

# CO2 in Vending Machine



SANYO Electric Co., Ltd.  
Commercial Solutions Company  
Daiki Shiomi

# Outline

1. Company Profile
2. CO<sub>2</sub> Compressor / Refrigeration System
3. CO<sub>2</sub> System Performance
4. VM Market Forecast / Achievement
5. Cost Analysis
6. Future Road Map

# SANYO Corporate Profile

President	Seiichiro Sano
Founded	February, 1947
Incorporated	April, 1950
Head Office	Osaka, Japan
Capital	2,731 Million USD
Net Sales	18,775 Million USD
Number of Employees	94,906
Subsidiaries*	275

( As of March 31, 2007 )

\* Exchange Rate at 31 March, 2007 (1\$=118)

# SANYO's Corporate Vision

General consumer-electronics manufacturer

SANYO'S VISION

## Think GAIA

Leading Provider of Environment & Energy related Products and Services



Absorption Chiller



Solar Battery



Heat Pump Water Heater



HEV Battery



Secondary Battery

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# Characteristic of CO<sub>2</sub> Refrigerant

## Challenges:

1. High working pressure & large pressure difference  
: 3 ~ 5 times higher than conventional refrigerant
2. System efficiency  
: Lower theoretical efficiency with normal refrigeration system

➔ Advanced technologies are required, especially for Compressor and Refrigeration system.

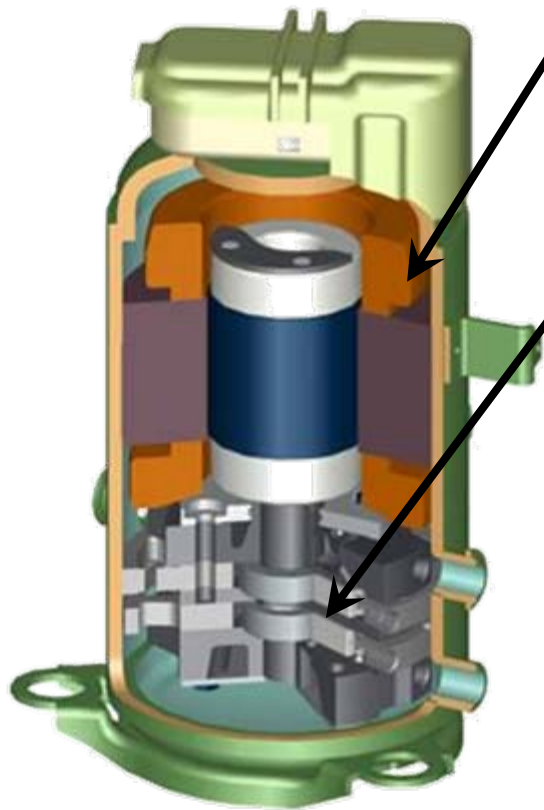
## Advantages:

1. Worldwide availability
2. High volumetric cooling capacity and heat transfer
3. Heat pump ability at low temperature ambient
4. No recovery or recycling required
5. Environmentally friendly (no ODP , GWP=1.0)
6. Nonflammable, Nontoxic

➔ **Contribute Green Environment**



# SANYO CO<sub>2</sub> Compressor



## Internal Intermediate Pressure Structure

- High Reliability
- Light Weight

## Two Stage Compression Mechanism

- Reduce Leakage Loss
- Lower Vibration
- Cycle Option (ex : Intercooling, Split cycle)

