

## REGIONAL REPORT ASIA AND PACIFIC

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**Abstract:** The technology development of the heat pump in Asia and Pacific Ocean state is summarized in this paper. In recent years of demand in this region, especially in China, the expansion of the air conditioner for residential and air conditioner for business use is remarkable. A climate varied from the cold district to the tropical zone is distributed, and moreover, a variety of heat pump equipment corresponding to the culture in each country are developed, and applied as for Asia and Pacific Ocean state. The use of the approach of the energy saving development, the load leveling of the equipment and utilizing the ground thermal energy has risen rapidly to secure the stable supply of energy, too. Recently, the argument of global warming measures has risen.

This paper introduces the energy saving approach of the heat pump, reduction of the greenhouse gases emission and concerning the approach for recycling in each country.

**Key Words:** *Asia and Pacific, Heat Pump technologies, energy saving, global warming*

### 1 INTRODUCTION

In this paper introduces the necessity of measures for global warming that is a recent topic and the measure of the energy saving in each country. It is becoming increase of the number of countries that have installed the regulatory limit of minimum COP additionally with the demand expansion of the air conditioner and becoming severe criteria value, too.

And the energy conservation performance is ranked, and the energy conservation competition intensifies. This trend should be welcomed for the global environment and for the consumer.

Furthermore, the research on the conversion to refrigerant with few global warming coefficients is done, and it approaches at very important period for Asia that is the air-conditioning demand country.

There are no statistic data of whole Asia and Pacific for heat pumps. It could be summarized referring to the report by JRAIA and JARN and country report from China and South Korea

### 2 CLIMATE CHANGE

Recent perceptions about the present state of affairs of global warming and the argument of the correspondence have risen. The argument of the post Kyoto Protocol was performed by the 13th Conference of the Parties to the Framework Convention on Climate Change (COP13) in Bali that had been held last year. Up to now, IPCC who won this year's Nobel Prize and the institution composed of the scientist has appealed the crisis of the global warming. Moreover, correspondence to the environment will be discussed in the G8 Lake Toya summit in Japan this year. The countermeasure of global warming with the greenhouse gases is an energy saving that can be done from now. 1/3 of the all parts of the world is Asia in Energy outlook 2004 that IEA issued in the energy consumption as shown in **Figure 1**. The trend of an increase is predicted about the energy utilization in the future as shown in **Figure 2**.

On the other hand, the Asia demand for the heat pump is large, and when the efficiency improvement of the heat pump equipment and the heat pump is applied, Asia is thought that it

is necessary to lead the world. Moreover, the sudden rise of recent crude oil and the sudden rise of primary materials according to it are very large impact for the heat pump production. Asia is called the production facility of the air conditioner in the world. It is necessary to advance the stable production, the control of the energy consumption, and recycling primary materials to build the sustainable society, and to build the circulating society.

