 10-15% of the market occupied by models with COP of 3.1 or higher.

Haier and Gree, the leading exporters, produce models with an average COP of 3.1 and 2.7, respectively. The energy efficiency of their exported units is about the same as units sold domestically. Energy efficiency of models produced by Japanese JVs, which are exported to

Japan and Southeast Asia, average 2.8-2.9. Meidi produces units with COP of 2.4-2.7. Units produced by Chunlan are less energy-efficient.

4.6 Hong Kong, China

Hong Kong, China is a major trading base between China and the world, which handles more than 1 million air conditioner units per year (*JARN* 1998c). Domestic demand accounted for about 450,000 units in 1997, with the balance of units being re-exported. Domestic demand for 1998 is projected to be lower, about 400,000 units or fewer (*JARN* 1998c).

Window units, cooling only, are the predominant kind of air conditioning equipment used domestically in Hong Kong, China. Most are made in Chinese Taipei and Southeast Asia under Japanese brands. Recently, Chinese products have begun to be sold in Hong Kong, China (*JARN* 1998c).

Exports of window/wall units are small, and almost all are destined for China. Imports totaled about US$200 million per year between 1994 and 1996. About 80% came from APEC economies. Leading sources are Malaysia and Thailand, which together accounted for about 35% of the 1996 market. A smaller amount of imports comes from Singapore and Japan. The value of units re-exported by Hong Kong, China ranged from US$75 million to US$118 million per year between 1994 and 1996. About 85% of these units by value were shipped to APEC economies, the vast majority of which were destined for China.

Table 4.11: Hong Kong, China trade flows of window/wall air conditioners, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	0.2	0.1	<0.1
Exports to APEC only	0.2	0.1	<0.1
Imports from world	201.4	198.7	195.7
Imports from APEC only	164.3	162.3	154.3
Re-exports to world	110.7	74.7	118.1
Re-exports to APEC only	97.4	61.4	98.0

Source: UN Commodity Trade Statistics

Hong Kong, China initiated a voluntary energy efficiency labeling scheme for room coolers in June 1996. Officials there are considering whether to institute a mandatory labeling program in the future, or perhaps to establish a minimum energy performance standard.

4.7 Indonesia

Data on the saturation of air conditioners in Indonesia is available only for Java, the most developed of the islands that make up Indonesia. A 1993 survey found that among Java households, just 2.7% had an air conditioner. This percentage varied greatly with income: of the 100,000 Java households in the highest rate category for residential electricity use, 64% had an

air conditioner. Window units have traditionally been the most popular type of air conditioner, however, split systems have been gaining ground, despite their higher price.

Table 4.12: Indonesian Air Conditioner Demand by Type			
Type of Building	Window	Split	Central
Apartments and houses	57%	42%	15%
Office buildings	40%	38%	22%
Hotels	3%	17%	80%
Other commercial buildings	39%	25%	36%
Public buildings	27%	18%	55%

Source: Opheim and du Pont 1995

Indonesian air conditioner sales reached 300,000 units in 1996 and 1997, but may fall 50% or more in 1998 (JARN 1998c). The market for home air conditioners has been dominated by local JV producer National Gobel (National, 49.5%), followed by PT Sanyo Industries (Sanyo, 18.4 %), Daikin Indonesia (Daikin, 18.2%), Topjaya Antariska (Toshiba, 12.1%), and PT Lippo Melco (Mitsubishi, 10.1%).

Indonesian production of air conditioners has been about 200,000 units annually. Production had been growing steadily, from 40,000 units in 1985 to 100,000 in 1990 to 160,00 by 1994 (Opheim and duPont 1995).

In addition to the Japanese JVs listed above, some brands from Korea and Chinese Taipei are more recent arrivals. Samsung has a JV company in Indonesia, PT Samsung Metrodata Electronics, which introduced three series of air conditioning machines. Lucky Goldstar has a local partner, Astra Group. Teco from Chinese Taipei has invested 1 billion Taiwanese dollars for an air conditioner plant through its JV partner, PT Teco Elektro Indonesia, which was to have started production in 1999 (Tasnim 1997).

Exports of window/wall units are very small, and were mostly destined for non-APEC markets.

As of the mid-1990s, imports accounted for about 10-15% of the domestic Indonesian air conditioning market. Central systems made up an estimated 50% of the import market by value. Window, split and packaged units accounted for another 40%, and the remaining 10% was parts for domestic assembly of small air conditioners (Opheim and duPont 1995).

Imports of window/wall units rose from US$1.7 million in 1994 to US$4.0 million in 1996. The share imported from APEC economies grew from 34% to 88% during this period. Thailand supplied about 30% of the import market in 1996, with Japan and China together supplying another 30%.

Data from 1991-1994 indicates that imports of split systems were valued from US$1.1 million to US$3.7 million per year.

Table 4.13: Indonesian trade flows of window/wall air conditioners, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	1.6	1.2	0.5
Exports to APEC only	<0.1	<0.1	<0.1
Imports from world	1.7	3.6	4.0
Imports from APEC only	0.6	2.1	3.5

Source: UN Commodity Trade Statistics

According to IIEC, most of the smaller air conditioner units sold in Indonesia are assembled locally, and probably are fairly energy-inefficient, although there are no test data to confirm this. As of 1995, the one of the most energy-efficient units found on the market was a ¾-ton unit with a listed EER of 13 BTU/Wh. In past years, imported units have tended to be higher quality and more energy-efficient.

4.8 Japan

Japan is the world's second largest market for air conditioning, accounting for about 30% of global demand for RACs (JRAIA 1998). The saturation of room air conditioners has increased from 52% of households in 1985 to 79% of households in 1996. By 1997, there were 179 air conditioning units per 100 Japanese households (JEMA 1997).

Major Japanese air conditioner brands are Matsushita, Toshiba, Mitsubishi Electric (Melco), Hitachi, Sanyo, Mitsubishi Heavy Industries (MHI), Daikin, Sharp, and Fujitsu-General. Matsushita is said to be the leading manufacturer, but the four following brands have only a slightly smaller market share (JARN 1998c).

All 9 major Japanese manufacturers released new air conditioner models with HFC refrigerant for the 1998 season. These are not expected to sell well, perhaps only 1-2% of total RAC/PAC demand, due to their higher price (15-30%), plus the difficulty of installation (JARN 1998c).

Shipments of RACs totaled 7.2 million units in 1997, a decline of 10% from 1996. Projections are for shipments to fall further in 1998, due to large inventories held over from 1997 (JARN 1998c). More than 95% of total shipments were split-type air conditioners, with the share of window types falling every year. Heat pumps accounted for 94% of RAC shipments, and 80% were inverter-driven heat pumps. Mass production of inverter units has lowered prices such that prices are only marginally ($100 or less) higher than those of cooling-only models (JARN 1998c).

Total production capacity for RACs and PACs is about 10 million units per year. Production of small ACs (window and split types under 2.25 kW) totaled 7.5 million units in Refrigeration Year[1] 1997 (RY 97), down 10% from RY96 (JARN 1998c). Japan accounts for a declining share of global production, decreasing from 36% in 1994 to 32% in 1995 and 28% in 1996 (JRAIA 1998).

[1] October to September.

Japanese air conditioner exports are declining sharply, as Japanese makers are increasingly moving production offshore to economies where costs are lower. According to JRAIA, exports of RACs fell to less than 700,000 units in 1996, a drop of 26% from 1995.

About 5% of total exports are window/wall units (JEMA 1997). The value of these exports decreased from US$52.2 million in 1994 to US$19.0 million in 1996. The percentage of units headed for APEC economies rose from 28% in 1994 to 47% in 1996. Singapore and Hong Kong, China are the leading destinations, accounting for about 35% of total exports.

Imports of window and wall air conditioners shot up from 26,000 in 1994 to 89,000 in 1995 to 143,000 units in 1996. Imports of other types of air conditioners have also increased dramatically, varying from 470,000 units to more than 850,000 units per year (Appliance 1998b). Chinese Taipei is the leading supplier, taking about 40% of the import market. Malaysia and Thailand each make up a 25-30% share of the import market (Nomoto 1997).

Table 4.14: Japanese trade flows of window/wall air conditioners, 1994-1996

Millions of US$

	1994	1995	1996
Exports to world	52.2	24.3	19.0
Exports to APEC only	14.4	9.3	9.0
Imports from world	9.6	29.7	43.1
Imports from APEC only	4.8	16.4	26.4

Source: UN Commodity Trade Statistics

The Japan energy conservation act establishes 1998 target values for the energy efficiency of air conditioners with cooling capacity up to 27kW. These target values are calculated based on actual performance in 1992. The average energy efficiency of each manufacturer's total shipments to domestic markets is calculated, and this figure should attain the target value or higher (JRAIA 1998).

Table 4.15: Japanese Target Energy Efficiency Values for Air Conditioners, 1998

Cooling capacity	1992 Actual COP		1998 Target COP	
	Cooling	Heating	Cooling	Heating
< 4 kW	2.55	3.06	2.67	3.20
4.0 kW ≤ capacity < 7.1 kW	2.28	2.49	2.34	2.56
7.1 kW ≤ capacity < 27 kW	2.39	2.55	2.45	2.62

Source: JRAIA

Note: Unit of COP is kW/kW (capacity/power consumption)

All the major Japanese RAC makers are claiming that their new models achieve substantial energy savings by using improved compressors, heat exchangers, electronic control valves and finer microprocessor controls (JARN 1998c). At the global climate change conference held in Kyoto, Japan in December 1997, several Japanese manufacturers announced goals for reducing the energy consumption of their products.

Meanwhile, MITI is examining the possible introduction of a "top runner" system for adopting the top energy-saving models and technologies as the basis of new standards for household appliances, including air conditioners. Targets are expected to be officially registered in April 1999.

4.9 Korea

In 1996, 14% of Korean households owned an air conditioner (Lee 1997). Saturations are higher in Seoul, where 60% of households are said to have an air conditioner (Craig 1998).

Most RACs are split systems, with a small share of window type units. Domestic demand was 1.3 million units in 1996, an increase of 500,000 units over 1995. Demand held steady in 1997, but is expected to drop to 1 million units in 1998 due to the economic situation in Korea (JARN 1998c). The 1996 market for household air conditioners was valued at US$308 million, an increase of 111% over 1995 (Lee 1997).

Major RAC makers are Daewoo Carrier, LG, and Samsung. Samsung and LG together account for about 70% of the market (Lee 1997). Other local air conditioner makers are Kyungwon and Mando (B.M. Lee 1998). Each of three major makers has a production capacity of several hundred thousand units per year. Total Korean production of window/wall types has been climbing steadily: the value of production rose from US$653.6 million in 1995 to US$779.8 million in 1997 (Yang 1998).

The major makers are all exporting heavily. Daewoo Carrier is using Carrier's sales network. LG and Samsung are selling in East Asia, US, and Europe, under their own brands and to OEMs (JARN 1998c). Exports of window/wall types rose from US$224 million in 1994 to US$389 million in 1996. The percentage of exports headed for APEC economies declined from 56% in 1994 to 40% in 1996. The US; Singapore; and Hong Kong, China accounted for about 26% of exports by value.

The Korean government opened the market for imports of household appliances in 1989. Imported air conditioners now account for only 0.5% of the total market, or about US$1.6 million (Lee 1997). This is due to the cost competitiveness of local makers. Semi-finished products are imported and assembled locally.

The import market for window/wall air conditioners was valued at US$9.4 million in 1996, a significant increase from US$4.0 million in 1994 and US$4.4 million in 1995. About 80% of imports came from APEC economies. Japan took about 56% of the market in 1996, and the US accounted for another 20%. However, purchases of imported appliances declined by 90% in December 1997, due to the economic crisis in Korea (Lee 1997).

Table 4.16: Korean trade flows of window/wall air conditioners, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	224.4	368.9	389.3
Exports to APEC only	125.4	165.1	154.6
Imports from world	4.0	4.4	9.4
Imports from APEC only	3.2	3.4	7.7

Source: UN Commodity Trade Statistics

Korea has mandatory energy performance standards and labeling for air conditioners. Standards for room air conditioners became effective in 1993 and were updated in 1996. A second update is possible in 1999.

