

The Future of Absorption Technology for BCHP

ABST-2000

Robert DeVault

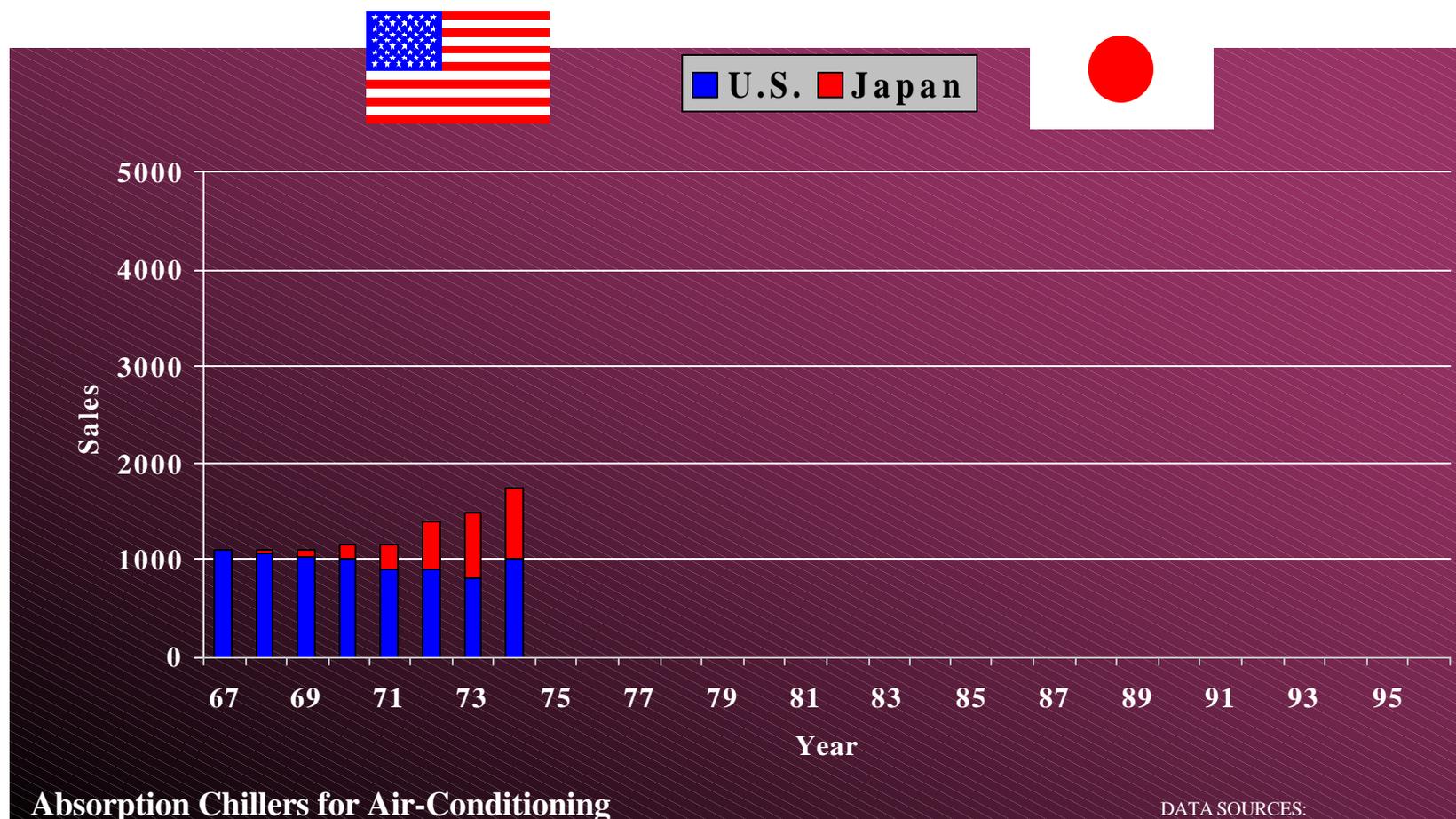
Thursday, June 8, 2000

Large Commercial Chiller Program

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U. S. DEPARTMENT OF ENERGY



US & Worldwide Sales of Absorption Chillers Peaked In The Early 1970s



Absorption Chillers for Air-Conditioning

DATA SOURCES:

