

JSRAE AND ADVANCED HEAT PUMP TECHNOLOGIES

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It is great honor for me to be invited to this conference with many of the authorities in the heat pump field, and to have the opportunity to give this address. All members of the Japan Society of Refrigerating and Air Conditioning Engineers, JSRAE would like to express our sincere congratulations to the 10th IEA Heat Pump Conference and its conference committees.

1 ADVANCED HEAT PUMP TECHNOLOGIES IN JAPAN

Japan is one of the industrialized countries with advanced refrigerating and heat pump technologies, which have supported global growth; the technologies have contributed to the modernization and to the improvement of all industries. As the leading-edge technologies, new refrigerants, high-performance heat exchangers, scroll and twin-rotary compressors, DC inverter motors, ice storage air-conditioner, carbon dioxide (CO₂) hot water supply heat pumps, absorption and adsorption cycle machines, gas-engine driven heat pumps, and Stirling refrigerators have been developed. 1,500,000 tons of refrigerated foods are produced and every Japanese consumes about 20 kg of refrigerated foods annually. Also, the refrigeration industries in Japan produce 19,000,000 units of high-efficiency refrigeration and heat pump machines including air-conditioning units for vehicles and export 6,000,000 units to all over the world every year.

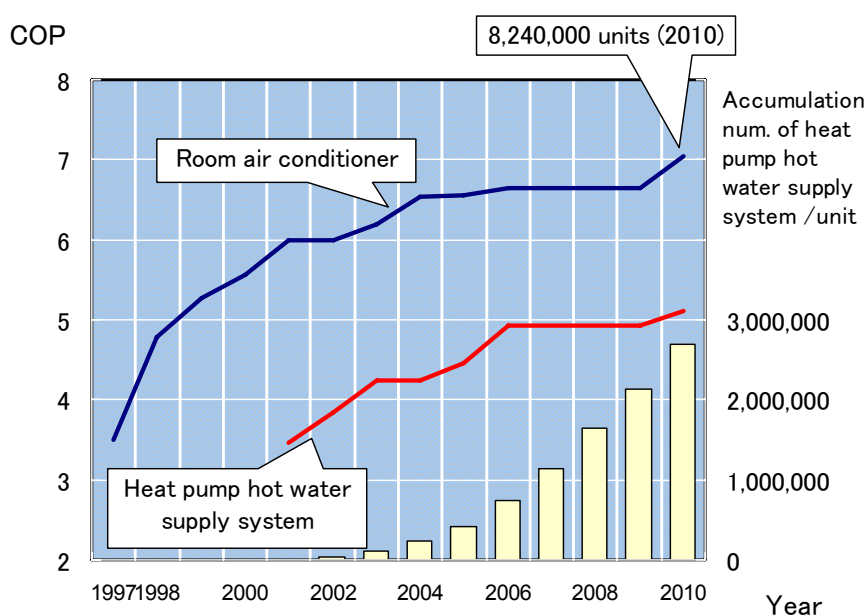


Figure 1: COP and Accumulation Number of Heat Pumps

2 ALLEVATING ENVIRONMENTAL AND ENERGY PROBLEMS

We are dealing with serious environmental and energy problems, which have to be considered on a global scale. From a viewpoint of the energy problem, remaining resources of fossil fuels and nuclear energy should be used effectively. Heat pumps are able to utilize the latent energy of fossil fuels because heat pumps use renewable energy of air heat, water heat, or exhaust heat.

Also, coefficient of performance, COP of heat pump is improving dramatically. Due to the higher COP, amount of electricity and energy, which are required to drive heat pumps, is decreasing. It leads to reducing usage of fossil fuel and nuclear energy and to reducing CO₂ emissions. Therefore, heat pumps can alleviate not only the energy problem but also the environmental problems, especially global warming. Instead of conventional systems using combustion energy, if heat pumps are utilized fully for heating and cooling in all sectors in Japan, 10% of the total CO₂ emission from Japan can be reduced.