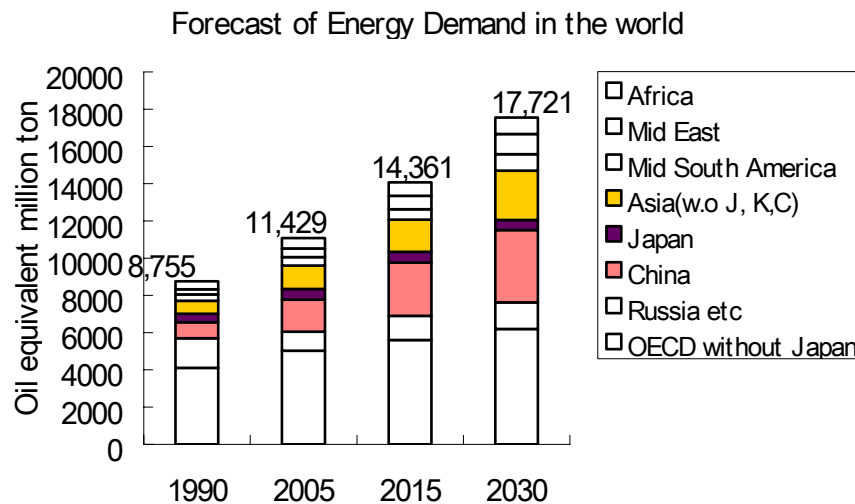


Figure 1: Energy Demand trend in the world

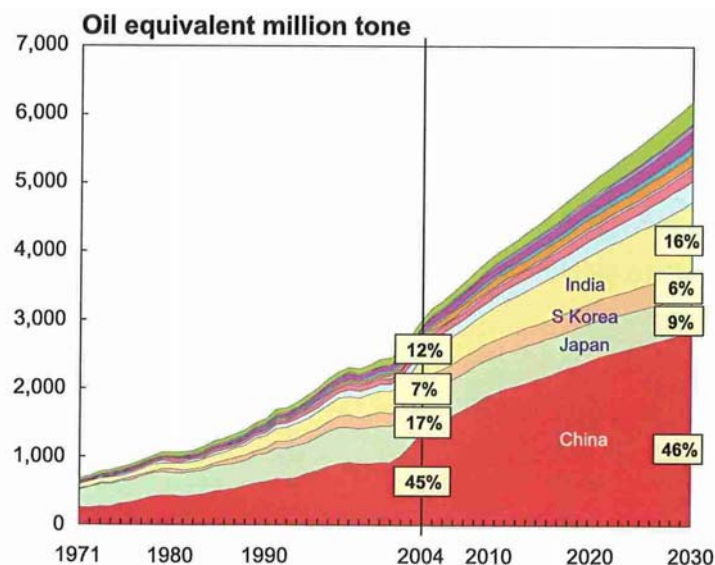


Figure 2: Asia Primary Energy Demand by Region (Source: IEE Japan World Energy Outlook 2006)

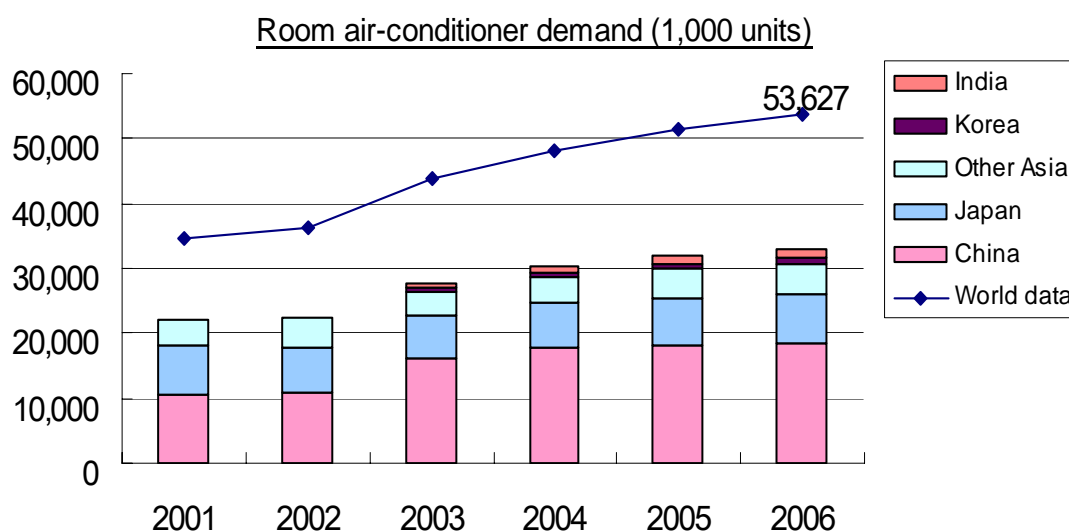
### 3 DEVELOPMENTS IN MARKET & TECHNOLOGY