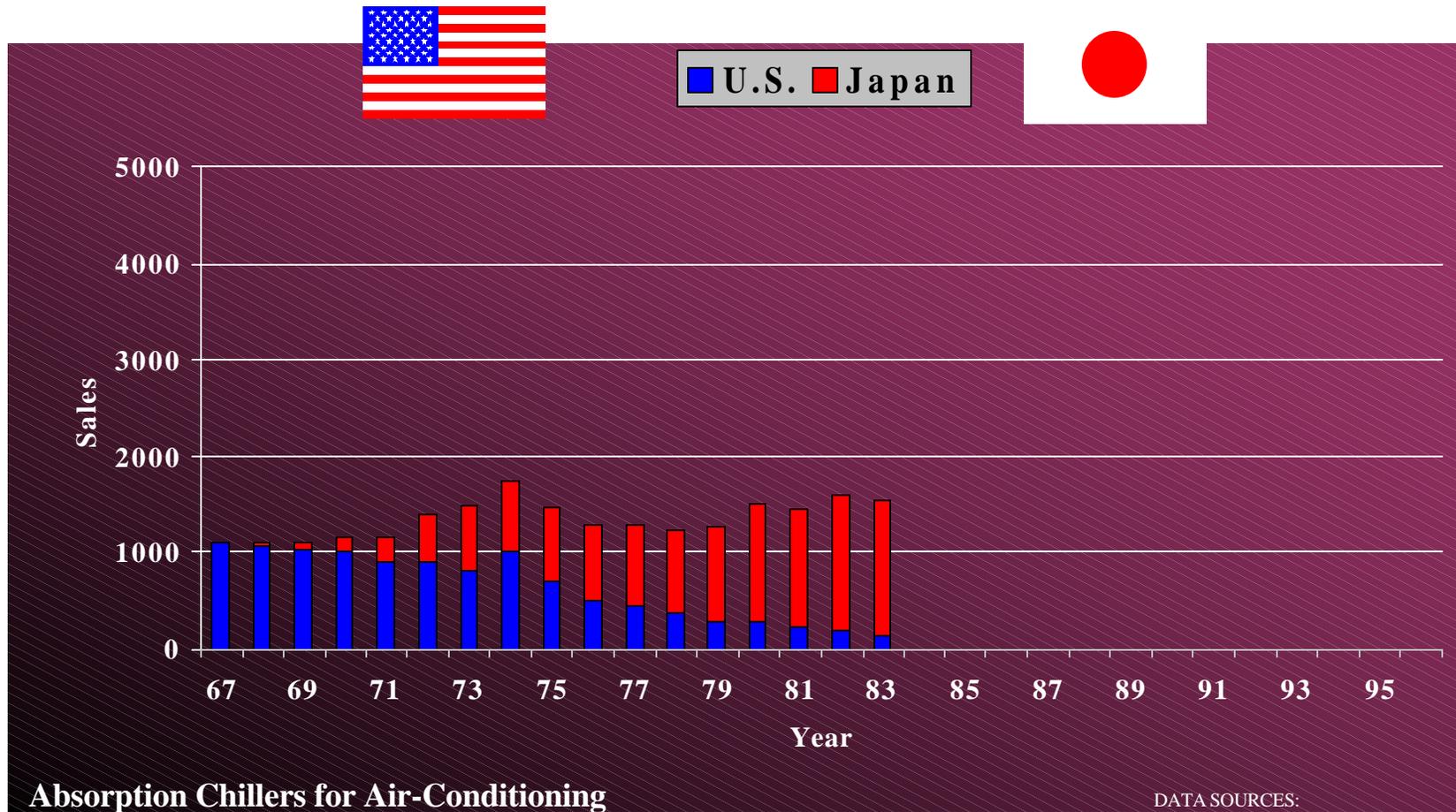
Large Commercial Buildings

IEA/JAPAN

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UT-BATTELLE

“Energy Crisis” Slowed Absorption Chiller Sales While Japanese Manufacturers Improved Product