Table 4.17: Korean Energy Efficiency Standards for Constant Speed Type Air Conditioners			
Category		Minimum EER (COP), as of Jan 1997	Target EER (COP), By the end of 1998
Window type		2.200 (2.525)	2.500 (2.869)
Split type	Cooling capacity< 3,550 kcal/h	2.500 (2.869)	2.700 (3.100)
	3,550 ≤ Cooling capacity ≤ 9,000 kcal/hr	2.200 (2.525)	2.500 (2.869)
	9,000 < Cooling capacity ≤ 15,000 kcal/hr	2.000* (2.295)	2.400** (2.754)

Source: S.G. Lee 1998 Note: EER is kcal/Wh.
as of September 1998; ** by the end of 1999

Table 4.18: Korean Energy Efficiency Standards for Variable Speed Type Air Conditioners			
Category		Minimum SEER, as of Jan 1997	Target SEER, By the end of 1998
Window type		2.310	2.630
Split	Cooling capacity < 3,550 kcal/hr	2.630	2.840
	3,550 ≤ Cooling capacity ≤ 9,000 kcal/hr	2.310	2.630
	9,000 < Cooling capacity ≤ 15,000 kcal/hr	2.100*	2.520**

Source: S.G. Lee 1998
Note: SEER is kcal/Wh.
* as of September 1998; ** by the end of 1999.

According to the Korean National Institute of Technology and Quality, Korean energy efficiency test procedures for air conditioners are compatible with those of IEC and ISO. The least energy-efficient class of air conditioners, Grade 5, is no longer manufactured, and the Korean government has recommended to manufacturers that they increase energy efficiency to at least Class 4.

About 60% of air conditioner models are now in the highest-efficiency class. This equates to an EER of more than 2.5 for a window-type, constant-speed unit. For constant-speed split systems, the EER required for Grade 1 varies according to cooling capacity. In the smallest capacity class, units with an EER of 2.9 or above earn a Grade 1; in the medium-capacity class, an EER of 2.6 is required; for the largest capacity splits, an EER of 2.4 earns a Grade 1 rating (S.G. Lee 1998).

Table 4.19: Distribution of Korean Air Conditioners by Energy Efficiency Grade, 1992-1997						
Year	Total models	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
1992	37	24	10	1	2	-
1997	281	183	78	20	-	-

Source: KEMCO

Samsung makes a high-efficiency air conditioner that is exported to the US market and that qualifies for rebate programs in New York State and Illinois. The company also exports 3- and 4-star models to Australia; 5-star models are not selling well there. Samsung reports that they make high-efficiency units for both domestic and export markets (B.M. Lee 1998).

4.10 Malaysia

The Malaysian domestic air conditioner market was about 400,000 units in 1997, but is expected be smaller in 1998. There are a few local manufacturers. O.Y.L. is a local firm with a major market share, which sells under the brand names Acson, York, and Mitsubishi, and also supplies OEMs in the US. O.Y.L. recently purchased McQuay in the US, will get access to the McQuay brand name and sales network (JARN 1998c).

Foreign makers also are active in Malaysia. Matsushita facilities have total production capacity of 1.8 million units per year. Hitachi and Carrier also have mass-production facilities.

Exports of window/wall air conditioning units are large and growing rapidly. The value of such exports rose from US$672 million in 1994 to US$1,328 million in 1996. The percentage of exports bound for APEC economies decreased from 79% in 1994 to 70% in 1996. The largest markets are Japan; Hong Kong, China; and Singapore. Together, these economies accounted for about 50% of exports.

Imports of window/wall units increased from US$20.9 million in 1994 to US$29.4 million in 1996. About 95% were imported from APEC economies. Japan; Thailand; and Hong Kong, China accounted for about 80% of imports in 1996.

Table 4.20: Malaysian trade flows of window/wall air conditioners, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	671.6	864.0	1,327.8
Exports to APEC only	533.1	646.9	933.4
Imports from world	20.9	29.4	29.4
Imports from APEC only	20.6	25.3	27.7

Source: UN Commodity Trade Statistics

4.11 Mexico

Of the 19 million households in Mexico, 3.1 million have air conditioners (Flores 1995). The local market is 120,000 units per year, the vast majority of which are produced by Carrier and York in factories at Monterey, Mexico (JARN 1998c).

From 1994 to 1996, exports of window/wall units ranged from US$36.1 million to US$50.1 million. About 95% were shipped to APEC economies, the vast majority to the US.

Due to the economic crisis in Mexico in 1995, imports of window/wall units fell to US$4.4 million, a decline of almost 80% from 1994. By 1996, imports recovered somewhat, rising to US$9.7 million. More than 90% of imports came from APEC economies. The US supplies more than 85% of the import market, with South Korea accounting for most of the remainder.

Table 4.21: Mexican trade flows of window/wall air conditioners, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	36.2	50.1	40.0
Exports to APEC only	35.2	47.7	37.0
Imports from world	21.1	4.4	9.7
Imports from APEC only	19.4	4.2	9.6

Source: UN Commodity Trade Statistics

Mexico has minimum energy performance standards for air conditioners. The standards and associated test procedures are very similar to those used in the US and Canada. The 1990 US MEPS for room air conditioners became effective in Mexico in 1996.

4.12 New Zealand

Due to the mild climate, the New Zealand market for air conditioning is quite small.

Exports of window/wall units amount to less than US$1 million per year. About 50% of 1996 exports were to Australia.

Imports of window/wall units have been increasing steadily, from US$1.9 million in 1994 to US$3.8 million in 1995 and US$4.8 million in 1996. More than 95% of exports were from APEC. Major suppliers are Japan, South Korea, and Thailand.

Table 4.22: New Zealand trade flows of window/wall air conditioners, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	0.8	0.5	0.8
Exports to APEC only	0.6	0.2	0.4
Imports from world	2.0	3.8	4.8
Imports from APEC only	1.9	3.6	4.8

Source: UN Commodity Trade Statistics

4.13 Philippines

Saturations in the Philippines remain quite low. There are 13 million households in the Philippines, of which 7.7 million are electrified. Among the "high usage" households served by the Manila electric utility, 12% own an air conditioner (IIEC 1998).

The size of the Philippines air conditioner market is estimated at 250,000 units per year. More than 80% of the market is window-type RACs, with the remainder made up by split-types. All are cooling only (JARN 1998a).

Table 4.23: Sales of Air Conditioners in the Philippines, 1994-1997				
	1994	1995	1996	1997
Room air conditioners	90,651	111,422	153,597	191,673
Split systems	5,714	8,357	12,815	17,579
Packaged air conditioners	7,311	9,060	12,643	16,146

Source: IIEC 1998

The Philippines air conditioner market is increasingly competitive, with several new entrants. There are a few local manufacturers such as Concepcion, ABB-Koppel, Alen, and Uni-Air. Concepcion is the top local maker. It produces RACs and PACs and sells them under three brand names— Condura, Carrier, and Kelvinator. Recently, Carrier started a JV with Concepcion, which should further strengthen Concepcion's market share (JARN 1998a).

Another top maker is Matsushita Electric-Philippines, which competes with Concepcion in the market for window units. Matsushita and Concepcion combined take 70% of the RAC market.

Besides Matshushita, other Japanese makers producing in the Philippines are Hitachi and Sharp. Hitachi has been producing PACs and recently began producing RACs. Sharp is reported to started local production of RACs in 98. In addition, Daikin launched a joint venture with Alen in April 1998. Korea's LG also is said to have launched local production (JARN 1998a).

Filipino exports of window/wall types are negligible. Exports declined from US$1.7 million in 1994 to US$890,000 in 1996, virtually all of which were sent to Hong Kong, China.

Imports of window/wall units rose dramatically form US$3.0 million in 1994 to US$11.3 million in 1996. About 90% of imports originate in APEC economies. Key sources are Korea, Thailand,

and China. According to JARN, overseas producers selling in the Philippines include LG (Korea), Samsung (Korea), Kolin (Chinese Taipei), Sampo (Chinese Taipei), and McQuay/O.Y.L. (Malaysia). It also appears that Gree of China is now selling in Philippines as well, and TECO of Chinese Taipei made its debut in the market in June 1998 (JARN 1998a).

Table 4.24: Philippines trade flows of window/wall air conditioners, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	1.7	1.4	0.9
Exports to APEC only	1.7	1.4	0.9
Imports from world	3.0	3.5	11.3
Imports from APEC only	2.8	3.5	9.2

Source: UN Commodity Trade Statistics

Mandatory energy efficiency testing and labeling for room air conditioners began in the Philippines in 1993. There are 56 certified models with a capacity of less than 12,000 kJ/h, of which 40 are locally manufactured and the rest imported. For larger capacity units, 45 models have been tested and labeled, of which 23 are imported. Most of the models tested had an EER of 9 or more (IIEC 1998).

In 1997, the efficiency standard was set at an EER of 8.3 for units with a capacity of 12,000kJ/h or less, and EER of 7.8 for larger capacity units. The Philippines government has announced that it will raise these standards over the next few years.

Table 4.25: Target EERs for Philippines Room Air Conditioners, 1997-2002

Cooling capacity	1997	1998	1999	2000	2001	2002
Below 12,000 kJ/hr	8.3	8.7	8.7	8.7	9.1	9.1
Above 12,000 kJ/hr	7.8	7.8	8.2	8.2	8.2	8.6

Source: FATL-DOE

4.14 Singapore

Rising affluence in Singapore has meant that increasing number of households are equipping their homes with air conditioning. Window units have been popular in the past, but mini-splits and central air-conditioning have become more popular (Cheng 1997).

Domestic air conditioning demand is about 150,000 units per year (JARN 1998c). The total market for air conditioning systems (including industrial and commercial as well as household) was about US$1,840 million in 1996, an increase from US$1,330 million in 1995 and US$969 million in 1994 (Cheng 1997). Key players in the Singaporean air conditioning market (includes commercial and industrial as well as household) are: Carrier, Whirlpool, York, Trane, Snyder General, Dunham-Bush, Fisher, Philco, Hussman Tempcool, Daikin, Sanyo, Toshiba, Hitachi, National, Mitsubishi, and Fujitsu General (Cheng 1997).

There is substantial local production of air conditioners as well as imports. Local production was valued at about US$500 million in 1996, rising from US$470 million in 1995 and US$420 million in 1994 (Cheng 1997).

Foreign brands, including Daikin, Sanyo, Toshiba, Mitsubishi, Carrier, and York, account for the majority of local production (Cheng 1997). The Sanyo plant alone has a production capacity of 400,000 units per year (JARN 1998c). The output of this plant is exported worldwide, under the Sanyo brand as well as that of GE and others.

Singaporean exports of window/wall units have been growing steadily, from US$228.2 million in 1994 to US$265.4 million in 1996. About 70% of exports are destined for APEC economies, principally the US and Hong Kong, China.

Imports of window/wall units declined from US$147.6 million in 1994 to US$127.3 million in 1995, then rose to US$194.2 million in 1996. The vast majority (98%) is imported from APEC economies. The US and Malaysia each take about 40% of the import market.

Table 4.26: Singapore's trade flows of window/wall air conditioners, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	228.2	258.5	265.4
Exports to APEC only	175.9	179.6	189.5
Imports from world	147.6	127.3	194.2
Imports from APEC only	146.5	124.9	188.6

Source: UN Commodity Trade Statistics

Singapore has no energy efficiency labeling program and no minimum energy performance standards. Window air conditioners of 9,000 BTU and above are required to have an EER of 8.0 or above, but there are no enforcement or verification schemes.

4.15 Chinese Taipei

Window type air conditioners predominate in Chinese Taipei, accounting for 65% of the RAC market. However, the split systems are becoming more prevalent (JARN 1998c).

The Chinese Taipei domestic market for RACs and PACs is estimated to be about 800,000 to 1 million units per year. Sales fluctuate with weather and economic conditions (JARN 1998c).

For the period 1995-1997, Chinese Taipei manufacturers produced about 1.6 million window and wall units per year. Annual production of unitary air conditioners is from 40,000 to 50,000 units. Teco is the leading maker. Other major RAC makers are Sampo, Matsushita, Hitachi, Kolin, and Sanyo. About 20 smaller manufacturers compete for remainder of market (JARN 1998c). Fedders said to have production facilities in Chinese Taipei.