#### 3.1 Space Conditioning

##### 3.1.1 Unitary air conditioners and heat pumps (RACs & PACs)

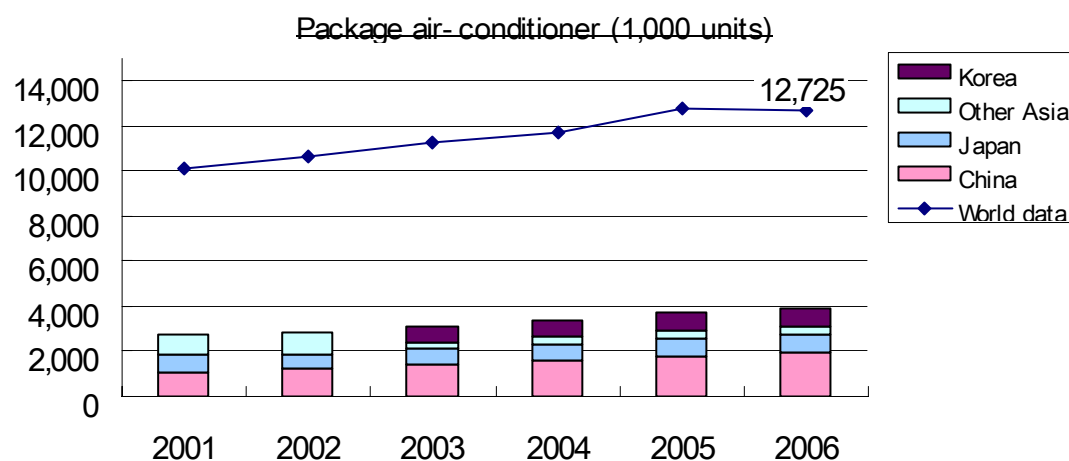
The demand for room air-conditioner in the Asia Oceania region is still increasing, and exceeded 30 million units. Asia occupies 2/3 of the demand for all parts of the world. As for

features of Asia, the cold district region, the warm-temperature region, and the tropical zone exist widely, and the air-conditioning for space cooling and the heat pump are used widely. The growing demand of China remarkably especially reaches 18.5 million as shown in **Figure 3** in 2006, and China is occupied by 50% or more of demand in the entire Asia. 99% is a heat pump in Japan, about 7.5 million demand is almost a situation of the level-off, and the structure of demand will be presumed to be a greatly not changeable in the future. On the other hand, India is a market that has expanded rapidly, and it has become a market where one million is exceeded.



**Figure 3: Room air-conditioner demand (1,000 units)**

On the other hand, 30% of the world demand is Asia in the package air conditioner as shown in **Figure 4**. It accounts for 80% of demand in the entire Asia in China, Japan, and South Korea.



**Figure 4: Package air-conditioner demand (1,000 units)**

Recently, the heating performance and the improvement of COP in the cold district are hoped to air source heat pumps. The heat exchanger, the compressor, and the system improvement are developed in South Korea, China, and Japan, and there have been commercialized through the demonstration. The merchandise that can be driven up to outdoor temperature -20°C to -25°C is developed, and an indispensable technology development for the spread of the heat pump in the future. Moreover, it goes side by side, the evaluation standard at the low

temperature is also necessary, and it is discussed in Japan.

### **3.1.2 Electric chillers and heat pumps**

An electric chiller with the water source heat pump and the air source heat pump are especially reciprocating, scroll, screw, and centrifugal-compressor, etc. , and are used the air conditioning usage of the Central air-conditioning in the building and to cool an industrial use. About 100,000 market demand is assumed in Asian Oceania region, China will especially reach 67,000 units soled in 2006, and the half of total chiller is air source heat pump chiller driven by scroll compressor. India and Japan are about 10,000 market demand respectively. In case of Japan, 70% is composed of the air source heat pump chiller, and the research of making to highly effective is performed. Moreover, by utilizing inverter compressor, merchandise that greatly exceeds COP=4 has gone out by using R410A refrigerant and modulation of the equipment, too. Moreover, the product to exceed COP=5 while using the water spray method to the outdoor machine heat exchanger appears, too.

### **3.1.3 Absorption chillers**

Absorption Chiller in Asia are China, Japan and South Korea are the main demand of the country. About 10,000 units / year is a market, but China is 2 / 3 occupy. In particular, most popular absorption chiller which is 80% in China is direct combustion system due to the shortage of electricity power supply. This is expected to change the future market situation by stabilizing of electric power supply. The absorption chiller system in Japan is shrinking every year and 2,200 units soled in 2006.