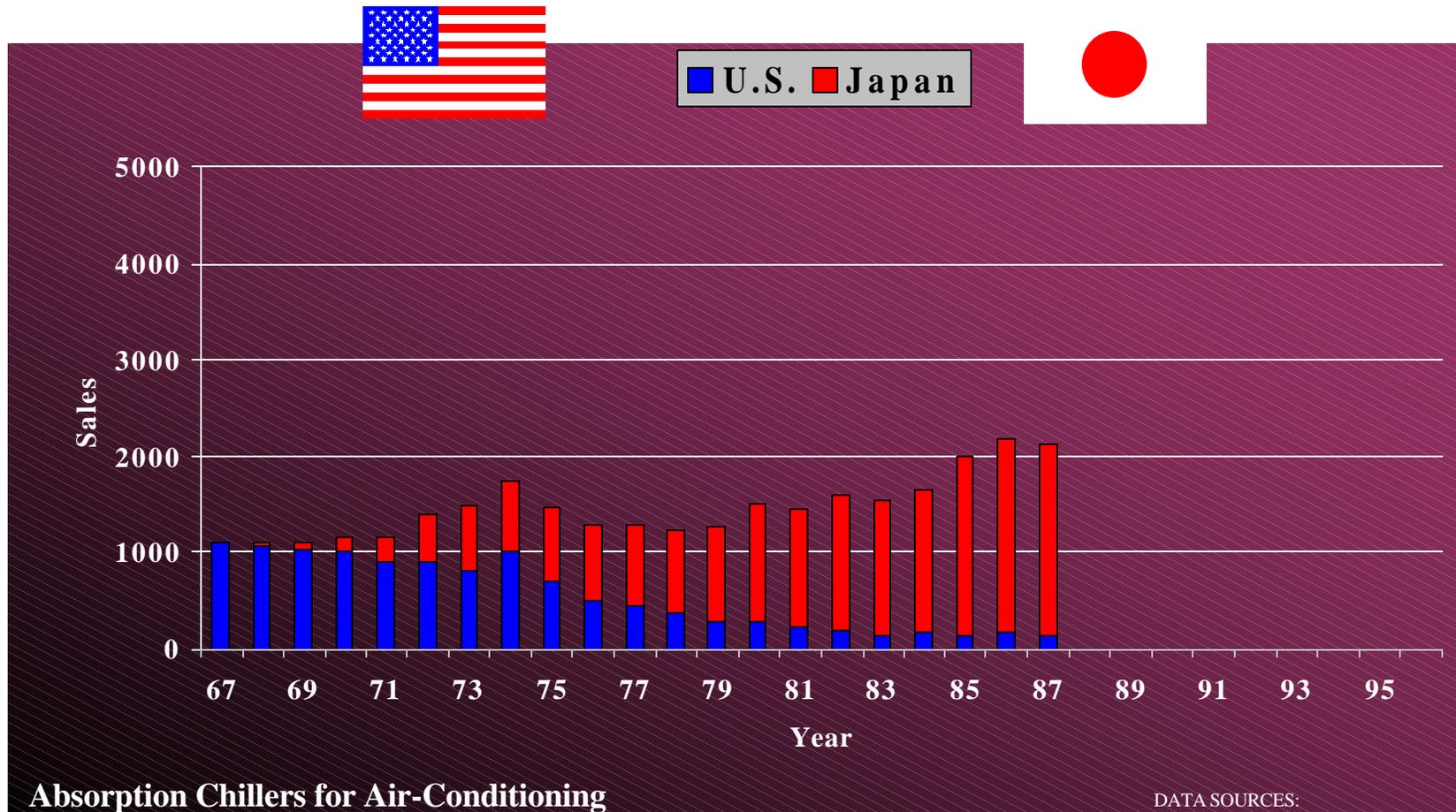
Absorption Chillers for Air-Conditioning

DATA SOURCES:

Large Commercial Buildings

BEA & JAPAN

In Mid - 1980s Worldwide Sales Increased Japanese Manufacturers Dominate Sales



Absorption Chillers for Air-Conditioning

DATA SOURCES:

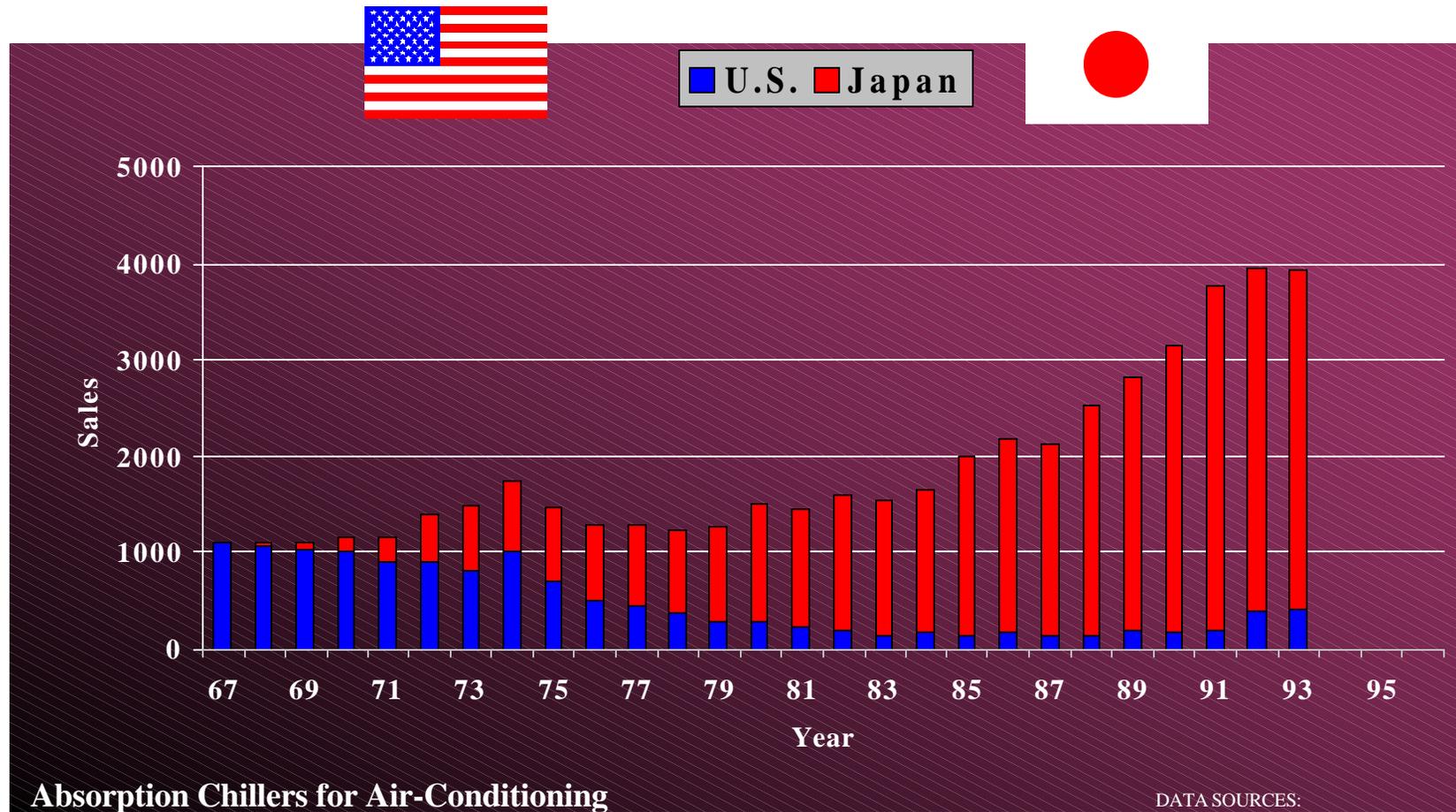
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Worldwide Growth of Absorption Chillers and US Sales Start To Increase in 1990s