Among Chinese Taipei air conditioner makers, Teco has been marketing worldwide for several years, and Sampo is working to strengthen its export strategy. Although Chinese Taipei itself is

minimally affected by the Asian recession, its exports have been seriously affected (JARN 1998c). Prior to the recession, Chinese Taipei's exports of window/wall air conditioner units ranged from 216,00 to 283,000 units per year. About 50-60% of exports were destined for APEC economies. The principal export market is Japan, which accounts for about 25% of exports. Other leading markets are Australia; Singapore; and Hong Kong, China.

Table 4.27: Chinese Taipei trade flows of window/wall air conditioners, 1995-1997
Millions of US$

	1995	1996	1997
Exports to world	66.5	93.9	85.4
Exports to APEC only	39.6	48.2	51.0
Imports from world	75.5	39.0	35.0
Imports from APEC only	73.1	38.0	33.0

Source: Calculated from Chinese Taipei Trade Statistics

Chinese Taipei reportedly has minimum energy efficiency standards for air conditioners. These standards were first established in 1981, and have been increased over the years. The standard currently requires an EER of 7.75 for window units and EER of 9.82 for packaged types. Chinese Taipei also is reportedly launching an energy efficiency labeling program for air conditioners.

4.16 Thailand

There are 3.4 air conditioners per 100 Thai households. The saturation is much higher in Bangkok, where 58 of every 100 households own an air conditioner. Prior to the economic crisis, saturations had been rising rapidly in recent years.

The Thai household air conditioner market is dominated by split systems, with window units accounting for only a small share of the market. The capacity of units commonly found in Thai households ranges from 9,000 to 36,000 BTU/hr (0.75 – 3 tons). The most popular sizes are between 1-1.5 tons (duPont 1996).

The local market was about 500,000 units in 1997, but is expected to be much less in 1998, due to the economic situation (JARN, May 1998). Major manufacturers are Mitsubishi Electric, Toshiba, Daikin MHI, Sharp, and Fujitsu General. Each has a production capacity of 400,000 to 800,000 units per year. Jointly with local capital, US companies Carrier and York produce and sell in Thailand. Samsung is said to have suspended plans to construct a RAC plant in Thailand due to the Asian economic situation.

In addition, there are more than 50 local Thai manufacturers, many of them small. Some leading local makers are producing RACs and PACs for overseas OEMs. Among well-known domestic makers are Unifab, Setpoint, and Bandor. Air conditioner production in Thailand consists mostly of assembly from locally produced components, however compressors are imported for larger units (duPont 1996).

Exports of window/wall units rose from US$244 million in 1994 to US$312 million in 1995. (Data from 1996 is not yet available). From 55% to 60% of exports are headed for APEC economies, mostly Japan; Hong Kong, China; Singapore; and Australia.

Imports of window/wall units are about US$3.7 million per year. APEC economies, notably Japan and Malaysia, supply 60-80% of imports.

Table 4.28: Thailand's trade flows of window/wall air conditioners, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	244.2	312.1	N. Av.
Exports to APEC only	133.7	183.9	N. Av.
Imports from world	3.6	3.7	N. Av.
Imports from APEC only	2.2	3.1	N. Av.

Source: UN Commodity Trade Statistics

Thailand has a voluntary energy efficiency labeling program for air conditioners, and has been considering the establishment of a minimum energy performance standard. Energy efficiency testing for the labeling program began in late 1995. Air conditioners produced by MNCs were found to be the most energy-efficient. Those firms launched promotional campaigns touting the advantages of energy efficiency, and chose to label only those units achieving the highest energy efficiency rating of 5. A rating of 4 was not deemed sufficient to provide an advantage in marketing.

IIEC reports that a survey of 208 models available in the market ranged in energy efficiency from 5.7 to 13.2 BTU/W, with an average of 7.3 BTU/W.

4.17 United States

More than 30% of households in the US own a window air conditioner. The saturation declined slightly to 31% in 1996 from a high of 33% in 1994 and 1995. Saturation levels for unitary air conditioners are higher, reaching 46% in 1996 (Appliance 1997b). Window units and ducted systems predominate in the US air conditioning market; demand for ductless splits is negligible.

Between 3 million and 5 million window air conditioners are sold each year in the US. Sales of ducted units are 4-6 million units per year (JARN 1998c). Three makers—Fedders, Electrolux/Frigidaire, and Whirlpool—account for 70% of sales in the US RAC market. The market is largely a replacement one, with projected replacement sales for room air conditioners of 2.8 million units in 1997 and 3.8 million units in 1998, based on an average unit life expectancy of 11 years (Appliance 1997a).

Domestic shipments of RACs totaled 4.12 million units in 1997, down from 4.82 million units in 1996. The decline was attributed to a cool summer in many parts of the country. Fedders and Friedrich are engaged in mass production of RACs within the US, with Fedders said to be

producing a little over 1 million units per year. Many others receive product supply from Southeast Asia to be sold under their own brands (JARN 1998c).

US exports of window/wall air conditioners have been growing in recent years. The value of exports rose from US$92.2 million in 1994 to US$131.7 million in 1995, but fell back to US$126.4 million in 1996. Between 40% and 50% of these exports were headed for APEC economies. Canada is a major and growing export market for the US, accounting for more than 30% of room air conditioner exports in 1996. Mexico and Hong Kong, China each accounted for another 5% of export sales in 1996.

Imports of window/wall units have been rising rapidly, from US$265.9 million in 1994 to US$374.5 million in 1996. About 85% of these imports originate in APEC economies. Leading sources are Singapore, South Korea, and Malaysia, which together take more than 60% of the market.

Table 4.29: US trade flows of window/wall air conditioners, 1994-1996

Millions of US$

	1994	1995	1996
Exports to world	92.2	131.7	126.4
Exports to APEC only	41.2	55.1	62.8
Imports from world	265.9	334.5	374.5
Imports from APEC only	232.1	286.1	321.0

Source: UN Commodity Trade Statistics

Minimum energy performance standard for room air conditioners came into effect in the US in January 1990. The current standards require EERs in the range of 8.0-9.0 BTU/hr/W, depending on the size and design of the unit. New air conditioner energy efficiency standards are to come into effect on 1 October, 2000. These standards will require EERs for window units of 9.7-9.8 for most window units, with the exception of the largest capacity units (20,000 BTU/hr and over), which will be required to have an EER of 8.5 or better.

The US Association of Home Appliance Manufacturers (AHAM) has reported on its Web site shipment-weighted data on the energy efficiency of US appliances. The data shows that the share of air conditioners with EERs of 9.5 or better has increased by more than five-fold between 1988 and 1996.

Table 4.30: Energy Efficiency Trends of US Room Air Conditioners, 1988-1996 (Shipment-weighted averages)			
Year	Capacity (BTU/hr)	Energy consumption (kWh per 750 hours of operation)	EER
1988	10,036	915	8.23
1990	10,034	862	8.73
1992	10,100	853	8.88
1994	10,087	843	8.97
1996	9,928	820	9.08

Source: AHAM

Table 4.31: Distribution of Energy Efficiency Ratings in US Room Air Conditioner Market, 1988-1996			
Year	% of Domestic Shipments by EER Classification		
	Less than 8.5 EER	8.5-9.4 EER	9.5 EER and above
1988	52.9	40.8	6.3
1990	28.9	58.3	12.8
1992	24.6	58.1	17.3
1994	24.1	50.9	25.0
1996	16.0	49.3	34.7

Source: AHAM

5. TRADE FLOWS AND ENERGY EFFICIENCY OF FLUORESCENT LIGHTING IN THE APEC REGIONAL MARKET

5.1 Overview of the Global and Regional Market

A fluorescent lamp is a pre-heated, low-pressure mercury vaporized electric discharge lamp. Ordinary fluorescent lamps are available as straight or circular tubes. Compact fluorescent lamps (CFLs) can serve as an energy-efficient alternative for many lighting applications otherwise served by incandescent bulbs.

Fluorescent lamp ballasts work as a controller to make the lamp discharge and generate ultraviolet radiation, which is transformed into visible light via the phosphor powder coated on the interior wall of the glass tube. There are two general types of ballasts: magnetic and electronic. Electronic ballasts are more energy-efficient but more expensive. Also, poorly manufactured electronic ballasts may be less reliable than magnetic ballasts. Low-loss magnetic ballasts have been developed that are more efficient than ordinary magnetic ballasts, but less efficient than electronic ballasts. The price of low-loss magnetic ballasts is intermediate as well.

Trade data classified according to the SITC system combines fluorescent lamps and other types of discharge lamps into one category. Analysis of this data shows that global trade in discharge lamps, including fluorescent lamps, rose from about US$2,000 million in 1994 to US$2,400 million in 1996.

APEC economies exported discharge lamps valued at a total of US$698 million in 1996. This represented an increase of 2% over 1995, which in turn was an 18% increase over 1994. About 70% of APEC exports of discharge lamps are sold to other APEC economies.

Total imports of discharge lamps by APEC economies were valued at US$918 million in 1996. The value of imports rose 15% from 1994 to 1995, and 12% from 1995-1996. About 65% of total imports by APEC economies came from other APEC economies.

Table 5.1: Trade flows of discharge lamps in APEC region, 1994-1996
Millions of US$

	1994	1995	1996
Total global exports	1,882.3	2,374.9	2,460.3
APEC exports to world	576.2	684.3	697.8
APEC exports to APEC only	407.9	476.2	499.7
Total global imports	2,014.0	2,327.6	2,328.0
APEC imports from world	710.0	818.2	918.2
APEC imports from APEC only	478.0	533.8	582.6

Source: UN Commodity Trade Statistics and Chinese Taipei Trade Statistics. Note that 1996 global statistics are incomplete.
Note: Chinese Taipei statistics not available for 1995 and 1996

The Harmonized System provides a separate category for fluorescent lamps, but HS data is available from the UN system for only one year (1996). This data indicates that global trade in fluorescent lamps in 1996 was valued at about US$1,200 million. Exports of fluorescent lamps from APEC economies only totaled US$398 million. Of this amount, about 70% were exports destined for other APEC economies. Comparison of 1996 HS data for fluorescent lamps and 1996 SITC data for discharge lamps indicates that fluorescent lamps make up about 60-70% of the larger category.

Global sales of CFLs rose to 350 million units in 1997, about a 25% increase over 1996. About 60% of these were self-ballasted integral units and the remainder were modular (pin-base) units. Large and growing production capacity in Asia is depressing prices of CFLs. The entry of new manufacturers into the market raises questions of quality and reliability of CFLs (Borg 1997).

Table 5.2: World Sales of Compact Fluorescent Lamps, 1994-1997
(millions of units)

	1994	1995	1996	1997
North America (excl. Mexico)	55.0	61.5	65.0	70.0
Latin America (incl. Mexico)	5.5	8.5	10.0	12.0
Western Europe	76.5	85.0	95.0	110.0
Eastern Europe	3.0	5.5	7.5	10.0
Japan	25.0	30.0	35.0	40.0
China	7.0	9.0	15.0	37.0
Asia-Pacific (excl. China and Japan)	27.5	37.0	50.0	65.5
Rest of world	6.0	7.5	9.0	12.0
Total	205.5	244.0	286.5	356.0

Source: Borg 1997

Global trade in ballasts for discharge lamps was valued at about US$1,300 million in 1996. Total exports of discharge lamp ballasts from APEC economies were valued at US$717 million in 1996. The value of APEC exports rose 45% from 1994-95 and 25% from 1995-1996. About 90% of ballasts exported from APEC economies were destined for other APEC economies.

Imports of ballasts by APEC economies totaled US$776 million in 1996. The value of such imports rose 38% from 1994 to 1995, and 10% from 1995-1996. Imports from one APEC economy into another account for 85% of total imports.

Table 5.3: Trade flows of discharge lamp ballasts in APEC region, 1994-1996 Millions of US$			
	1994*	1995	1996
Total global exports	763.1	1,069.7	1,303.3
APEC exports to world	351.0	581.1	717.7
APEC exports to APEC only	312.3	526.3	649.1
Total global imports	903.5	1,137.2	1,243.5
APEC imports from world	504.1	706.3	751.5
APEC imports from APEC only	470.4	593.0	648.3

Source: UN Commodity Trade Statistics and Chinese Taipei Trade Statistics. Note that 1996 global statistics are incomplete. *Data not available from Chinese Taipei

5.2 Australia

Australia has one factory for producing fluorescent lamps. This facility makes only halophosphor lamps; triphosphor lamps are all imported. Leading APEC import sources of discharge lamps are Japan and the United States.