However, heat pump has a drawback. Major working fluids of heat pump are fluorocarbons that cause a hole of the ozone layer and global warming. To alleviate the ozone layer depletion problem (the Kyoto Protocol), hydrofluorocarbons (HFC) refrigerants and their machines were developed. However, HFC refrigerants have higher potentials of global warming (GWP). The present global leakage amount from refrigeration and heat pump machines is equivalent to 2 billion tons of CO₂ and account for 8% of total global CO₂ emissions (from IPCC/TEAP Repot).

There are two possibilities for future use of heat pumps:

1. Establishing refrigerant managing system

HFC refrigerants realize high efficiency and are widely applied among heat pumps. Consequently, it seems they are the indispensable refrigerants used for mid-term range. A refrigerant managing system must be established to control HFC refrigerants for their adequate use with the cooperation of manufactures, installers, and operators.

2. Developing low-GWP system

To minimize the effect of global warming by refrigerant use, acceleration of research and development is required. The research and development must develop heat pumps with low-GWP refrigerant including natural refrigerant. Especially, heat pump systems that are suited for low-GWP refrigerant of newly produced material should be developed as fast as possible.

For the ultimate goal to transform heat pumps into responsible and eco-friendly technologies, JSRAE has many activities. Before the entry into force of the Kyoto Protocol in February 2005, JSRAE and the refrigeration and air-conditioning industry have played an important role to alleviate the energy and environmental problems. This challenge has affected the entire world.

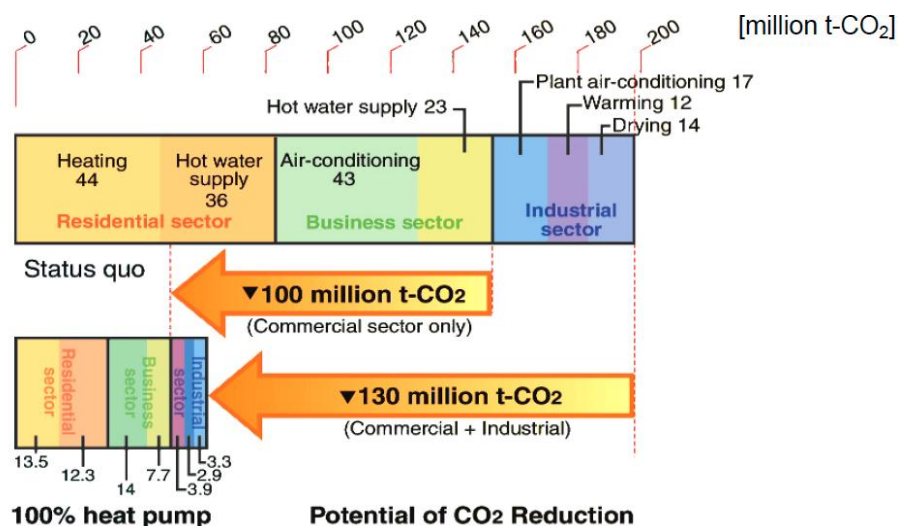


Figure 2: Heat Pump Potential Realizing CO₂ Reduction in Japan

3 INTRODUCTION OF JAPAN SOCIETY OF REFRIGERATING AND AIR CONDITIONING ENGINEERS

In 1925, the Japanese Association of Refrigeration, JAR, which is the predecessor of the Japan Society of Refrigerating and Air Conditioning Engineers, JSRAE (<http://www.jsrae.or.jp/jsrae/Eindex-2.html>), was established to develop and disseminate knowledge on refrigerating technology nation wide and also internationally. Since then it has functioned over 85 years as a non-profit academic organization in a field of refrigeration, air conditioning, food refrigeration and associated science and technology in Japan. Today JSRAE consists of about 4,700 individual members including 84 student members and about 250 corporate members.

In order to achieve its goals, JSRAE covers a wide range of activities including:

1. International liaison and collaboration with the International Institute of Refrigeration, IIR, the American Society of Heating, Refrigerating and Air-Conditioning Engineers, ASHRAE, the Society of Air-Conditioning and Refrigerating Engineers of Korea, SAREK, and other foreign societies and associations.
2. Survey, research, education, training, awards, and certificate recognition for entitled engineers and scientists
3. Organization of annual JSRAE meeting (180 oral presented papers and 480 attendees in 2010), roundtable conferences, training short courses, workshops, technical visits, and other events.
4. Monthly publication of journal "Reito"(refrigeration), quarterly publication of Transactions of JSRAE, various books, textbooks, and handbooks.
5. Implementation of correspondence education system.
6. Other miscellaneous activities essential to fulfill the objectives.