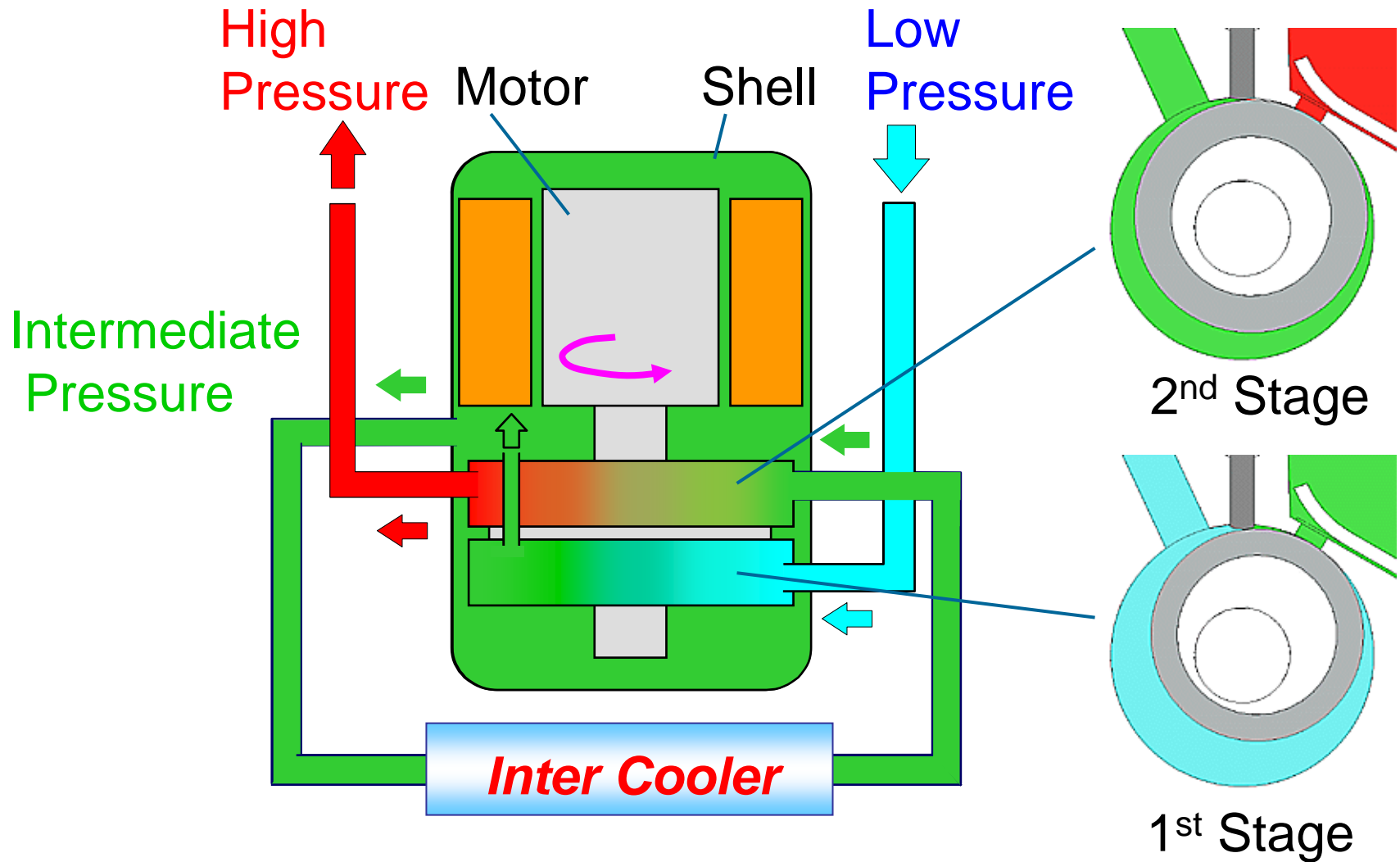
## Various Availability

- Fixed Speed / Vertical : 300W ~ 1400W
- Fixed Speed / Horizontal : 300W ~ 750W
- Variable Speed / Vertical : 500W ~ 3000W
- Various Power Source

## Experiences

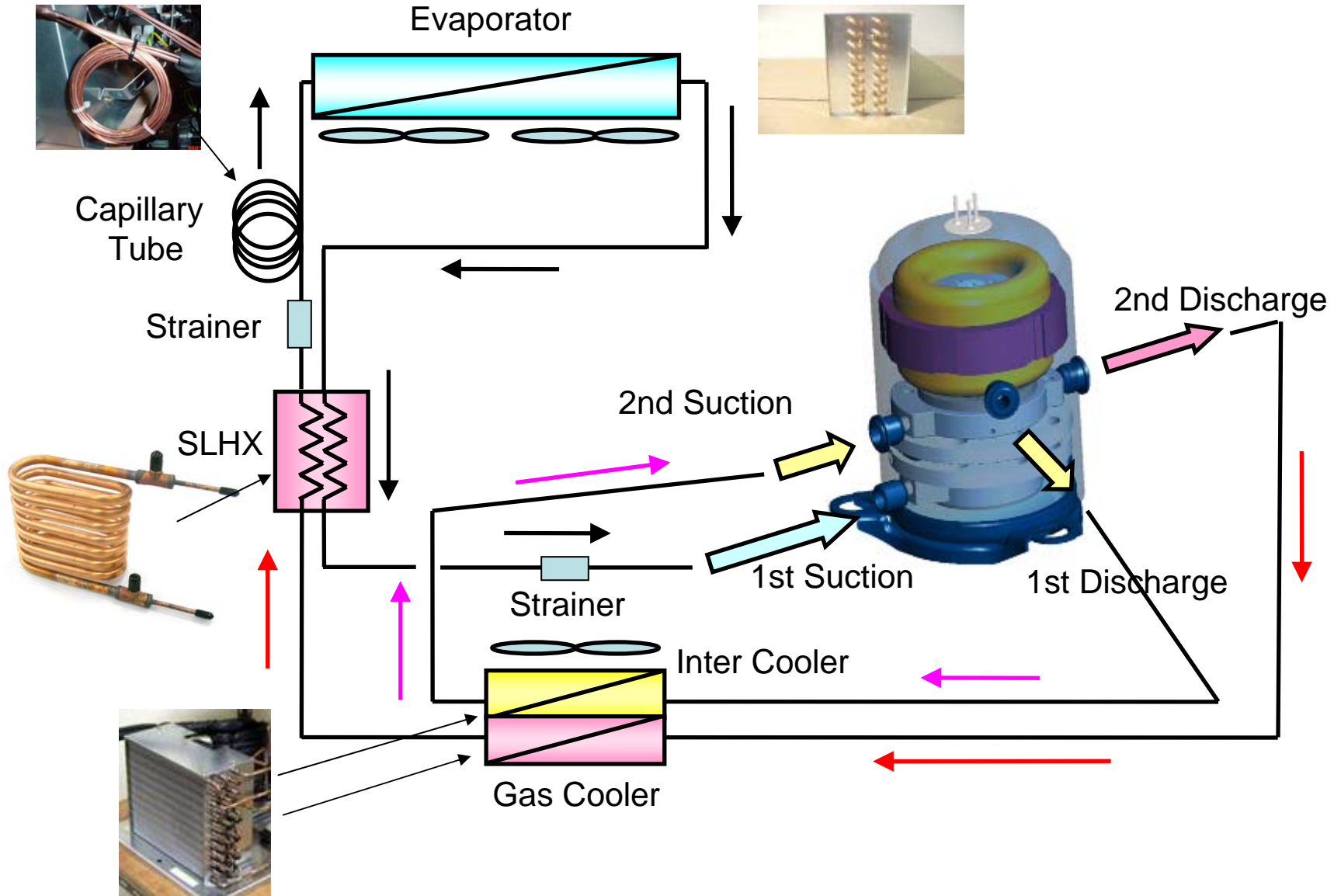
- Production History Since Y2001
- Assembly Technology