Table 5.4: Australian trade flows of discharge lamps, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	1.9	1.8	1.4
Exports to APEC only	1.4	1.5	1.2
Imports from world	35.9	41.0	42.5
Imports from APEC only	19.0	21.0	21.1

Source: UN Commodity Trade Statistics

There is one major ballast producer in Australia, which exports its products as well as selling them locally. This producer is capable of producing low-loss ballasts, but is waiting for the Australian government to strengthen the market for energy-efficient ballasts by enacting a minimum energy performance standard (Cogan 1998). Key APEC export markets for Australian ballasts are Singapore and Hong Kong, China.

Table 5.5: Australian trade flows of discharge lamp ballasts, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	24.9	20.9	18.8
Exports to APEC only	17.9	14.8	14.3
Imports from world	2.4	3.8	4.7
Imports from APEC only	0.3	0.5	1.1

Source: UN Commodity Trade Statistics

Australia is considering establishing a minimum energy performance standard for fluorescent lamp ballasts (Cogan 1998).

5.3 Canada

In the North American market, including the US and Canada but excluding Mexico, CFL sales grew by 6-8% per year in 1996 and 1997, a fall from the 10% annual growth of 1994 and 1995. Modular units outsell integral lamps by 20% (Borg 1997).

Table 5.6: Canadian trade flows of discharge lamps, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	15.0	33.6	43.2
Exports to APEC only	14.8	32.4	42.7
Imports from world	69.5	74.9	74.4
Imports from APEC only	64.2	68.4	66.8

Source: UN Commodity Trade Statistics

Table 5.7: Canadian trade flows of discharge lamp ballasts, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	10.9	12.5	17.8
Exports to APEC only	10.6	12.3	17.1
Imports from world	58.0	72.0	65.0
Imports from APEC only	57.3	71.6	63.1

Source: UN Commodity Trade Statistics

Canada has adopted US minimum energy efficiency standards for fluorescent lamps. Canada has also established minimum energy performance standards for fluorescent lamp ballasts.

5.4 Chile

The Chilean lighting market is estimated to be worth US$25 million annually. Philips and GE are the market leaders, and Philips in particular is aggressively pursuing the market for energy-efficient lighting in Chile. Other players in the market are Osram-Sylvania, local importer Rolec, and imports from Asia (Lord 1995).

Five million fluorescent lamps are sold in Chile annually. About 90% of these are domestically produced. T12, 40 W or 20W, is the most common lamp size. Philips introduced the more energy-efficient T10 lamp, 36W and 18W, in 1981, and is now producing T10s locally. As of 1995, Philips said that 30% of its sales were T10.

Chilean sales of CFLs reached 200,000 units in 1994, valued at more than US$2 million. Sales growth was rapid in the mid-1990s due to heavy promotion.

Chile exports 2 million fluorescent lamps annually. Philips exports T10 and T12 lamps to the US. Specialty lamps are imported into Chile, while high-volume items are produced locally.

Table 5.8: Chilean trade flows of discharge lamps, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	3.7	4.3	5.3
Exports to APEC only	1.6	1.5	1.6
Imports from world	5.8	6.3	7.9
Imports from APEC only	1.9	2.3	2.6

Source: UN Commodity Trade Statistics

Two million fluorescent lamp ballasts, valued at US$5 million, are sold annually. Most are magnetic ballasts for 40W and 20W fluorescent lamps. GE and Philips use both imported and locally produced ballasts. As of 1995, there was no local production of electronic ballasts in Chile, although Philips had targeted Chile for expanded imports of electronic ballasts.

Table 5.9: Chilean trade flows of discharge lamp ballasts, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	0.1	0.1	0.05
Exports to APEC only	-	-	-
Imports from world	1.5	2.2	2.7
Imports from APEC only	0.8	0.9	1.4

Source: UN Commodity Trade Statistics

5.5 China

According to the Chinese Association of Lighting Industry (CALI), the annual output of the Chinese lighting industry is 6,000 million units, making China the largest producer in the world. As recently as 1993, annual production was estimated at 3.6 billion lamps. Lamp production has been growing by about 15% per year in recent years (Guan and Mills 1995).

Historically, illumination levels have been lower in China than equivalent levels in Europe or North America. However, lighting designers are increasingly using internationally recommended levels of illumination, and the gap is closing. This means that lighting growth is likely to be faster than economic growth generally.

There are about 600 lamp factories in China. Approximately 60% of lamp production is incandescent. Production of linear fluorescent lamps was about 250 million units in 1993 (7% of market). Of this number, 10 million were T8, 1 million with triphosphors. Exports of fluorescent

lamps totaled 70 million in 1993 (Guan and Mills 1995). In 1994, T8 production was 5 million units, 4 million with halophosphors and 1 million with triphosphors.

In the current market, 30% of fluorescent straight-tube lamps are T12, 60% are T10 or T9, and 10% are T8. T8 lamps are projected to take increasing market share, maybe as much as 30% by 2000, although this is optimistic (Chen 1998). Mr Chen of CALI predicts that fluorescent lamps will capture one-sixth of the total market by 2000.

Several JVs, including GE, Philips, Osram, and Matsushita, are producing straight-tube fluorescent lamps in China. JVs account for 10% of sales, while domestic producers take 90% of the market. JVs are producing T8 and T10 lamps; T9s are imported from Chinese Taipei (Chen 1998). In addition to these JVs with the large, global lighting companies, there are also many JVs between local producers and small and medium overseas companies, mostly from Chinese Taipei and Hong Kong, China.

Chinese production of CFLs grew rapidly in the mid-1990s, from 38 million units in 1993 to 60 million units in 1994 and 100 million units in 1995. CALI estimates that 100 million CFLs were sold in 1997. Integral lamps make up about 90% of production (Borg 1997). Production capacity for CFLs may be as high as 300 million units. There are several JVs producing CFLs in China, including Philips, Osram, Matsushita, and Toshiba (Chen 1998). Estimates of the total number of CFL producers currently manufacturing in China range from 300 to 1,000.

About 50-60% of Chinese CFL production is exported. In particular, JVs are producing largely for the export market, with 20 million units exported in 1995. The highest quality lamps are exported to markets where consumers are able to pay top prices.

Quality is a significant concern in the Chinese lighting market. Some of the Chinese producers of CFLs have a reputation for poor quality. In recent years, only 20-30% of the lamps produced in China met international quality standards. The service life of some Chinese CFLs range from 1,000-3,000 hours, versus 5,000-20,000 hours for CFLs made in the West. Output is 25-40 lumens per watt, versus 40-100 lumens per watt in the West. (Guan and Mills 1994).

However, some local producers have raised the quality of their output. According to Mr Chen of CALI, Philips and GE purchased 12-20 million CFLs from independent producers in 1997 to be sold under their own labels. In addition, the Chinese government is discussing whether to raise performance standards for fluorescent lamps to require 5,000 hours of service life, and perhaps requiring a minimum output (lumens/watt) as well.

Table 5.10: Chinese trade flows of discharge lamps, 1994-1996

Millions of US$

	1994	1995	1996
Exports to world	40.7	69.6	77.2
Exports to APEC only	26.7	42.2	48.7
Imports from world	16.1	15.8	22.8
Imports from APEC only	13.2	12.8	17.1

Source: UN Commodity Trade Statistics

There are 200-300 producers of magnetic ballasts for fluorescent lamps in China, and 10 major producers of electronic ballasts. Ballast production is 110 million per year, of which 80 million are magnetic ballasts and the rest are electronic. The proportion of electronic ballasts has increased from 1% in 1990 to 27% in 1997 (Electric Light Source Committee 1998). There is no reliable data on the production of low-loss magnetic ballasts.

Table 5.11: Ballast Production in China, 1994-1997

Millions of units

Year	Ballasts for fluorescent lamps		Ballasts for CFLs
	Magnetic	Electronic	Magnetic
1994	47.50	17.30	7.30
1995	52.70	20.00	8.10
1996	58.50	25.00	9.00
1997	65.00	30.00	10.00

Source: Electric Light Source Committee

Note: As electronic ballasts for CFLs are integral to the lamp, output of this type of ballast is not reported here. Ballast output for HIDs is minimal and not reported here.

Total exports of ballasts were estimated at 70 million units in 1997 (Electric Light Source Committee 1998). Philips and Osram are thought to be exporting about 90% of the 5-6 million electronic ballasts they produce yearly.

Table 5.12: Chinese trade flows of discharge lamp ballasts, 1994-1996

Millions of US$

	1994	1995	1996
Exports to world	31.1	106.1	141.7
Exports to APEC only	25.3	90.0	119.1
Imports from world	4.3	5.8	12.6
Imports from APEC only	3.4	4.2	7.1

Source: UN Commodity Trade Statistics

5.6 Hong Kong, China

Hong Kong, China imports about US$125 million worth of discharge lamps annually. Leading APEC sources of imported lamps are China, Thailand, and Japan. Hong Kong, China also re-exports considerable volumes of discharge lamps, with China and Indonesia as the principal destinations.

Table 5.13: Hong Kong, China trade flows of discharge lamps, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	9.0	5.7	4.0
Exports to APEC only	5.8	4.6	3.3
Imports from world	93.7	121.5	124.2
Imports from APEC only	79.7	101.0	101.2
Reexports to world	59.8	75.5	82.6
Reexports to APEC only	32.0	38.7	37.9

Source: UN Commodity Trade Statistics

Hong Kong, China is developing an energy efficiency labeling program for compact fluorescent lamps. Launch of the program is anticipated in late 1998.

Imported ballasts for discharge lamps are obtained principally from China and Australia. Hong Kong, China re-exports a large volume of ballasts, with most of this trade destined for the United States, Mexico, China, and Indonesia.

Table 5.14: Hong Kong, China trade flows of discharge lamp ballasts, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	2.0	1.4	1.7
Exports to APEC only	1.4	1.2	1.3
Imports from world	14.4	38.4	53.1
Imports from APEC only	13.0	36.1	50.2
Reexports to world	12.4	35.8	48.2
Reexports to APEC only	9.7	22.6	35.9

Source: UN Commodity Trade Statistics

5.7 Indonesia

Domestic sales of electric light bulbs was US$117 million in 1996, a 17% increase over 1995 (Jusuf 1997). Sales of fluorescent lamps in 1993 were 16 million, accounting for only 5% of total lamp sales (Opheim and duPont 1995).

Indonesian production of fluorescent lamps has been rapidly escalating. Production in the early 1990s was reported to be about 55 million lamps per year (Opheim and duPont 1995). This figure rose to 158 million in 1994 to 167 million in 1995 and 180 million in 1996 (Yusuf 1997). The largest producer is an Indonesian JV with Matsushita, which produced an estimated 47 million units in 1997. GE and Philips each produce 40 million per year. Philips is reported to be manufacturing energy-efficient T8 lamps in Indonesia, with production expanding to 18 million units per year as the mid-1990s.

CFL sales expanded quickly in the mid-1990s, with annual growth rates of 30-40%. Sales reached 4 million lamps per year by 1995. Philips has 40% of market, and Chinese brands take another 40%. The remaining 20% is dominated by Japanese brands.

A total of 46 million fluorescent lamps were exported from Indonesia in 1993. Export growth rates averaged 26% annually in the early 1990s. Imports made up 6% of Indonesia's total lamp supply in 1993. About 6.4 million fluorescent lamps were imported.

Table 5.15: Indonesian trade flows of discharge lamps, 1994-1996

Millions of US$

	1994	1995	1996
Exports to world	14.2	15.2	21.6
Exports to APEC only	4.9	4.5	6.9
Imports from world	14.5	17.6	21.5
Imports from APEC only	5.6	5.9	12.8

Source: UN Commodity Trade Statistics

As of 1995, an Indonesian market for energy-efficient ballasts, including electronic and low-loss magnetic ballasts, was just beginning to emerge. Electronic ballasts produced locally or imported from Chinese Taipei were found to consume 10-15% more energy than high-end versions from the US and Europe. In 1995, ETTA Industries of the US entered into a JV agreement with an Indonesian firm to produce electronic ballasts and controls. Production was anticipated to be 50,000 units per month.