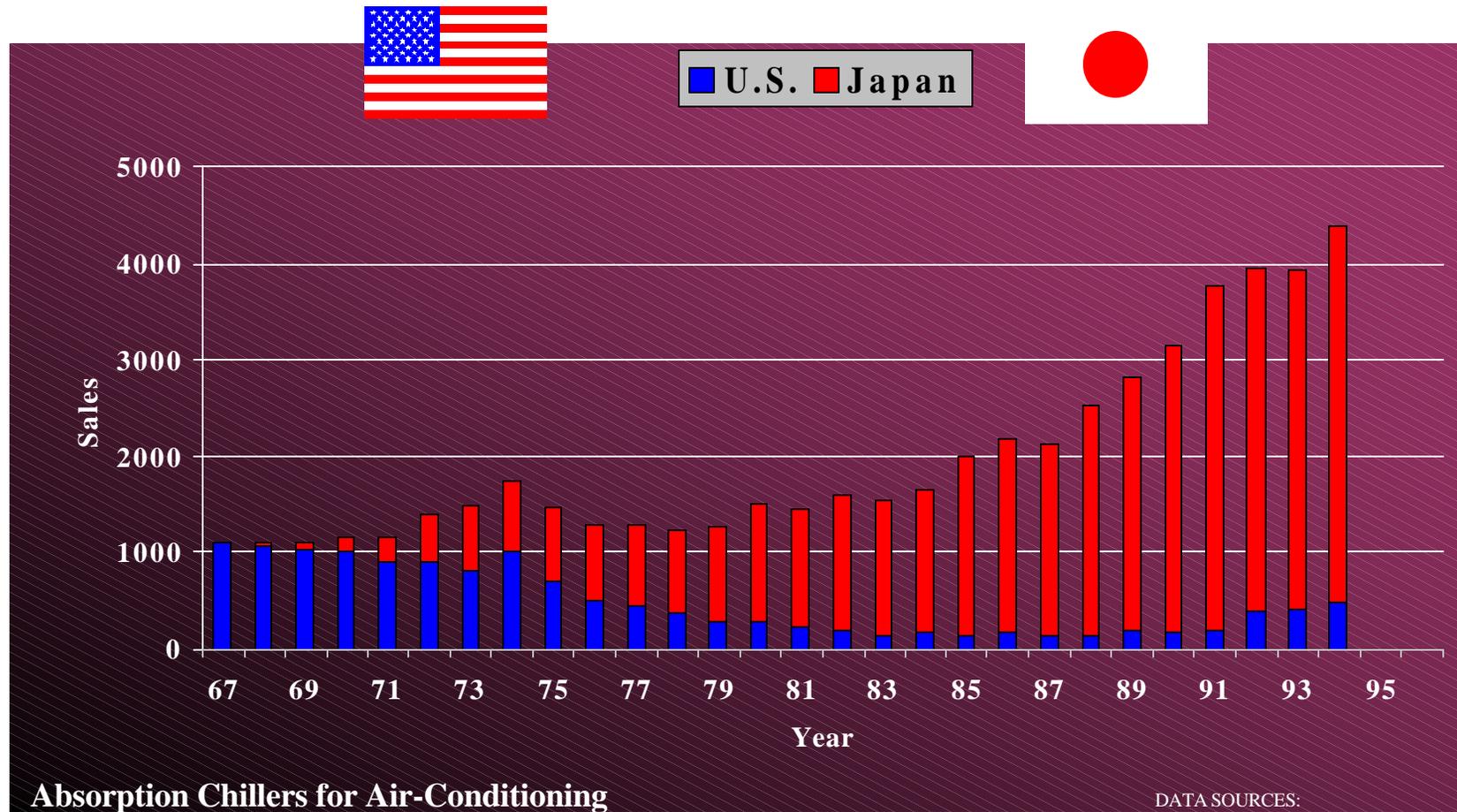
Absorption Chillers for Air-Conditioning

DATA SOURCES:

Large Commercial Buildings

DATA JAPAN

Japanese Absorption Chiller Sales Increase Faster Than US Manufacturers' Sales in 1994



Absorption Chillers for Air-Conditioning

DATA SOURCES:

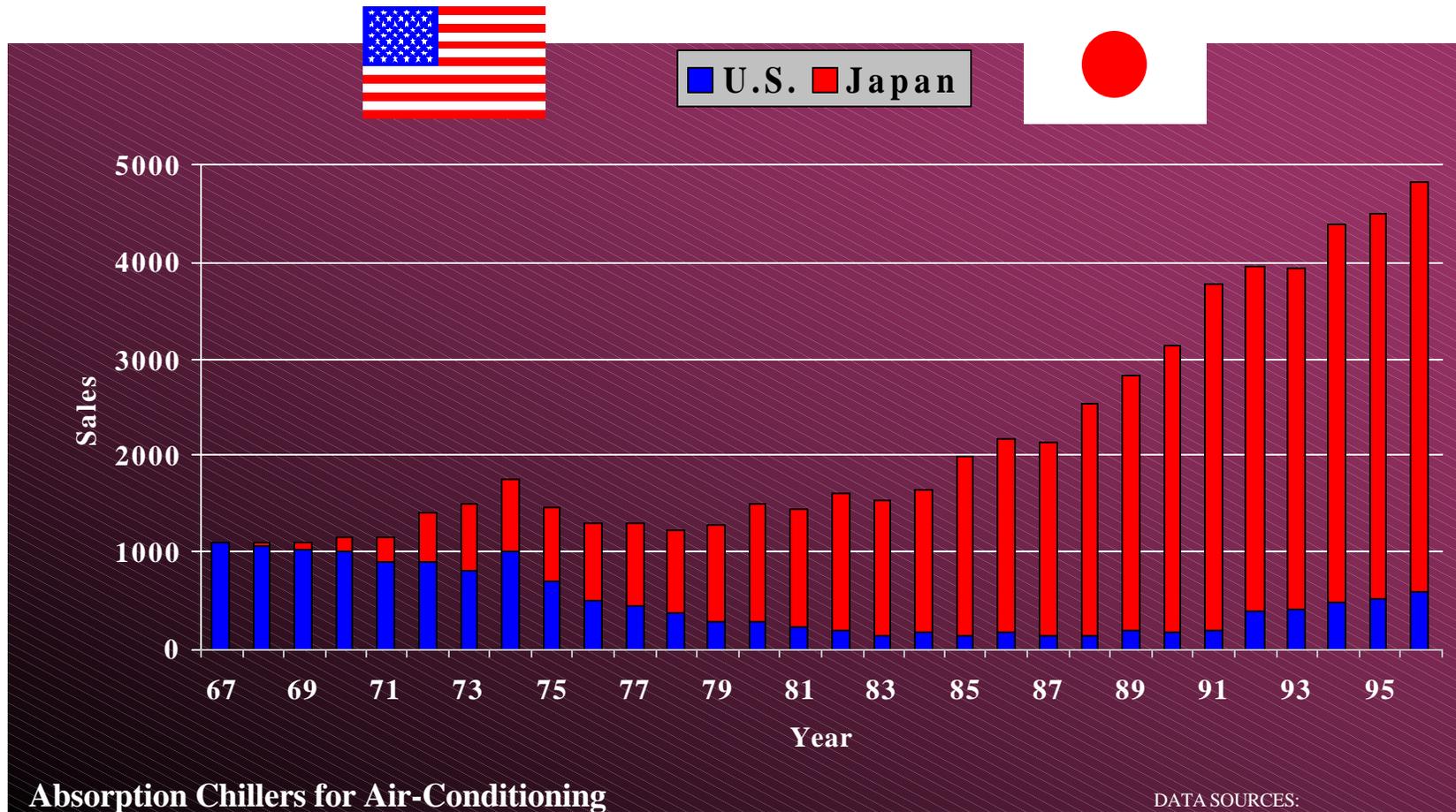
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DATA JAPAN

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Absorption Chiller Sales Continue to Increase In 1995, 1996



Absorption Chillers for Air-Conditioning

DATA SOURCES:

Large Commercial Buildings

DATA JAPAN

Large Commercial Chiller Program

PROJECT OVERVIEW:

- **Develop the Technology to Design, Build and Test an Advanced, High-Efficiency Absorption Chiller.**
- **Use Triple-Effect Cycle to Provide Substantial Improvement in Energy Efficiency**

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PROJECT OBJECTIVES:

Improved Energy Efficiency - Increased COP:

	<u>Cycle COP</u>	<u>Gas COP</u>
1-Effect	0.70	N/A
2-Effect	1.20	1.00
3-Effect Target	1.73	1.36-1.44

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PROJECT OBJECTIVES:

- **Product Considerations:**

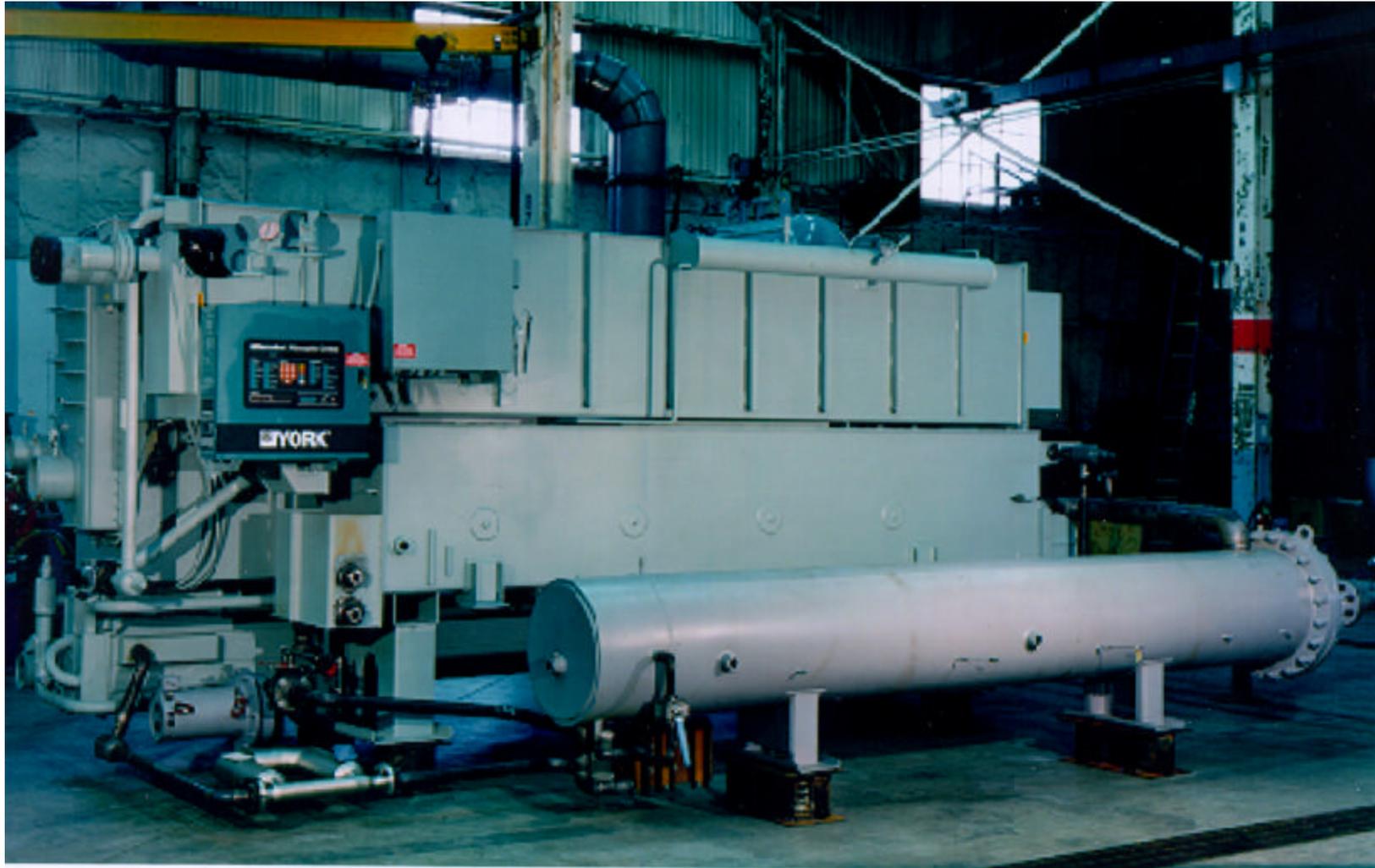
- **Environmental Issues:**

- Ozone Depletion