Also, JSRAE has Technical Subcommittees for refrigerant, heat exchanger, compressor, ammonia refrigeration equipment, next-generation refrigeration system, and cycle control. Each subcommittee has own activities, e.g., information exchange for new technologies, organizing sessions at conferences, workshops, and publications. For example, the Refrigerant Subcommittee publishes thermodynamic tables including transport property information and p - h charts of major refrigerants, and software to calculate the property data. The Subcommittee of Next-generation Refrigeration System discusses about magnetic refrigeration, thermoacoustic refrigerator, and high efficiency system. The Subcommittee of Ammonia Refrigeration Equipment researches NH₃/CO₂ systems in the market.

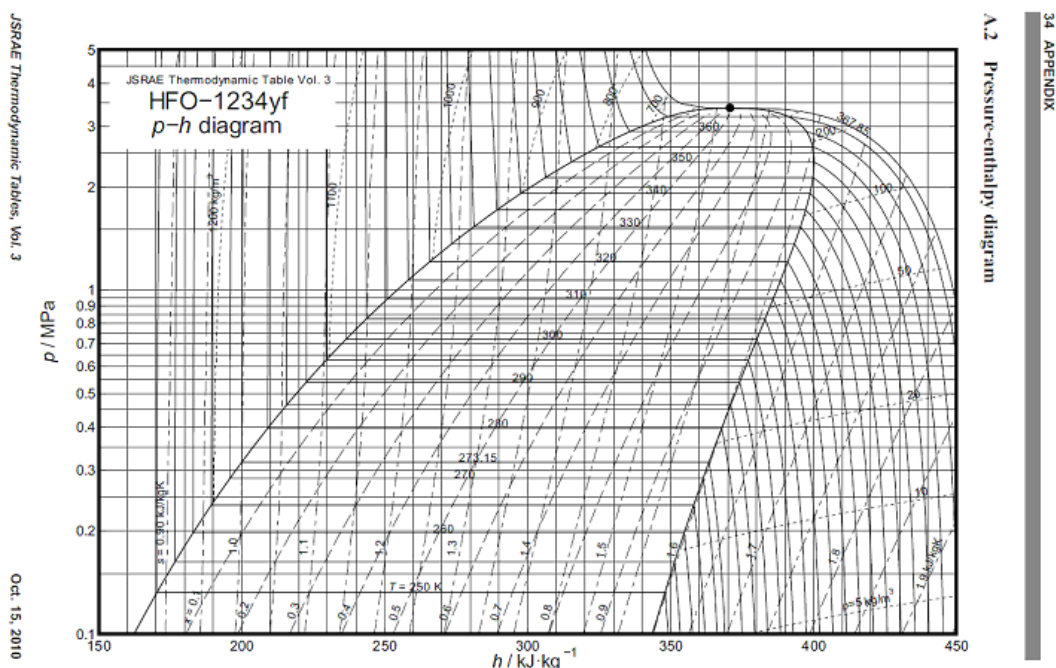


Figure 3: p - h Diagram of R 1234yf

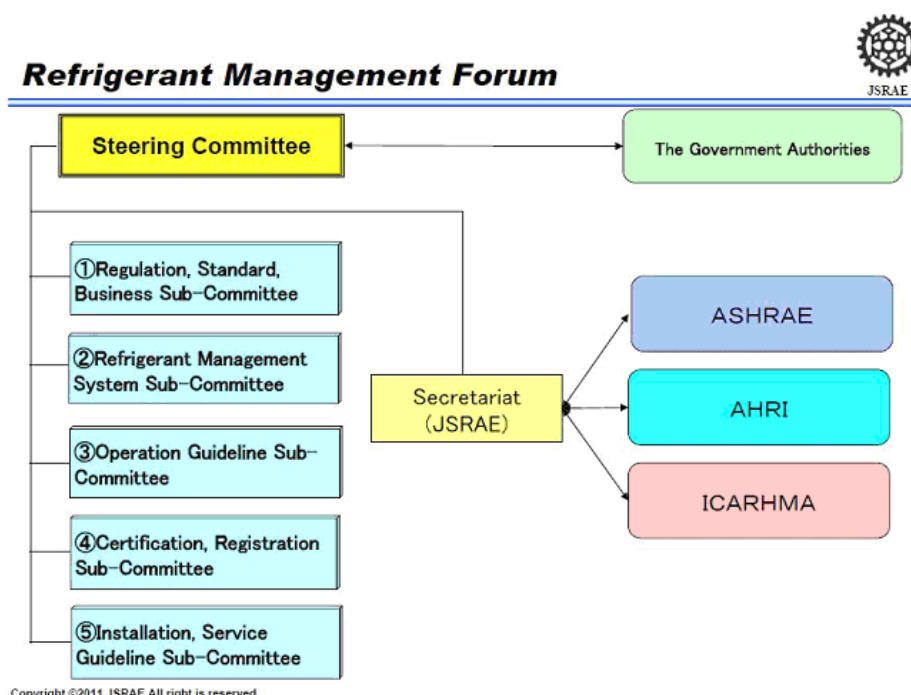


Figure 4: Refrigerant Management Forum

4 REFRIGERANT MANAGING COMMITTEE

Recently JSRAE established the Refrigerant Managing Committee. The committee discusses about the best way to establish a refrigerant managing system in Japan. An examination of the refrigerant management measures on both the supply and demand sides. The committee includes the Japan Fluorocarbon Manufactures Association, JFMA, the Japan Refrigeration and Air Conditioning Industry Association, JRAIA, the Japan Association of Refrigeration and Air-Conditioning Contractors, JARAC, the Industrial Conference for

Ozone Layer and Climate Protection, JICOP, and the Industrial Network for Fluorocarbon Recovery Promotion, INFERP.

Record keeping cost responsibilities and related regulation, role and responsibilities of the participants for establishing the managing system, and outline of establishing the national center for the refrigerant management are being discussed. Furthermore, field test of a refrigerant tracking system and discussion with Japanese government are being prepared. JSRAE has also presented related information to ASHRAE, the Air-Conditioning, Heating, and Refrigeration Institute, AHRI, and the International Council of Air-Conditioning, Refrigeration, and Heating Manufacturers' Associations, ICARHMA for the purpose of obtaining international consensus for the effective international refrigerant management.