Table 5.16: Indonesian trade flows of discharge lamp ballasts, 1994-1996

Millions of US$

	1994	1995	1996
Exports to world	4.5	4.7	6.8
Exports to APEC only	4.5	4.2	4.0
Imports from world	4.9	9.1	7.8
Imports from APEC only	2.7	6.3	5.4

Source: UN Commodity Trade Statistics

5.8 Japan

Total CFL sales reached 40 million units in 1997. Growth rates are slowing, from 20% per year in 1994 to 15% in 1997. The sales gap between integral and pin-base lamps closed to about 20% in 1997 (Borg 1997).

Japan has target efficiency values for fluorescent lamps to be met by 2000. The target value is 62 lumens per watt for residential lighting and 75 lumens per watt for commercial and public lighting.

Table 5.17: Japanese trade flows of discharge lamps, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	188.6	221.6	223.7
Exports to APEC only	125.9	143.1	156.0
Imports from world	52.9	43.5	57.3
Imports from APEC only	44.2	29.9	32.3

Source: UN Commodity Trade Statistics

Table 5.18: Japanese trade flows of discharge lamp ballasts, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	12.0	19.1	20.6
Exports to APEC only	6.2	13.0	14.5
Imports from world	6.0	6.7	10.9
Imports from APEC only	5.6	5.0	7.4

Source: UN Commodity Trade Statistics

5.9 Korea

Osram leads the market in Korea, with a 12-18% share. T10 is the dominant size of fluorescent lamp in Korea, with Osram producing 10 million T10 lamps per year. Osram is introducing T8 in Korea, with lamps imported from Germany. T8 lamps make up 3-5% of the Korean market.

Osram produces 3 lines of CFLs in Korea. Current production is 7-8 million units per year, with capacity for 6 million more. Osram-Korea supplies Osram/Sylvania-US with 1 million CFLs per year, and also exports to Japan, Malaysia, and Indonesia (Bierbrauer 1998).

Table 5.19: Korean trade flows of discharge lamps, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	13.9	18.9	19.2
Exports to APEC only	10.0	12.1	12.1
Imports from world	30.9	46.8	56.7
Imports from APEC only	23.5	36.0	40.9

Source: UN Commodity Trade Statistics

Korean energy performance standards for fluorescent lamps went into effect in 1994 and were upgraded in January 1996. Minimum energy efficiency values (as of January 1997) and target levels (to be achieved by the end of 1998) are shown below.

Table 5.20: Korean Energy Efficiency Standards for Fluorescent Lamps			
Type	Watts	Minimum (lm/W)	Target (lm/W)
Straight tube	20	58	72
Straight tube	40	70	85
Circular	30	52	68

Source: S.G. Lee 1998

Lamps achieving the target value are given Grade 1. Lamps that are within 10% of the target are Grade 2; between 10% and 20% of the target value is Grade 3. Lamps that achieve only the minimum standard currently are classified as Grade 4. The share of fluorescent bulbs falling into highest energy efficiency grade increased from 11% in 1992 to 30% in 1997.

Table 5.21: Distribution of Korean fluorescent lamp models by energy efficiency rating, 1992-1997						
Year	Total Models	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
1992	88	10	29	25	11	88
1997	174	40	61	64	9	-

Source: KEMCO 1998

Korean sales of fluorescent lamp ballasts rose from a value of 110,000 million won in 1995 to 135,000 million won in 1997. Production increased from 131,000 million won in 1995 to 154,000 million won in 1997.

Table 5.22: Korean trade flows of discharge lamp ballasts, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	16.5	30.0	30.8
Exports to APEC only	15.9	29.7	29.9
Imports from world	4.4	3.5	4.0
Imports from APEC only	3.5	2.9	3.3

Source: UN Commodity Trade Statistics

Korean energy performance standards for fluorescent lamp ballasts went into effect in January 1995. Minimum and target efficiency values are given below.

Table 5.23: Korean energy efficiency standards for discharge lamp ballasts			
Type	Watts	Minimum efficiency	Target efficiency
Straight tube	20	0.92	1.15
Straight tube	40	0.97	1.18
Circular	30	0.97	1.15

Source: S.G. Lee 1998

Note: Efficiency is defined as the measured ballast efficiency compared to a reference ballast efficiency.

The share of Korean ballast models qualifying for energy efficiency Grade 2 increased from 22% in 1992 to 33% in 1997. (No models qualified for Grade 1.)

Table 5.24: Distribution of Korean ballast models by energy efficiency rating, 1992-1997

Year	Total Models	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
1992	216	-	47	57	21	91
1997	388	-	129	176	68	15

Source: KEMCO

5.10 Malaysia

Malaysia imports more than US$50 million worth of discharge lamps annually. Leading APEC sources of imported lamps are Japan, Singapore, and China.

Table 5.25: Malaysian trade flows of discharge lamps, 1994-1996

Millions of US$

	1994	1995	1996
Exports to world	1.8	4.2	1.2
Exports to APEC only	1.7	3.8	0.9
Imports from world	23.0	25.5	56.7
Imports from APEC only	11.0	10.8	27.5

Source: UN Commodity Trade Statistics

Malaysian exports of ballasts for discharge lamps from 1994 to 1996 were small but growing. The leading APEC export market was Singapore. Major APEC sources of imported ballasts were Australia, Singapore, Japan, and Korea.

Table 5.26: Malaysian trade flows of discharge lamp ballasts, 1994-1996

Millions of US$

	1994	1995	1996
Exports to world	2.6	4.0	6.7
Exports to APEC only	1.9	3.0	6.3
Imports from world	4.5	4.2	8.0
Imports from APEC only	3.5	3.0	5.7

Source: UN Commodity Trade Statistics

5.11 Mexico

Mexican exports of discharge lamps grew to almost US$60 million in 1996. The vast majority of Mexican trade in discharge lamps was with the United States.

Table 5.27: Mexican trade flows of discharge lamps, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	47.3	54.4	59.0
Exports to APEC only	44.4	50.8	56.3
Imports from world	47.6	42.9	58.6
Imports from APEC only	44.0	37.6	47.8

Source: UN Commodity Trade Statistics

Mexico's exports of ballasts for discharge lamps are considerable, with most of this trade conducted with the United States.

Table 5.28: Mexican trade flows of discharge lamp ballasts, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	167.7	257.2	334.1
Exports to APEC only	167.5	257.0	333.1
Imports from world	20.1	18.9	42.6
Imports from APEC only	16.6	18.4	42.4

Source: UN Commodity Trade Statistics

Mexico is the process of developing minimum energy efficiency standards for CFLs.

5.12 New Zealand

Fluorescent lamps are no longer manufactured in New Zealand. Production lines were not up to international standards and were closed. The CFL market is not well developed due to low electricity prices and lack of purpose-built fixtures for CFLs. New Zealand imports ballasts from Australia (Cogan 1998).

Table 5.29: New Zealand trade flows of discharge lamps, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	0.2	0.2	0.2
Exports to APEC only	0.1	0.1	0.1
Imports from world	8.4	8.8	8.4
Imports from APEC only	3.5	3.3	3.2

Source: UN Commodity Trade Statistics

Table 5.30: New Zealand trade flows of discharge lamp ballasts, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	0.1	0.2	0.2
Exports to APEC only	0.1	0.1	0.1
Imports from world	3.0	4.3	3.3
Imports from APEC only	2.5	0.5	2.3

Source: UN Commodity Trade Statistics

New Zealand is considering establishment of energy efficiency performance standards for both fluorescent lamps and ballasts (Cogan 1998).

5.13 Philippines

Fluorescent lamps take a larger market share in the Philippines than incandescent lamps. However, only a small number of CFLs are sold.

GE and Philips are the main producers for local consumption and exports. Philips has production capacity of 6.2 million units of fluorescent lamps. There is no local production of energy-efficient lamps, which are imported by Philips, GE, Hitachi, National, Sylvania, and others.

The Philippines government is planning a program to promote use of energy-efficient lighting. This program will include testing of CFLs for reliability, and may include reduction of import duty on CFLs (IIEC 1998).

Table 5.31: Philippines trade flows of discharge lamps, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	0.9	0.3	0.2
Exports to APEC only	0.8	0.2	0.2
Imports from world	7.1	7.4	11.6
Imports from APEC only	3.7	3.0	6.6

Source: UN Commodity Trade Statistics

The Philippines government is developing a voluntary labeling program for fluorescent lamp ballasts. The program will involve affixing a label containing information on wattage loss.

Table 5.32: Philippines trade flows of discharge lamp ballasts, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	0.2	0.2	7.5
Exports to APEC only	-	0.2	0.3
Imports from world	5.2	5.2	7.4
Imports from APEC only	3.0	2.7	3.3

Source: UN Commodity Trade Statistics

5.14 Singapore

Singapore is both an active importer and exports of discharge lamps. Leading APEC export markets are Malaysia and Japan, while most imports are obtained from Japan and the United States.

Table 5.33: Singapore trade flows of discharge lamps, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	36.5	60.4	56.7
Exports to APEC only	26.9	48.6	48.4
Imports from world	43.4	50.8	46.3
Imports from APEC only	24.3	26.6	25.5

Source: UN Commodity Trade Statistics

Principal APEC sources for Singapore's imported ballasts for discharge lamps are Australia and Malaysia.

Table 5.34: Singapore trade flows of discharge lamp ballasts, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	5.4	5.3	4.5
Exports to APEC only	4.5	4.6	3.4
Imports from world	16.5	20.7	24.4
Imports from APEC only	11.4	12.2	15.4

Source: UN Commodity Trade Statistics

5.15 Chinese Taipei

The market in Chinese Taipei for straight-tube fluorescent lamps is 60 million per year. An equal number of incandescent bulbs are sold. There are two domestic producers of fluorescent lamps, China Electric and Taiwan Fluorescent. Together these two producers account for 90% of sales.

The most common size for fluorescent lamps is T9 and T10, which make up 90% of the market. T12 lamps have been phased out of the market, and T8s take less than 1% of the market. Osram, Philips, GE and some Japanese makers are importing T8 lamps.

The market for CFLs in Chinese Taipei is 8 million lamps per year. Osram and Philips each take 20% of the market. GE accounts for another 10-15%. Several Japanese brands, including National, Mitsubishi, and Hitachi, make up a further 10%. The remainder is local producers and imports from the PRC. The quality of some locally produced lamps and some lamps imported from the PRC is not up to international standards (Brennhausen 1998)

The market for fluorescent lamp ballasts is 18 million units per year, with a value of US$100 million. Electronic ballasts make up 10% of this market (Liu 1998b). There are 44 ballast manufacturers on the island. China Electric produces 400,000 magnetic ballasts per month, or about 40% of total production.

Early attempts at manufacture of electronic ballasts in Chinese Taipei failed due to technical problems. Recently, China Electric and Mitsubishi formed a JV to manufacture electronic ballasts. The JV began operations in early 1998, and planned output is 50,000 units per month (Liu 1998b). Two new laboratories for testing electronic lighting components, including ballasts, have been established in Chinese Taipei.

Exports of ballasts declined from US$41 million in 1995 to US$31 million in 1997. The US is the principal export market, accounting for about 90% of exports. Imports of ballasts rose from US$6.3 million in 1995 to US$7.6 million in 1997. Australia is the leading source, taking about 60% of market.

Table 5.35: Chinese Taipei trade flows of discharge lamp ballasts, 1994-1996
Millions of US$

	1995	1996	1997
Exports to world	41.0	32.0	31.3
Exports to APEC only	40.8	30.5	29.4
Imports from world	6.3	6.0	7.6
Imports from APEC only	4.9	2.9	5.3

Source: Chinese Taipei Trade Statistics

Chinese Taipei has been reported to have minimum energy performance standard for fluorescent lamp ballasts. However, no information on these requirements could be obtained for this report.

5.16 Thailand

The Thai market for fluorescent lamps is increasing at an estimated 25% per year. 1991 production was 40 million fluorescent tubes, with 35 million destined for local consumption (duPont 1996).

T12 is the most common size of fluorescent lamp in Thailand, and T8 and T10 are both available. About half the lamps sold are 40W and half are 20W. Philips and Thai Toshiba each take about one-third of the market.

Philips began producing T8 lamps (18W and 38W) in 1991 and has stopped producing 20W and 40W. Their production of T8s reached 19 million in 1994. In September 1993, the Thai government signed agreement with lamp manufacturers to convert all production to T8 by the end of 1995.

Thailand imported 5.9 million fluorescent lamps in 1993. Exports skyrocketed from 4.9 million in 1990 to 309 million in 1993.