# SANYO CO<sub>2</sub> Compressor

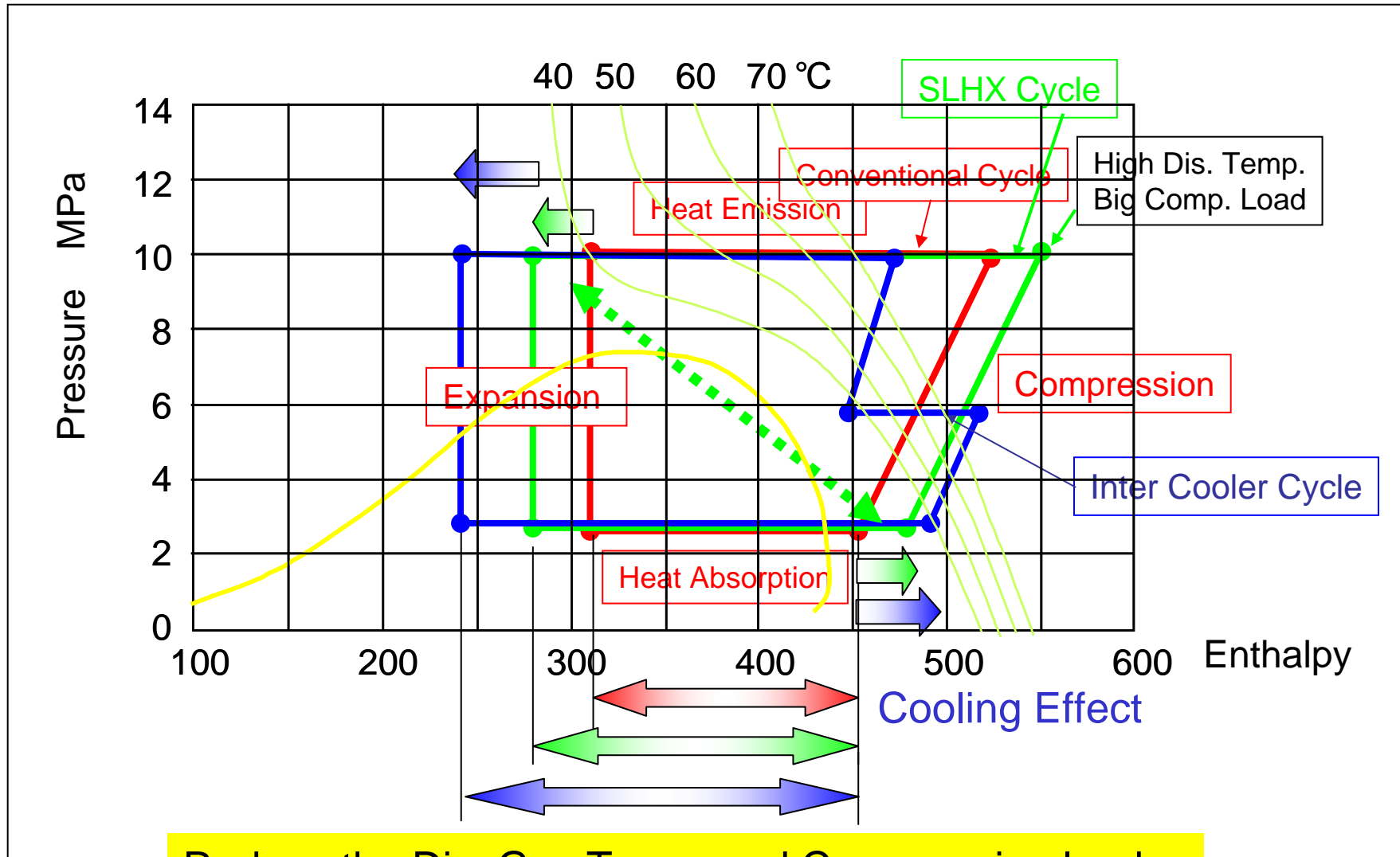




# CO<sub>2</sub> Refrigeration Cycle



# CO<sub>2</sub> Refrigeration Cycle



Reduce the Dis. Gas Temp. and Compression load.  
→ Big Improvement of Cooling Effect and Efficiency.