5 ICR2015 PREPARATION COMMITTEE

The International Institute of Refrigeration (IIR, www.iifir.org) is the only independent intergovernmental organization which promotes knowledge of refrigeration and associated technologies to address today's major issues, including food safety, protection of the environment (reduction of global warming, prevention of ozone depletion), and the development of the least developed countries (food, health). The IIR commits itself to improving quality of life and promotes sustainable development.

A series of the IIR International Congresses of Refrigeration, ICR has milestone events. It has been held once every 4 years organized by IIR since 1908. The conference brings together large numbers of refrigeration stakeholders from all parts of the world. At the ICR, relating to the cryology, gas processing, thermodynamics, equipment and systems, biology and food technology, storage and transport, air conditioning, heat pumps, and energy recovery fields, important technical issues are discussed.



Figure 5: Conference Venue of the 24th International Congress of Refrigeration (Yokohama, Japan, August 31 – September 6, 2015)

The 23rd ICR will be held at Prague, Czech Republic, from August 21 to 26 in this year. In 2015 (August 31 – September 6), the 24th ICR will be held at Yokohama, Japan. The program, calls for papers, registration, technical tours, and a wide range of historic and exciting places will be announced in the website (www.ICR2015.or.jp, available from August, 2011).

CONCLUSION

Heat pumps are the key technology in the modern society needed to simultaneously achieve the effective utilization of fossil fuels and nuclear energy, the improvement of energy conservation, and the reduction of CO₂ emission. All members of JSRAE recognize the importance of the responsibility toward the future of the heat pump technologies the attendees of this conference carry from all over the world. On this occasion it would be very productive to be able to have heart-to-heart discussion with the attendees. Also, the talks would be expected to produce a meaningful out-come.

----- Please accept my sincere condolences toward the victims of the earthquake and tsunami on March 11, 2011.