The Thai market for CFLs has also experienced rapid growth. Sales in 1990 reached 500,000 units, an annual growth rate of 40%. Modular units accounted for 60-70% of sales. Philips, with the largest share of sales, began local assembly in 1992 from imported components.

Table 5.36: Thailand trade flows of discharge lamps, 1994-1996

Millions of US$

	1994	1995	1996
Exports to world	30.2	37.5	N Av
Exports to APEC only	21.9	25.8	N Av
Imports from world	14.1	25.6	N Av
Imports from APEC only	7.2	10.3	N Av

Source: UN Commodity Trade Statistics

Thai production of fluorescent lamp ballasts was 10-12 million units in 1990. The vast majority of these (99%) are magnetic, and almost all are low-power-factor units. Low-loss magnetic ballasts were just beginning to enter the market as of the mid-1990s. Production capacity for low-loss ballasts is 300,000 per year. Thailand imported 1.43 million ballasts in 1993, and exported 1.26 million.

The Thailand Industrial Standards Institute tests magnetic ballasts. Electronic ballasts not required to be tested as of the mid 1990s.

Table 5.37: Thailand trade flows of discharge lamp ballasts, 1994-1996

Millions of US$

	1994	1995	1996
Exports to world	4.2	3.9	N Av
Exports to APEC only	1.0	1.0	N Av
Imports from world	8.6	8.8	N Av
Imports from APEC only	5.7	6.3	N Av

Source: UN Commodity Trade Statistics

5.17 United States

Exports of discharge lamps climbed to US$185 million in 1996, of which about 65% were headed to APEC economies, mostly Canada and Mexico. Imports exceeded US$310 million in 1996, of which about 60% originated in APEC economies. Key APEC suppliers were Mexico, Canada, and Japan, which together made up about 55% of imports.

Table 5.38: US trade flows of discharge lamps, 1994-1996

Millions of US$

	1994	1995	1996
Exports to world	172.3	166.5	184.9
Exports to APEC only	121.1	105.0	121.4
Imports from world	245.2	289.7	310.6
Imports from APEC only	132.4	164.7	177.3

Source: UN Commodity Trade Statistics

Minimum energy performance standards for fluorescent lamps became effective in 1994-95. These standards require a minimum average lamp efficacy that ranges from 64-68 lumens/W for 2-foot U-shaped lamps to 80 lumens/W for 8-foot lamps.

Table 5.39: US Minimum Energy Performance Standards for Fluorescent Lamps

Lamp Type	Total Nominal Lamp Watts	Min. Average Lamp Efficacy (lumens/W)	Minimum Average CRI
4-foot medium bi-pin	≤ 35 W	75	45
	>35 W	75	69
2-foot U-shaped	≤ 35 W	64	45
	>35 W	68	69
8-foot slimline	≤ 65 W	80	45
	> 65 W	80	69
8-foot high output	≤ 65 W	80	45
	> 65 W	80	69

Source: CFR

Ballasts. The US market for fluorescent lamp ballasts has been shifting toward increasing use of electronic ballasts, due in part toward utility incentives for the purchase of energy-efficient ballasts. Sales of electronic ballasts grew from fewer than 5 million units in 1990 to about 25 million units in 1993 (Friedman 1996). Electronic ballasts accounted for 31% of the market in 1995 and 1996. The value of the electronic ballast market is US$1 billion.

Exports of discharge lamp ballasts increased to US$92 million in 1996, with about 80% destined for APEC markets. Leading exports markets were Canada and Mexico. Imports of ballasts

reached almost US$500 million in 1996, more than 85% of which came from APEC economies. Mexico supplied 60% of imported ballasts, with China providing another 20%.

Table 5.40: US trade flows of discharge lamp ballasts, 1994-1996

Millions of US$

	1994	1995	1996
Exports to world	66.7	72.6	92.4
Exports to APEC only	55.3	54.4	75.2
Imports from world	348.0	496.5	499.2
Imports from APEC only	341.0	417.9	437.4

Source: UN Commodity Trade Statistics

Minimum energy performance standards for fluorescent lamp ballasts were issued in 1990. Revised standards proposed in 1994 would essentially require electronic ballasts (Friedman 1996).

Table 5.41: US Minimum Energy Performance Standards for Fluorescent Lamp Ballasts

Application	Ballast Input Voltage	Total Nominal Lamp Wattage	Ballast Efficacy Factor
One F40T12 lamp	120 V	40	1.805
	277 V	40	1.805
One F40T12 lamp	120 V	80	1.060
	277 V	80	1.050
Two F96T12 lamps	120 V	150	0.570
	277 V	150	0.570
Two 110W F96T12HO lamps	120 V	220	0.390
	277 V	220	0.390

Source: CFR

6. TRADE FLOWS AND ENERGY EFFICIENCY OF INDUSTRIAL MOTORS IN THE APEC REGIONAL MARKET

6.1 Overview

Trade flows of industrial motors in the APEC region are quite large. The SITC classification of trade data includes only two categories for industrial motors. These are DC motors and generators, and AC motors. (AC generators are classified separately, as are all motors with capacity of less than 37.5 W.) Within the APEC region, trade in AC motors is larger by value than trade in DC motors and generators.

Table 6.1: Overview of trade flows of motors in the APEC region

Millions of US$

	1994*	1995	1996
DC motors and generators			
Total global exports	2,122.8	2,333.0	2,095.3
APEC exports to the world	1,119.6	1,146.4	1,068.6
APEC exports to APEC only	856.8	913.8	843.6
Total global imports	2,376.0	2,522.6	2,534.1
APEC imports from world	1,208.3	1,344.2	1,407.0
APEC imports from APEC only	978.3	1,079.1	1,109.7
AC Motors			
Total global exports	4,300.4	5,398.0	5,703.7
APEC exports to the world	1,278.2	1,852.6	2,201.2
APEC exports to APEC only	1,118.8	1,484.8	1,824.3
Total global imports	4,817.8	5,757.4	5,725.5
APEC imports from world	2,205.4	2,581.3	2,961.8
APEC imports from APEC only	1,633.5	1,898.5	2,131.3

Source: Calculated from UN Commodity Trade Statistics and Chinese Taipei Trade Statistics. Note that 1996 global statistics are incomplete.
*Data from Chinese Taipei not available for 1994

Trade statistics classified according to the Harmonized System provide somewhat more detailed information on trade flows of industrial motors in the APEC region. For the purposes of this study, such data is available for the year 1996 only. HS data shows that trade flows within APEC of DC motors from 750 W to 75 kW are larger by value than trade in DC motors from 75 kW to 375 kW. For AC motors, APEC trade flows of single-phase motors are largest in value, followed by multi-phase motors between 750 W and 75 kW.

Table 6.2: APEC trade flows of industrial motors, 1996 (detail) Millions of US$					
	DC motors > 750 W, <75kW	DC motors > 75 kW, <375kW	AC motors, single phase	AC motors, multiphase, >750W, <75kW	AC motors, multiphase, > 75 kW
APEC exports to the world	129.4	50.7	773.8	568.4	347.0
APEC exports to APEC only	88.6	36.4	630.7	466.8	284.8
APEC imports from world	195.0	79.5	1,220.7	728.6	509.4
APEC imports from APEC only	118.6	53.9	1,068.8	456.8	240.6

Source: Calculated from UN Commodity Trade Statistics

6.2 Australia

About 100,000 motors with capacities greater than 0.75 kW are sold in Australia each year (Cogan 1998). Australia is a net importer of industrial motors, although there are a few significant local producers. Major sources of imported motors include Chinese Taipei (30% market share), Japan (11%), and the US (3%).

Table 6.3: Market data for Australian motors, 1996			
Motor size (kW)	Sales (units)	Sales-weighted efficiency (%)	Maximum efficiency (%)
1.1	12,664	75.9	84.10
1.5	15,049	78.1	87.50
2.2	14,471	81.0	88.50
3	10,422	82.7	88.20
4	13,117	84.8	89.50
5.5	9,961	86.4	91.10
7.5	10,303	87.7	90.90
11	5,026	89.3	92.00
15	3,886	90.1	92.40
18.5	2,215	90.7	93.50
22	2,323	91.8	93.70
30	2,291	92.2	94.10
37	1,610	92.6	94.60
45	2,179	92.8	95.00
55	1,838	93.3	95.40
75	1,219	93.6	96.10
90	712	93.6	96.00
110	805	94.0	96.30
132	535	94.7	96.00
150	339	95.0	96.20

Source: Harrington 1998

Table 6.4: Australian trade flows of DC motors and generators, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	8.1	7.8	6.6
Exports to APEC only	7.8	7.5	6.1
Imports from world	36.8	35.0	51.4
Imports from APEC only	27.7	25.8	42.6

Source: UN Commodity Trade Statistics

Table 6.5: Australian trade flows of AC motors, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	2.2	1.3	4.1
Exports to APEC only	1.9	1.2	3.9
Imports from world	71.1	77.7	95.4
Imports from APEC only	31.3	32.4	31.0

Source: UN Commodity Trade Statistics

Australia is considering establishing a minimum energy performance standard for industrial motors, as well as a high-efficiency motor endorsement and labeling program. The MEPS under consideration are less stringent than those of in US and Canada. The more stringent of the alternative proposed MEPS for Australia are on the order of 9% less efficient for small motors, 3% less efficient for medium sized motors, and 1% less efficient for large motors than US standards. Hence, the objective of the high-efficiency endorsement program would be to encourage consumers to buy motors that exceed the proposed MEPS. The cutoff for the proposed high-efficiency motor endorsement program in Australia is generally comparable to the US motor MEPS, but is below US MEPS for small motors.

6.3 Canada

Canada's motor trade is carried on mostly with the United States. Canada has established minimum energy performance standard for industrial motors. These standards are harmonized with those of the US.

Table 6.6: Canadian trade flows of DC motors and generators, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	172.5	179.7	186.4
Exports to APEC only	136.8	153.8	145.9
Imports from world	117.0	147.8	139.3
Imports from APEC only	105.3	129.5	118.1

Source: UN Commodity Trade Statistics

Table 6.7: Canadian trade flows of AC motors, 1994-1996			Millions of US$
	1994	1995	1996
Exports to world	56.7	121.2	101.3
Exports to APEC only	55.9	118.2	94.9
Imports from world	198.6	246.1	263.5
Imports from APEC only	171.4	210.6	215.4

Source: UN Commodity Trade Statistics

6.4 Chile

Chilean motor sales totaled US$18 million in 1994. Sales have been growing at an annual rate of 15%. Virtually all motors are imported, and Chile has a highly competitive motors market (Lord 1995).

There are two main groups of suppliers. Standard motors are sold by South American, Eastern European and Asian manufacturers. High-quality motors are marketed by US and European makers. As of 1995, Japanese makers did not sell in Chile. Standard motors take three-quarters of the market; high-quality motors take the rest. High-performance, energy-efficient motors make up 1% of the market. Energy-efficient motors command a 25-40% price premium.

Table 6.8: Chilean trade flows of DC motors and generators, 1994-1996			Millions of US$
	1994	1995	1996
Exports to world	<0.1	<0.1	<0.1
Exports to APEC only	<0.1	<0.1	<0.1
Imports from world	6.3	5.8	5.5
Imports from APEC only	4.0	3.0	2.7

Source: UN Commodity Trade Statistics

Table 6.9: Chilean trade flows of AC motors, 1994-1996			Millions of US$
	1994	1995	1996
Exports to world	0.2	0.3	0.3
Exports to APEC only	<0.1	<0.1	<0.1
Imports from world	24.4	29.7	23.9
Imports from APEC only	10.6	17.0	9.0

Source: UN Commodity Trade Statistics

6.5 China

There are more than 300 motor producers in China. International JVs are producing motors in China with more modern designs, but most are made for export. Some of the JVs have begun efforts to promote domestic sales (Hinge and Nadel 1997).

Chinese motor exports have been growing rapidly. A relatively small number of manufacturers make up significant share of export market. The top 5 producers take 40% of the market. The main products exported are small and medium Y series asynchronous motors, motors manufactured according to NEMA standards, some AC generators and a small number of DC motors.

Most motors imported into China are specialty motors. The Chinese import market for motors has been valued at around US$200 million per year in recent years.