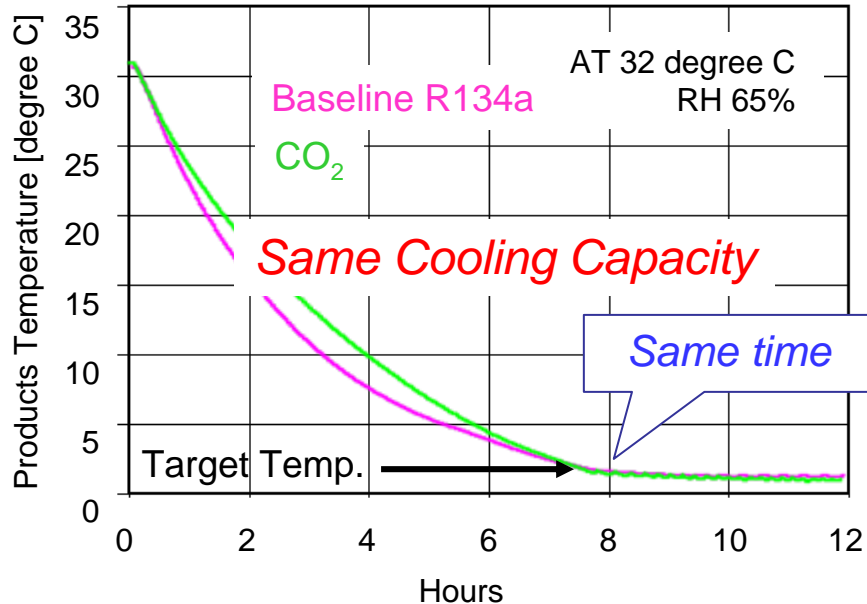
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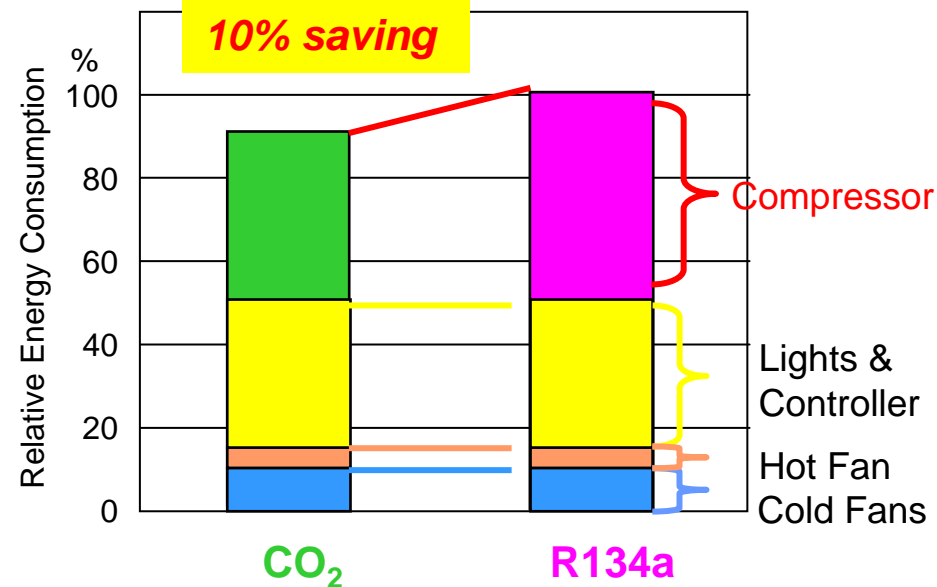
# CO<sub>2</sub> System Performance

## Test Result at Environmental Chamber / Y2004

### Pulldown Performance



### Energy Consumption Comparison



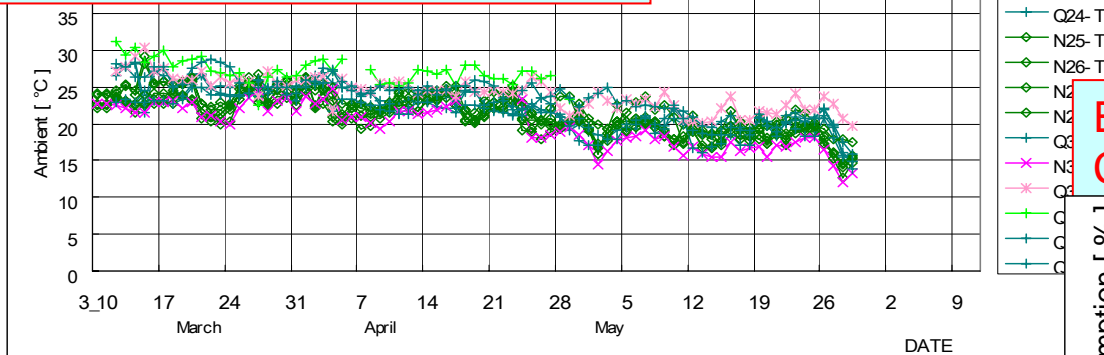
CO<sub>2</sub> system for European Vending Machine was optimized to have the same pull down performance as baseline R134a system without changing fan, fan motor, electric light and physical dimension of the installation room.