### **3.1.4 Thermal (cool) storage systems**

As a mean to shift peak power demand to off-peak time, ice or water thermal (cool) storage systems, coupled with chillers or heat pumps, have extensively been used in Japan, with total cumulative system installation of 26,200 until 2006. The peak shift power that depended on it reached 1.66 million kW in 2006. There are also growing demand for ice thermal storage systems in Korea and China with an estimated total cumulative installation of about more than 1,000 systems. In addition to ice or water storage central air conditioning system, ductless multi-split ice storage system was uniquely developed in Japan in the early 1990's, and the market has grown to about 10 thousands units/year with total cumulative installation of about 66,000 units until 2006. Large ice or water thermal storage systems have rather extensively been used for district cooling in Malaysia and Japan.

The key motivation for the installation of thermal storage system is the employment of time-of-use electricity price structure favorable for peak power shift, with the current largest peak to off-peak price ratio of about third to one as seen in China and Japan, additionally backed up by incentives prepared by the government or electric utilities.

### **3.1.5 Gas engine heat pumps**

The demand for the gas heat pump is a fall feeling compared with electric. In the case with South Korea, the demand for the gas engine heat pump has risen by the power supply shortage of the summer peak and the sudden rise of the electricity bill. Afterwards, after the price down of the electricity bill, it is rapid and the fall and fluctuating considerably are the current states in the demand for the gas engine heat pump.

It is thought that it is substituted from the gas engine heat pump by the development of an electric heat pump with the heating effect also in the cold district.

### **3.1.6 Ground Source heat pumps**

A rapid expansion of demand is seen about the ground source heat pump in China, South

Korea, and Japan. Especially 45% is ground water, 35% is a soil heat source, and the surface water use is 20% in China. The heat pump using ground source heat grows to cover 80 millionm<sup>2</sup> in 2007, and accomplishes about three times fast growth compared with the previous year. This is the impact of the 2008 Olympic Games, China's 212 government subsidy system for a pilot project (700 million RMB) in a statement.

The ground source heat pump grows up rapidly like this by the favor that the spread promotion policy of a Chinese government backs up.

Korea is the use of alternative energy and renewable energy policies from the government is required to accelerate the growth of GSHP has been significant in recent years. Between 2005-2007, total capacity delivery ratio has been 5.5 times.

### 3.2 Tap Water Heating

#### 3.2.1 CO<sub>2</sub> heat pump water heater

The Japanese Government is drawing great expectations to a drastic effectiveness of reduction of energy of a domestic supplying hot water by the spread of a domestic water heater (Eco-Cute) using CO<sub>2</sub> refrigerant. The introduction subsidy system was introduced to aim at 5.2 million total spread by fiscal year 2010 in 2001. In a domestic water heater, COP=4.0 or more becomes an object, and 273Euro (165 JPY/Euro) for one unit in fiscal year 2007. It was able to reach 1.24 million units total sales by the system by fiscal year 2007 as shown in **Figure 5**.

On the other hand, the Japanese Government has installed a supplementary system of the energy conservation technology development support for energy conservation promotion. Because the energy conservation effect in the residential sector is large, the development of the heat pump water heater is located with the emphasis countermeasure in the energy conservation technology development subsidy. There are concretely downsizing for the out door unit and measure for cold district, and each manufacturer is developing while receiving the support of the government.