Table 6.10: Chinese trade flows of DC motors and generators, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	13.1	23.1	18.1
Exports to APEC only	9.3	16.9	13.1
Imports from world	30.9	54.0	70.2
Imports from APEC only	23.9	42.8	58.0

Source: UN Commodity Trade Statistics

Table 6.11: Chinese trade flows of AC motors, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	132.0	156.5	185.0
Exports to APEC only	92.9	110.4	134.8
Imports from world	86.2	110.0	98.0
Imports from APEC only	49.9	78.3	57.7

Source: UN Commodity Trade Statistics

The energy efficiency of Chinese motors is generally much lower than that of motors used in the developed economies. Y-series motors are only about 87% efficient at full load (using the US test procedure), while comparable US high-efficiency motors are about 91% efficient. Chinese makers have developed the YX series of high-efficiency motors, but the incremental costs of these motors is so high that market penetration is very low.

There is a standard requiring that efficient motors be used for all applications where annual operating times exceed 3,000 hours with a load factor above 50%. It appears that this regulation is not widely enforced.

6.6 Hong Kong, China

Hong Kong, China imports more than US$140 million worth of AC motors annually. Leading APEC sources of imported AC motors are China, Japan, Singapore, and Malaysia. Re-exported AC motors are destined mainly for the United States and China.

Table 6.12: Hong Kong, China trade flows of DC motors and generators, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	12.3	12.3	2.9
Exports to APEC only	11.8	12.0	2.5
Imports from world	9.7	6.4	6.8
Imports from APEC only	7.5	4.0	5.4
Re-exports to world	17.4	19.2	36.0
Re-exports to APEC only	14.3	15.8	28.3

Source: UN Commodity Trade Statistics

Table 6.13: Hong Kong, China trade flows of AC motors, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	3.9	6.6	3.2
Exports to APEC only	3.4	4.8	2.6
Imports from world	97.1	116.6	143.1
Imports from APEC only	75.8	94.6	106.7
Re-exports to world	78.1	109.4	121.3
Re-exports to APEC only	58.4	81.7	96.7

Source: UN Commodity Trade Statistics

6.7 Indonesia

Indonesian data for motor imports, exports and production are often unreliable or incomplete. Indonesia began exporting electric motors, mainly to Japan, in the late 1980s. Most of the exports were single-phase AC motors (Opheim and duPont 1995).

Production of motors reached 265,000 units in 1991, valued at US$6.7 million.

The overall market size for industrial motors was 635,000, but was expected to double to 1.3 million units by 1996.

The total Indonesian market for AC motors was estimated at US$50 million in 1994.

Imports of AC motors totaled US$45 million in 1994. Of this amount, US$10 million were in completed knocked down form and US$35 million in completely built up form. Half of the value of the completely built up motor imports was for large industrial motors of more than 75kW.

There have been a few Indonesian companies assembling and distributing electric motors for the local market. Two are companies associated with firms from Chinese Taipei, and one is a joint venture with Sweden's ABB. The only company manufacturing motors in Indonesia has been a JV between Tatung of Chinese Taipei and an Indonesian partner. This firm began producing in 1992, and has had a capacity of 200,000 units per year. As of 1995, 15% of its market was high-efficiency, and growing.

Table 6.14: Indonesian trade flows of DC motors and generators, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	4.8	9.7	15.2
Exports to APEC only	<0.1	9.6	7.4
Imports from world	15.2	16.0	11.9
Imports from APEC only	9.1	12.3	7.4

Source: UN Commodity Trade Statistics

Table 6.15: Indonesian trade flows of AC motors, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	18.2	44.4	70.4
Exports to APEC only	17.0	42.6	67.0
Imports from world	61.2	54.7	64.5
Imports from APEC only	42.1	36.2	44.8

Source: UN Commodity Trade Statistics

6.8 Japan

According to JEMA, Japanese production of industrial motors is valued at about US$8,000 million per year. Small motors (defined by JEMA as less than 70W) make up more than half of this total. AC motors account for most of the remainder. More than 38 million AC motors are produced each year, of which about 60% are single-phase induction motors and 30% are three-phase induction motors. Production of variable speed motors declined from 46,000 in 1994 to 14,000 in 1996 (JEMA 1997). Production of servo motors increased from 4.9 million units in 1994 to 9.6 million units in 1996. There is no official definition of what constitutes a high efficiency motor in Japan.

Japanese exports of single-phase AC motors totaled 1.8 million units in 1996, a decline from 2.1 million units in 1995 and 2.3 million in 1994. Meanwhile, exports of 3-phase AC motors increased from 700,000 in 1994 to 2.1 million in 1996. Exports of DC motors fell from 8.2 million units in 1994 to 3.8 million units in 1996. Exports of AC/DC motors totaled 3,000 units in 1996.

Imports of AC motors rose from 4.3 million in 1994 to 7.5 million in 1996. About 80-85% of these imports were single-phase AC motors. About 16,000 AC/DC motors were imported in 1996. Korea's Hyundai reports that it is not able to see its high efficiency motors in Japan, only its standard-efficiency line.

Table 6.16: Japanese trade flows of DC motors and generators, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	380.9	293.9	240.9
Exports to APEC only	255.7	223.3	168.4
Imports from world	33.4	54.9	73.9
Imports from APEC only	22.8	38.9	51.8

Source: UN Commodity Trade Statistics

Table 6.17: Japanese trade flows of AC motors, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	379.1	500.5	525.3
Exports to APEC only	278.9	363.4	389.3
Imports from world	112.7	161.4	197.9
Imports from APEC only	54.1	87.2	104.7

Source: UN Commodity Trade Statistics

6.9 Korea

Korea is a major producer and importer of industrial motors. A leading maker is Hyundai, which produces both standard efficiency and high efficiency models. The firm reports that its only export markets for high efficiency motors are in the US and Canada.

Table 6.18: Korean trade flows of DC motors and generators, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	55.1	53.5	41.2
Exports to APEC only	53.8	52.3	40.8
Imports from world	132.8	126.3	84.8
Imports from APEC only	115.8	115.8	73.2

Source: UN Commodity Trade Statistics

Table 6.19: Korean trade flows of AC motors, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	69.1	90.0	112.1
Exports to APEC only	63.3	75.4	97.2
Imports from world	154.2	176.2	247.0
Imports from APEC only	116.6	132.5	170.1

Source: UN Commodity Trade Statistics

6.10 Malaysia

Malaysia imports of AC motors totaled more than US$320 million in 1996. Leading APEC sources of imported AC motors were Japan, Singapore, and the United States. Exports of AC motors exceeded US$100 million, most of which were exported to Thailand and Singapore.

Malaysia has established a series of minimum energy performance standard for industrial motors, but these standards are not very stringent.

Table 6.20: Malaysian trade flows of DC motors and generators, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	20.1	20.1	44.1
Exports to APEC only	18.9	18.1	41.5
Imports from world	122.3	144.0	226.3
Imports from APEC only	87.8	121.5	198.6

Source: UN Commodity Trade Statistics

Table 6.21: Malaysian trade flows of AC motors, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	32.7	47.3	107.5
Exports to APEC only	23.2	34.8	76.4
Imports from world	112.4	112.6	320.9
Imports from APEC only	92.3	90.7	263.5

Source: UN Commodity Trade Statistics

6.11 Mexico

Mexico's motor trade is conducted mostly with the United States. Exports of AC motors reached US$440 million in 1996, while imports totaled US$110 million.

Table 6.22: Mexican trade flows of DC motors and generators, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	107.2	112.6	155.6
Exports to APEC only	106.3	110.7	153.7
Imports from world	72.1	92.9	118.3
Imports from APEC only	54.2	72.0	93.2

Source: UN Commodity Trade Statistics

Table 6.23: Mexican trade flows of AC motors, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	249.0	285.2	443.2
Exports to APEC only	243.9	273.1	436.2
Imports from world	137.6	90.5	108.4
Imports from APEC only	116.6	75.0	86.8

Source: UN Commodity Trade Statistics

6.12 New Zealand

About 16,500 motors with capacities larger than 0.75 kW are sold each year in New Zealand. New Zealand does not have any domestic motor manufacturers. Major sources of imported motors include Chinese Taipei (26% of market) and China (12% of market).

Table 6.24: New Zealand trade flows of DC motors and generators, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	<0.1	0.1	<0.1
Exports to APEC only	<0.1	<0.1	<0.1
Imports from world	4.1	3.2	3.8
Imports from APEC only	2.4	1.7	1.9

Source: UN Commodity Trade Statistics

Table 6.25: New Zealand trade flows of AC motors, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	0.2	0.1	1.3
Exports to APEC only	0.1	0.1	1.0
Imports from world	18.0	18.9	25.7
Imports from APEC only	11.0	10.8	15.3

Source: UN Commodity Trade Statistics

Motors account for 27% of total electricity consumption in New Zealand, including large shares of industrial and agricultural electricity use. New Zealand is considering establishing minimum energy performance standards for motors. Studies have indicated that such standards could remove the least energy-efficient 20% of motors from the market at no additional cost to New Zealand motor purchasers (Cogan 1998).

6.13 Philippines

The market share of energy-efficient motors in the Philippines is unknown, as no end-use assessment has yet been performed. High-efficiency motors are available in the market, although

they are not in great demand. Such motors are supplied by foreign companies through subsidiaries or importers. Brands available include Baldor, Leroy-Somer, Franklin, US Motors (IIEC 1998).

Imports predominate in the market generally, and have been increasing in recent years. The majority of imports of DC motors are under 750W. Most imported AC motors were single-phase motors with capacity of less than 225kW. Much of the lower capacity motor imports come from Chinese Taipei and Japan. Japan is a major source of secondhand or surplus units.

Table 6.26: Philippines trade flows of DC motors and generators, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	<0.1	<0.1	0.3
Exports to APEC only	<0.1	<0.1	<0.1
Imports from world	1.3	1.4	3.2
Imports from APEC only	0.9	1.0	1.7

Source: UN Commodity Trade Statistics

Table 6.27: Philippines trade flows of AC motors, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	-	<0.1	<0.1
Exports to APEC only	-	<0.1	<0.1
Imports from world	23.6	27.9	43.1
Imports from APEC only	14.4	18.2	28.0

Source: UN Commodity Trade Statistics

Table 6.28: Philippines motor imports, 1995-1997			
	1995	1996	1997 (Jan-Oct. only)
DC motors, of an output exceeding 750W but not exceeding 75kW	334	362	231
DC motors, of an output exceeding 75kW but not exceeding 225kW	14	32	30
DC motors, of an output exceeding 225kW but not exceeding 375kW	3	40	6
DC motors, of an output exceeding 375kW	12	4	7
Universal motors of an output not exceeding 3.75 kW	11,134	6,926	13,992
Universal motors of an output exceeding 3.75 kW but not exceeding 225kW	5,434	2,769	4,538
Universal motors of an output exceeding 225 kW	-	-	-
AC motors of an output not exceeding 225kW, single-phase	1,354,000	1,635,261	2,217,193
AC motors of an output exceeding 225kW, single-phase	1	-	-
AC motors of an output exceeding 750W but not exceeding 75kW, multi-phase	16,353	12,930	17,360
AC motors of an output exceeding 75kW but not exceeding 225kW, multi-phase	229	576	-
AC motors of an output exceeding 225kW, multi-phase	-	-	-

Source: IIEC

6.14 Singapore

Singapore's exports of AC motors totaled US$92 million in 1996. Leading APEC markets were Malaysia, Thailand, and the United States. Imports of AC motors were valued at US$116 million, with Japan and the United States the principal APEC suppliers.

Table 6.29: Singapore trade flows of DC motors and generators, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	58.0	55.9	63.0
Exports to APEC only	50.4	46.1	52.0
Imports from world	122.6	108.2	79.0
Imports from APEC only	113.5	85.1	59.8

Source: UN Commodity Trade Statistics

Table 6.30: Singapore trade flows of AC motors, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	94.0	82.2	92.4
Exports to APEC only	74.4	67.9	76.1
Imports from world	123.3	122.4	116.1
Imports from APEC only	85.0	91.9	72.2

Source: UN Commodity Trade Statistics

6.15 Chinese Taipei

Trade statistics available from Chinese Taipei are classified according to the Harmonized System. Hence, trade statistics are broken out into two sizes of DC motors. Data on AC motors is broken out by single-phase motors and two sizes of multi-phase motors.