Energy Consumption of CO<sub>2</sub> system is **10% less** than that of R134a system at 32 degree C / 65 % RH.

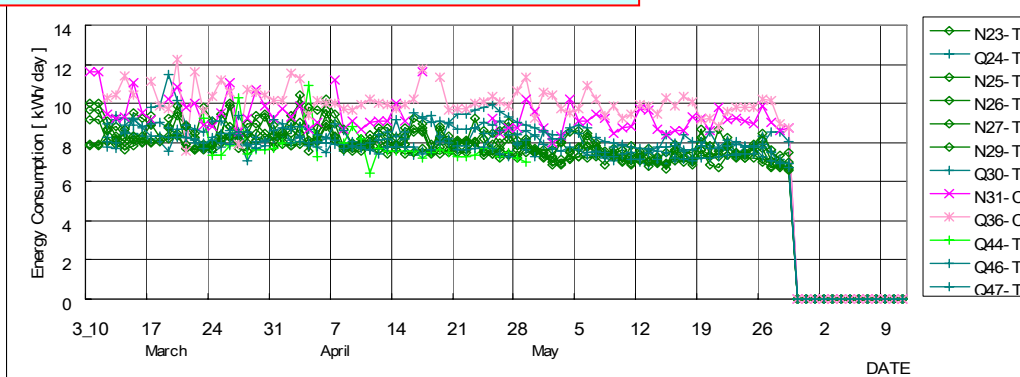
# CO2 System Performance

## Field Test Result / Y2004 in Australia

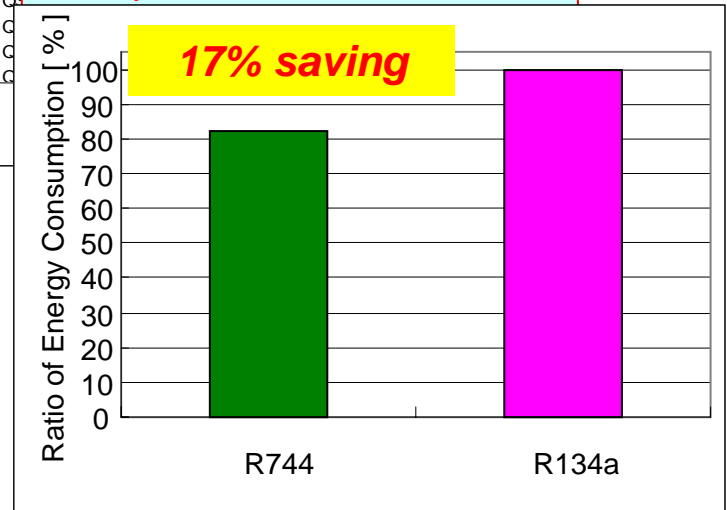
Ambient Temperature (degree C)



Energy Consumption (kWh/day)