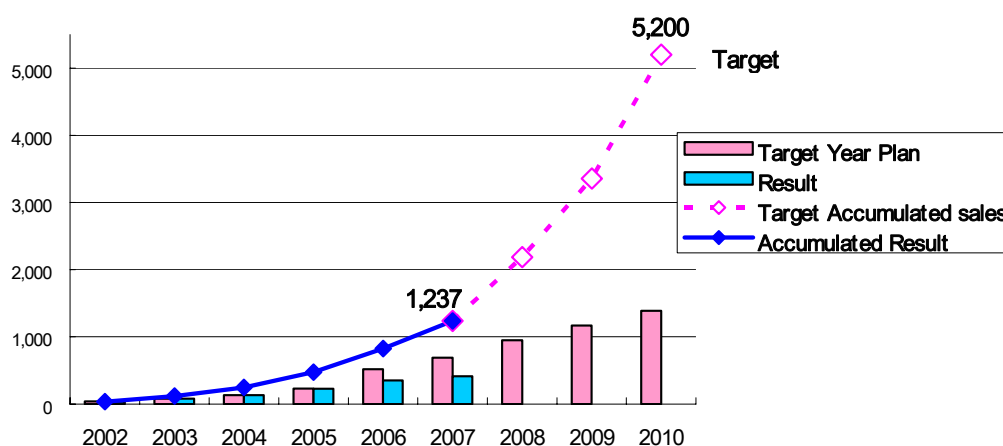


Figure 5: CO<sub>2</sub> Heat Pump Water Heater (Eco Cute) in Japan (1,000 units)

## 4 POLICY & REGULATORY MEASURES

The spread of the heat pump is a remarkable region in Asia. The correspondence of the energy conservation measure and the global warming measure in each country of the heat pump is required on the energy security point of view and the global environmental protection point of view.

## 4.1 Energy Conservation

As for the energy conservation regulation of each country of Asia, a variety of measures are developed in the place in which it is paid attention in recent years. First point is to provide a minimum requirement of the energy conservation indication. As a result, the energy saving of each equipments advance, and it is possible to contribute to the bottom rising of energy conservation in the entire heat pump. Second point is that the system of the labeling is introduced, and the purchase client can understand easily energy conservation level by this indication. And purchase client can select more high performance product in many products. Each country such as China, Australia Thailand, and South Korea institutionalizes, and the system of this labeling is a running, and specifies the rank of energy conservation like Australia adopted star rank. The indicated value of the energy label of each country showed **Figure 6**.

Each country has the plan to increase the standard one by one. For instance, the criteria value has been increased step by step since 2004, and it is in review in 2009 to make the regulatory limit severer in Australia. Moreover, there is a case to operate a severer COP standard originally in the urban area like the Shanghai region in China, too.

Moreover, Japan, South Korea, China, and Australia are countries that use Heat Pump. Year's standard of energy efficiency is being maintained in the countries. Not only the argument of COP of the rated point of cooling and heating, energy efficiency through the season is important.

Promptly the display of APF (Annual Performance factor) was adopted in 2006 and the duty was put in RAC/PAC of Japan.

In RAC, the "TOP RUNNER" basis was restarted, and APF set up 6.6 by 2010 as minimum requirement shown **figure 7**.