Table 6.31: Chinese Taipei trade flows of DC motors, 1995-1997 Millions of US$						
	1995		1996		1997	
	850132	*850133*	*850132*	*850133*	*850132*	*850133*
Exports to world	0.9	1.5	3.1	0.7	2.0	1.1
Exports to APEC only	0.8	0.7	2.9	0.7	1.8	0.7
Imports from world	15.7	3.4	14.0	3.1	13.8	4.2
Imports from APEC only	11.4	2.1	8.4	1.3	8.9	2.9

Source: Chinese Taipei Trade Statistics
850132 denotes DC motors with capacity between 750W and 75kW.
850133 denotes DC motors with capacity between 75kW and 375kW.

Table 6.32: Chinese Taipei trade flows of AC motors, 1995-1997 Millions of US$									
	1995			1996			1997		
	850140	*850152*	*850153*	*850140*	*850152*	*850153*	*850140*	*850152*	*850153*
Exports to world	44.8	80.4	21.7	47.0	92.8	25.8	56.4	106.5	17.6
Exports to APEC only	36.7	65.8	20.9	36.9	85.1	24.7	45.2	97.4	16.7
Imports from world	18.1	29.2	4.6	13.9	25.1	6.0	12.2	36.0	3.8
Imports from APEC only	16.5	17.7	2.6	12.7	15.6	3.7	10.8	25.0	2.3

Source: Chinese Taipei Trade Statistics
850140 denotes AC motors, single-phase
850152 denotes AC motors, multi-phase, between 750W and 75kW
850153 denotes AC motors, multi-phase, greater than 75kW

Chinese Taipei has been reported to have minimum energy performance standard for electric motors. However, no information on these requirements could be obtained for this report.

6.16 Thailand

Production in 1991 was 990,000 motors. The great majority of these motors were fractional kilowatt. Survey data indicate that the average size was 28 HP (duPont 1996).

As of the mid-1990s, there was no production of energy-efficient motors in Thailand, but imported models are available. These account for probably less than 5% of the Thai market, according to research conducted by IIEC.

Imports of AC multi-phase motors was 680,000 units in 1993. The value of motor imports rose 242% from 1988-1993. The largest growth segment was DC motors.

Exports rose dramatically from 1988 to 1993. AC single-phase motor exports increased from 27,000 to 227,000 units. Exports of multi-phase AC motors climbed from 646,000 to 7.2 million. Exports of DC motors rose from 82,000 to 5.5 million.

Table 6.33: Thailand trade flows of DC motors and generators, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	24.3	74.3	N. Av.
Exports to APEC only	22.9	57.5	N. Av.
Imports from world	44.0	20.5	N. Av.
Imports from APEC only	37.4	11.3	N. Av.

Source: UN Commodity Trade Statistics

Table 6.34: Thailand trade flows of AC motors, 1994-1996
Millions of US$

	1994	1995	1996
Exports to world	32.8	13.8	N. Av.
Exports to APEC only	31.7	12.2	N. Av.
Imports from world	59.0	82.6	N. Av.
Imports from APEC only	29.3	55.6	N. Av.

Source: UN Commodity Trade Statistics

6.17 United States

The most commonly used industrial motor in the US is the AC multi-phase induction motor. Nearly 2 million are sold each year, and 25 million such motors are currently installed. Motors at or below 5 HP make up more than 60% of unit sales, however motors over 20 HP account for almost 70% of sales by capacity (Friedman 1996).

Table 6.35: US trade flows of DC motors and generators, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	263.1	300.9	290.3
Exports to APEC only	183.0	204.3	200.9
Imports from world	459.4	508.8	515.4
Imports from APEC only	365.9	401.1	385.6

Source: UN Commodity Trade Statistics

Table 6.36: US trade flows of AC motors, 1994-1996 Millions of US$			
	1994	1995	1996
Exports to world	308.2	356.2	389.4
Exports to APEC only	232.2	257.1	298.0
Imports from world	925.1	1,102.3	1,169.3
Imports from APEC only	733.0	830.5	894.2

Source: UN Commodity Trade Statistics

Minimum energy performance standards for industrial motors were incorporated in the US Energy Policy Act of 1992 and came into effect in 1997. These standards were based on voluntary standards adopted by the industry association (the National Electrical Manufacturers Association) a decade earlier.

Table 6.37: US Minimum Energy Performance Standards for Electric Motors						
Nominal Full-Load Efficiency						
	2-pole/ 3,600 rpm		4-pole/1,800 rpm		6-pole/1,200 rpm	
HP	Open	Closed	Open	Closed	Open	Closed
1	-	75.5	82.5	82.5	80.0	80.0
1.5	82.5	82.5	84.0	84.0	84.0	85.5
2	84.0	84.0	84.0	84.0	85.5	86.5
3	84.0	85.5	86.5	87.5	86.5	87.5
5	85.5	87.5	87.5	87.5	87.5	87.5
7.5	87.5	88.5	88.5	89.5	88.5	89.5
10	88.5	89.5	89.5	89.5	90.2	89.5
15	89.5	90.2	91.0	89.5	90.2	90.2
20	90.2	90.2	91.0	91.0	91.0	90.2
25	91.0	91.0	91.7	91.0	91.7	91.7
30	91.0	91.0	92.4	92.4	92.4	91.7
40	91.7	91.7	93.0	92.4	93.0	93.0
50	92.4	92.4	93.0	93.0	93.0	93.0
60	93.0	93.0	93.6	93.0	93.6	93.6
75	93.0	93.0	94.1	93.6	93.6	93.6
100	93.0	93.6	94.1	94.1	94.1	94.1
125	93.6	94.5	94.5	94.1	94.1	94.1
150	93.6	94.5	95.0	95.0	94.5	95.0
200	94.5	95.0	95.0	95.0	94.5	95.0

Source: US Energy Policy Act of 1992

Energy-efficient motors (as defined by the National Electrical Manufacturers Association) now account for about 25% of total sales. This proportion varies widely from one market segment to another. In the distributor market, it may be as high as 40-45%, due in part to utility rebate and incentive programs. Sales of energy-efficient motors to OEMs remain low, about 5-10% (Friedman 1996).

7. IMPLICATIONS OF TRADE FLOW STUDY FOR DECISION-MAKING ON APEC'S WORK PROGRAM FOR REGIONAL HARMONIZATION OF ENERGY EFFICIENCY TESTING

The findings of this study have several implications for decision-making by APEC bodies concerning a program of work on harmonizing aspects of energy efficiency testing and verification within the region.

- **Implications of relative size of trade flows**

One possible criterion that APEC decision-makers may wish to take into account is the economic significance of regional trade in various kinds of energy-using equipment. This study has shown that air conditioning equipment and industrial motors are the most valuable trade flows among the equipment designated for this study. Each accounts for more than US$3,000 million per year in trade within the APEC region.

In the case of air conditioning equipment, there has been a growing trend for multi-national makers to establish production facilities in low-cost centers for reimportation into higher-wage economies and other regional export markets. China, Thailand and Malaysia are all important offshore production centers for Japanese brands. An increasing number of U.S. and Korean brands have also established joint-venture or wholly-owned enterprises in such offshore locations. China continues to be a key producer and exporter, and the Philippines has recently become a host of new JV operations with overseas makers. The current economic situation in many Asian economies has caused some makers' expansion plans to be put on hold, and has hit the exports of other makers hard. Nevertheless, it seems likely that such arrangements will pick up again as economic recovery begins.

Trade in refrigerators is also highly economically significant, with a value of about US$1,100 million per year. Numerous offshore production centers for refrigerators have been established in the APEC region trade as well.

Trade in lighting equipment is much less economically significant if fluorescent lamps and ballasts are considered separately. Trade in each is about half as large by value as trade in fridges and fridge-freezers. However, taken together, the value of trade in fluorescent lamps and ballasts is as large as that of fridges and fridge-freezers.

- **Implications of existing and planned energy efficiency policies**

Another key criterion is the relationship of trade flows to existing and planned programs of APEC member economies that establish energy efficiency testing or performance requirements for imports of equipment covered by this study. At present, a large volume of APEC regional trade occurs between economies with similar or even identical energy efficiency testing and/or performance requirements, such as trade between Canada, the U.S. and Mexico. However, several APEC member economies are contemplating the establishment of new energy efficiency labeling and/or performance requirement. This indicates that an increasing share of APEC

regional trade in energy-using equipment will be subject to a patchwork of unrelated requirements.

Considering only mandatory labeling and performance programs that are currently in effect in APEC economies, imported fluorescent lamp ballasts are currently most subject to energy efficiency requirements. This is because two countries with existing MEPS for ballasts—the U.S. and Canada—account for such a large proportion of the total APEC import market for ballasts. Not much change in the overall energy efficiency aspects of this trade is expected from economies now considering whether to implement MEPS for ballasts.

Perhaps more important than the coverage of existing energy efficiency requirements is the impact of the possible implementation of new policies. Several APEC economies are considering establishing or revising energy efficiency policies addressing air conditioners and refrigerators. Changes in such policies could cause a considerable shift in the regional APEC import market, and may indicate that these two appliances are important targets for priority attention.

Currently, about 70% of APEC imports of air conditioners are subject to mandatory energy efficiency performance standards or labeling. About half this amount is composed of imports by Canada, the U.S., and Mexico, which have already harmonized energy efficiency requirements. The remainder is composed of economies with more or less unrelated energy efficiency policies.

However, two key market participants could have a large effect on energy efficiency and regional trade flows of air conditioners. Hong Kong, China is a major importer of air conditioning equipment, which currently has a voluntary air conditioner labeling program, and is considering whether to institute mandatory requirements in the future. In addition, Japan now has voluntary energy efficiency targets for air conditioners, but is considering the establishment of a "top runner" scheme for mandating energy efficiency improvements. If these and other APEC economies shift from voluntary to mandatory programs, the share of total APEC air conditioner imports subject to mandatory energy efficiency testing or performance requirements could exceed 96%.

Another potentially large shift concerns the trade in refrigerators. At present, about 60% of total APEC imports of refrigerators are subject to mandatory energy efficiency testing. Two-thirds of this amount is made up of imports to the harmonized North American market. As before, the economies likely to have the largest impact on energy efficiency testing and trade flows are Japan and Hong Kong, China. If these and other APEC economies establish policies with mandatory energy efficiency testing or performance requirements, the share of total APEC refrigerator imports subject to such requirements could reach 84%.

A few APEC economies are now considering establishing MEPS for industrial motors, however these appear unlikely to cause a major shift in regional trade flows. Similarly, some economies are considering programs concerning the energy efficiency of fluorescent lamps. Mexico is developing a minimum energy performance standard for compact fluorescent lamps, and China is reportedly considering a similar course of action. These efforts will affect only trade in compact fluorescent lamps, which make up a tiny fraction of the overall trade in discharge lamps. Hence, a major shift in regional trade seems improbable.

- **Potential for energy savings**

The potential to save energy is a logical and important criterion for making decisions concerning APEC programming. The various end uses specified for this study each make up a significant but varying share of electricity demand in APEC economies. Data on the share of electricity demand attributable to traded versus domestically produced equipment is not available.

However, it may be useful to consider the energy implications per unit of expenditure on each type of equipment covered by this study. As shown in the table below, rough estimates indicate that the ratio of energy costs to purchase price is largest for industrial motors and fluorescent lighting equipment.

Table 7.1: Ratio of Lifetime Energy Costs to Purchase Price for Selected Equipment

Item	Estimated Lifetime Energy Use (kWh)	Lifetime Energy Costs (US$)			Estimated Purchase Price (US$)	Ratio of Lifetime Energy Cost to Purchase Price
		US$0.05 per kWh	US$ 0.10 per kWh	US$0.15 Per kWh		
Window air conditioner	20,000	1,000	2000	3000	500	From 2:1 to 6:1
Fridge-freezer	10,000	500	1000	1500	500	From 1:1 to 3:1
Fluorescent lamp	300	15	30	45	5	From 3:1 to 9:1
Industrial motor	100,000+	5,000+	-	-	-	Large

For each type of equipment, there is anecdotal evidence to indicate that trade flows are composed of some high-efficiency goods, some low-efficiency goods, and some goods of "standard" efficiency. As an increasing number of APEC economies take steps to strengthen local consumer demand for energy-efficient goods, it seems likely that trade in (as well as domestic production of) such goods will grow. Thus, it appears that the commitment of APEC member economies to develop and implement energy efficiency initiatives addressing particular kinds of equipment is an important indicator of large potential energy savings associated with harmonization of energy efficiency testing.

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