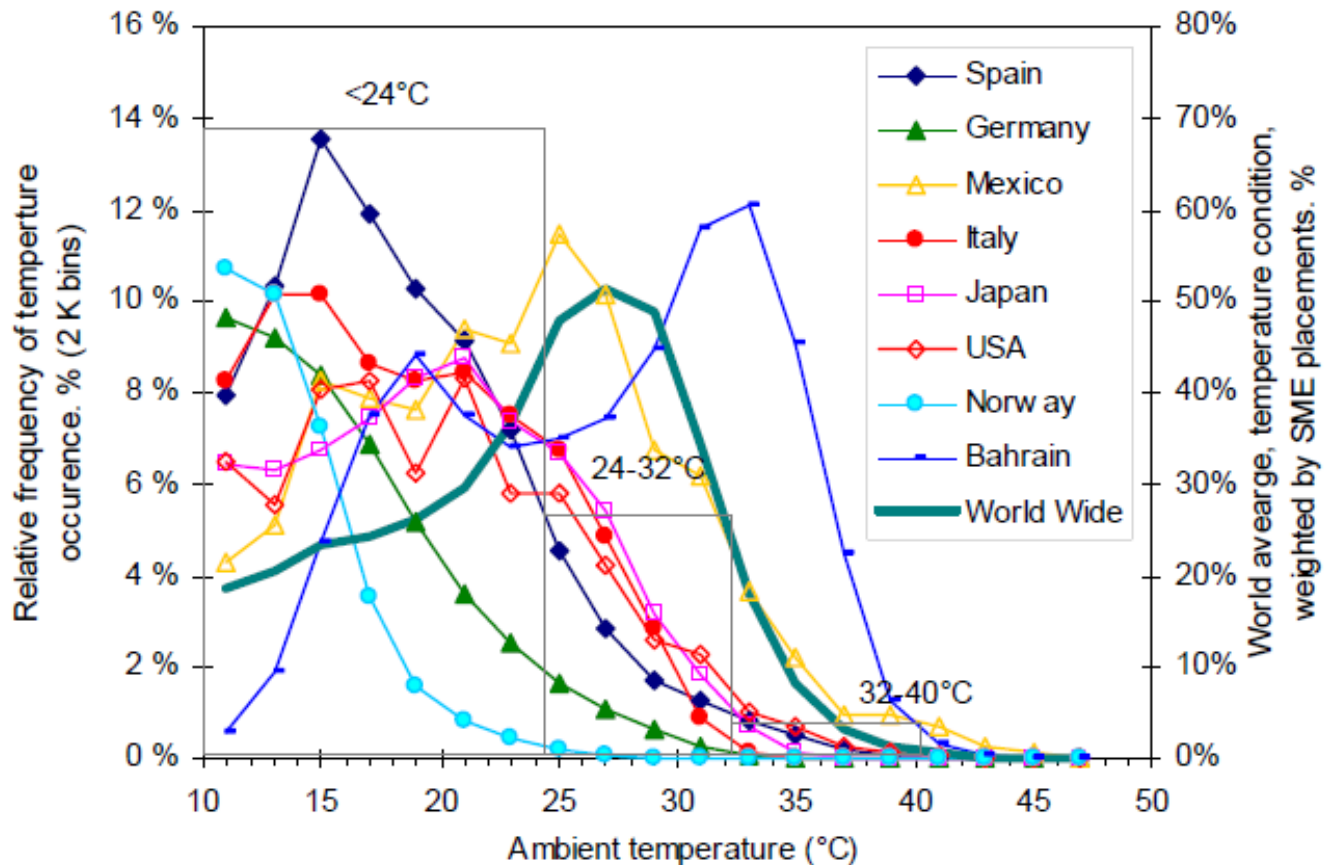
Energy Consumption Comparison



10 CO2 systems and 2 R134a systems were installed to the field. Their energy consumption and ambient temperature were measured by DAQ system.

Energy Consumption of CO2 system is **17% less** than that of R134a system in the field test during the summer season.

# World Average Temperature



(Jacob et al. 2006)

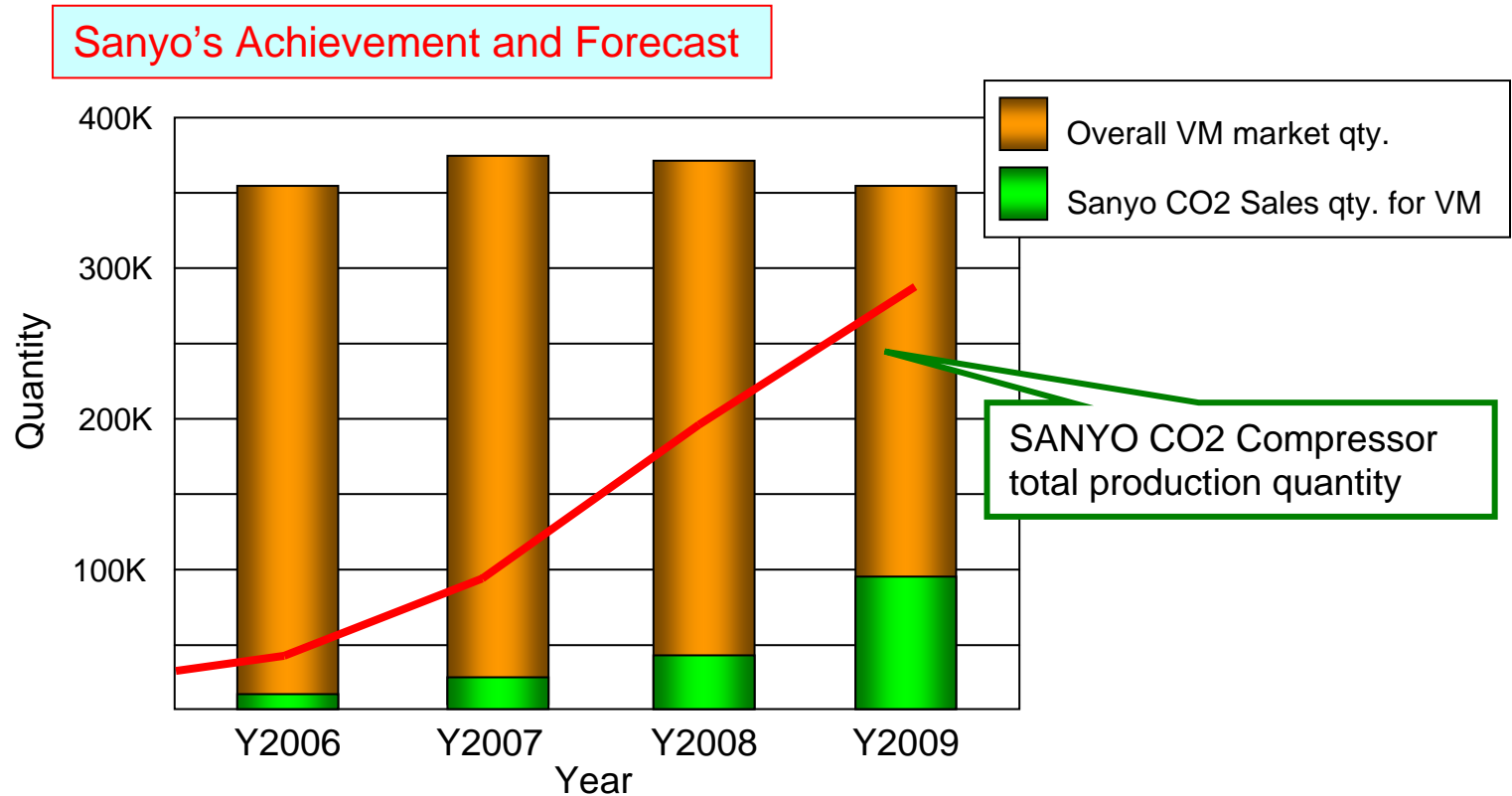
In many regions, the dominated ambient temperatures are less than 24 degree C.