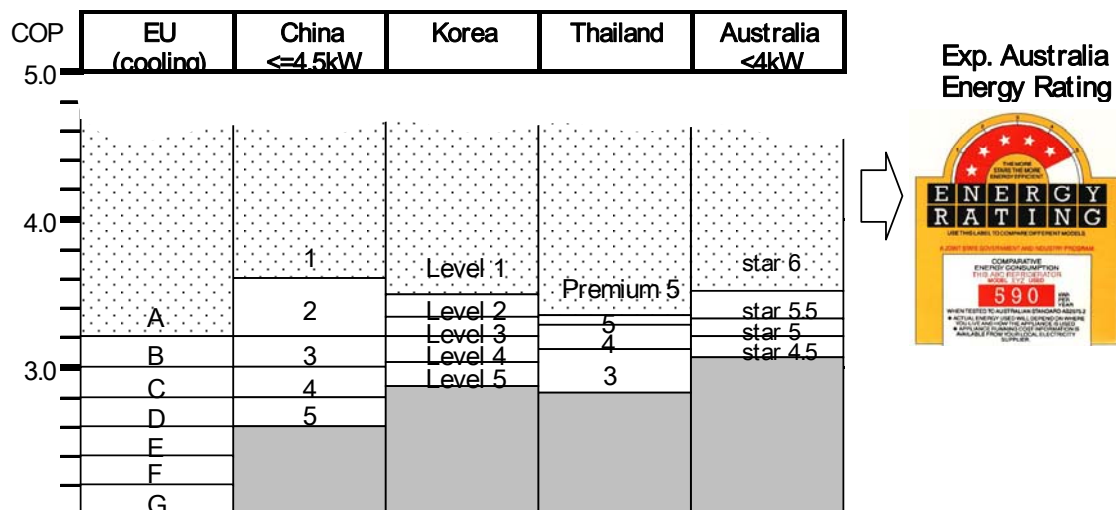


Figure 6: Energy Labeling system on each region

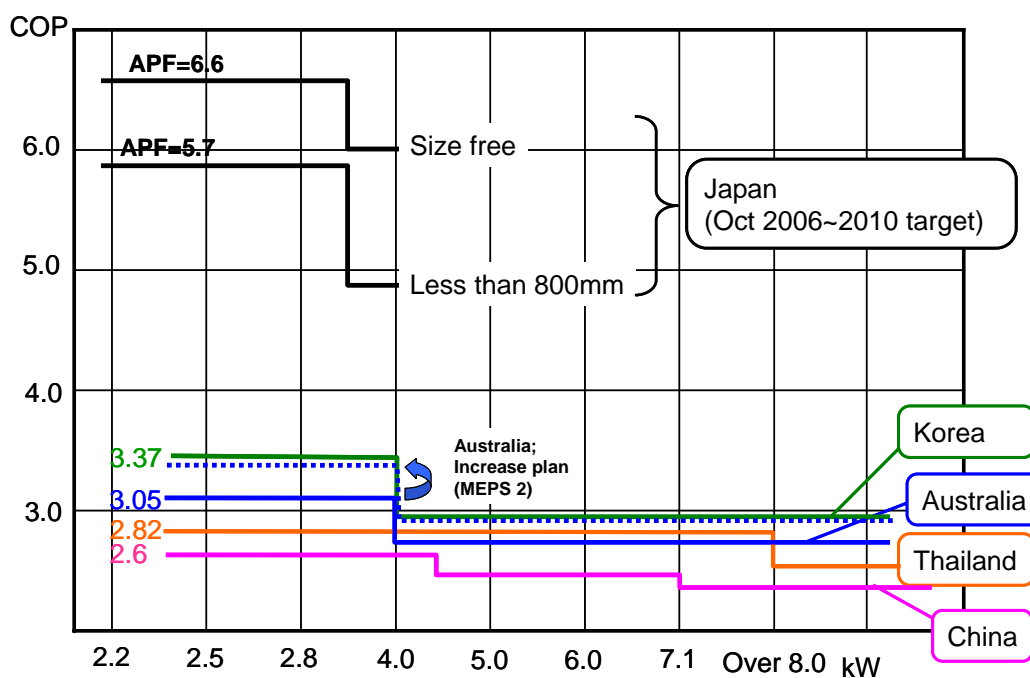


Figure 7: COP standard comparison on each region

## 4.2 Power Load Leveling

As a result of the expanded use of air conditioning and the subsequent increase in power demand, in countries like China, South Korea, Thailand and Japan, it became stringent to sustain stable and efficient electric power supply coping with power shortage and deteriorating power load factor. **Figure 8** shows, the subsidy system for five years from 1998 was installed for the spread of the heat storage system, the effect was shown remarkably, and the peak shift of 1.66 million kW was able to be done in Japan last year. **Figure 9** shows, as an example, the annual load factors trended downward over a long period of time, but gradually improved to become 64% in 2006.