70% of world average temperature is less than 24 degree C and only 5% of world average temperature is more than 32 degree C.

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# Japanese Vending Machine Market



Total quantity of CO2 systems installed to Japanese vending machine market is more than **30,000** as of today.

Sanyo's production quantity includes Heat Pump Water Heater and other refrigeration usage.



# SANYO CO2 Achievement

Athens Olympic 2004

50 CO2 compressors for vending machines



Torino Olympic 2006

1,000 CO2 compressors for glass door merchandisers



FIFA World Cup 2006

2,400 CO2 compressors for glass door merchandisers



Beijing Olympic 2008

5,000 CO2 compressors for glass door merchandisers



Others

As total, more than 15,000 CO2 compressor produced for many coolers including 5,000 for Beijing all around the world.

In addition, 150,000 compressors have been produced for Heat Pump Water Heater without any serious reliability issue in the field since 2001.

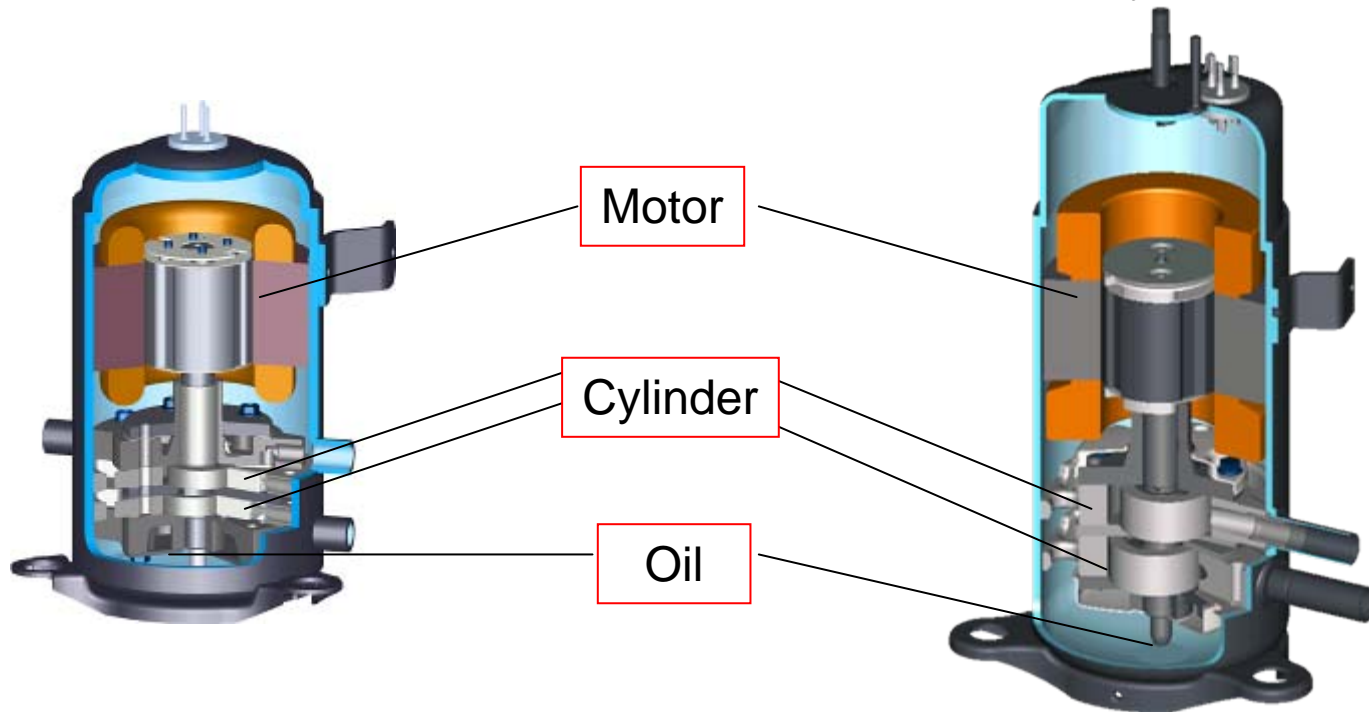
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# Cost Analysis

CO<sub>2</sub> Compressor

Conventional Rotary Compressor for AC



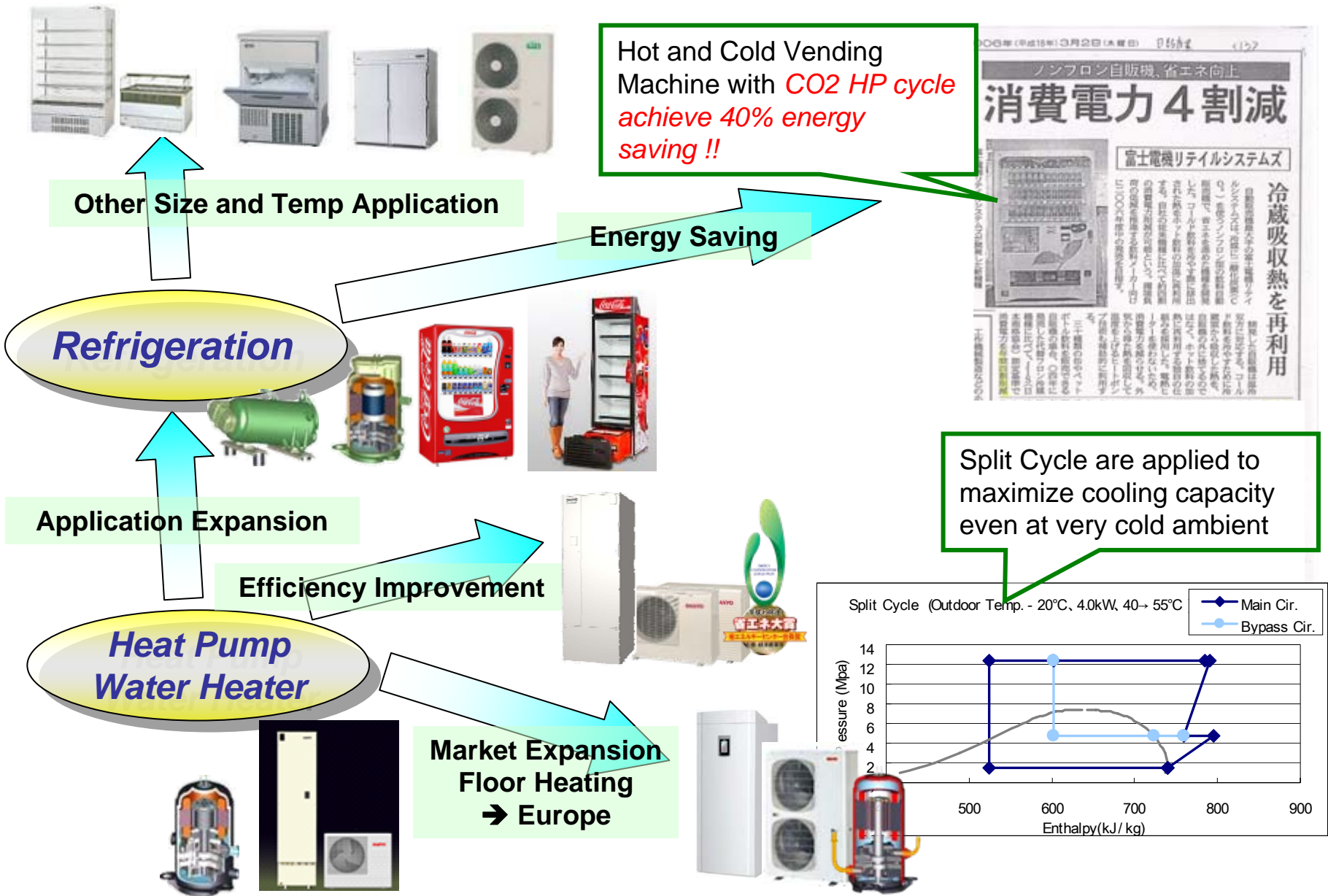
Parts and materials used for CO<sub>2</sub> compressor are almost same as those for conventional HFC or HCFC rotary compressor for AC.

If the production quantity of CO<sub>2</sub> compressors is closer to that of the conventional rotary compressors for AC, the incremental cost of CO<sub>2</sub> compressor will ultimately become the difference of material usage.

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# SANYO CO<sub>2</sub> Road Map





SANYO New VISION

# Think GAIA

Restore a beautiful earth to future generations