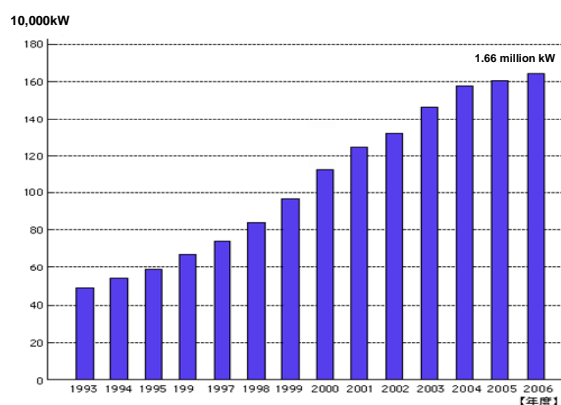


Figure 8: Peak shift power kW by Thermal Storage system in Japan

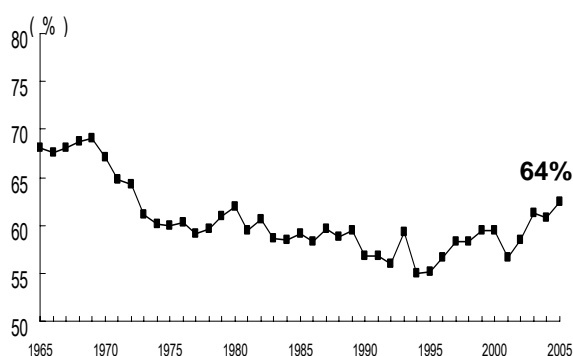


Figure 9: Annual load power factors in Japan

## 4.3 Environmental Issues

### 4.3.1 Phase-out and recovery of ODSs

Under the 1987 Montreal Protocol, countries in Asia and the Pacific have phased-out or are in the process of phasing-out ODSs (Ozone Depleting Substances: CFCs and HCFCs) as refrigerant. The situation of phasing out ODSs is different from country to country in this region. For countries defined as article 5 countries in the Montreal Protocol, phasing out ODSs is an issue to be tackled by the refrigeration and air conditioning industries. Other countries like Australia, New Zealand, South Korea and Japan have already phased out CFCs and are in the process of phasing out HCFCs and shifting to HFCs or other natural working fluids like ammonia, hydrocarbon and carbon dioxide.

Recovery, recycling and destruction of ODSs from scrapped equipment is an issue, and as part of the home appliances recycling law, refrigerant recovery from scrapped room air conditioners and household refrigerators is mandated in Japan since April 2001. Furthermore recovery and destruction of all fluorinated gases from commercial air-conditioning and refrigeration equipment and mobile air conditioners is mandated in Japan since April 2002 under the “fluorinated gas recovery and destruction law”.

Moreover, to adjust the refrigerant recovery ratio of the business refrigeration and air conditioning equipment to 60% in October, 2007, the desired value was set.

#### **4.3.2 Greenhouse gas emission reduction**

It is recognized that the role of the heat pump is very large for the energy conservation and the reduction of greenhouse gases. The target year's start of the reduction desired value of the greenhouse gases in the “Kyoto Protocol” from this year. Recently in addition improving of the energy conservation performance, the recovery of fluorocarbon and destroying, front loading to HFC, the development of the natural refrigerant equipment is hoped for. CO<sub>2</sub> refrigerant was applied to the heat pump water heater in Japan. On the other hand, suitable refrigerant in the air-conditioning equipment, freezing and refrigeration equipment is researched in the industry, the university, and the institution with cooperation and/or each. Moreover, this conversion is also researched to refrigerant with few global warming potential in China and South Korea.

#### **4.3.3 Recycling of materials**

Recently, the regulation related to effective use and the disposal of resources is being maintained. Home Appliance Recycling Law (specified kinds of home appliance re-commercialization law) is enforced on April 1, 2001, and seven years have already passed in Japan. The manufacturer finally receives the air conditioner that has been used at home, and 60% or more of overall weight is recycled, and the refrigerant fluorocarbon is collected. And China also is adopted “3R management” (Recycling, Recovery, and Reclamation) in HVAC/R industries for refrigerant management.

## **5 CONCLUSIONS**

To maximum use the heat pump that is break through technology of the greenhouse gases reduction, an important action in three points is requested.

- 1) the technology developments of the energy saving
- 2) the evolving strategy of the energy saving measure by the each country government
- 3) the dissemination activities to understand the Heat Pump technology

G8 (summit) is held in Japan in July this year. The argument for the environment protection that is the difficulty in Gleneagles summit in 2001 is scheduled to be performed. The heat pump technology that has big potential to reduce the CO<sub>2</sub> emission, it should be impressed more and more this technology.

The heat pump is a means to use the ambient heat energy well, and it has various possibilities



of heating and cooling. Asia where big air-conditioning demand is held should steadily execute developing equipment, the application development, and the spread measures. We are wishing to fulfill global environmental protection's responsibility as Asia where the demand for the heat pump expands. So let's save the Earth with "Heat Pumps"!

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