 - Global Warming
 - NOx Emissions

- **Utility Trends**

- Uncertainty and Volatility Surrounding Deregulation

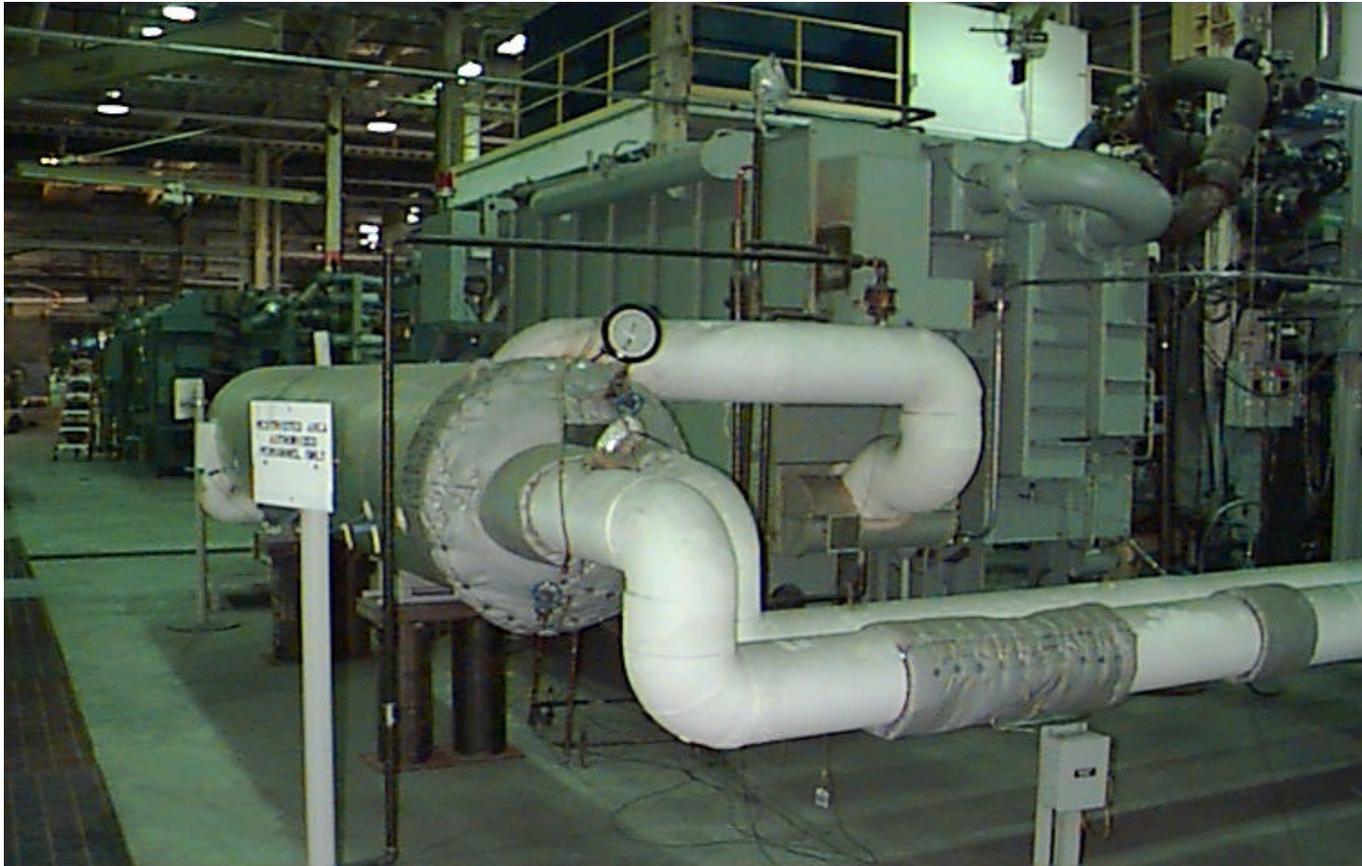
York Triple-Effect Prototype



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Indirect Fired Triple Effect Chiller



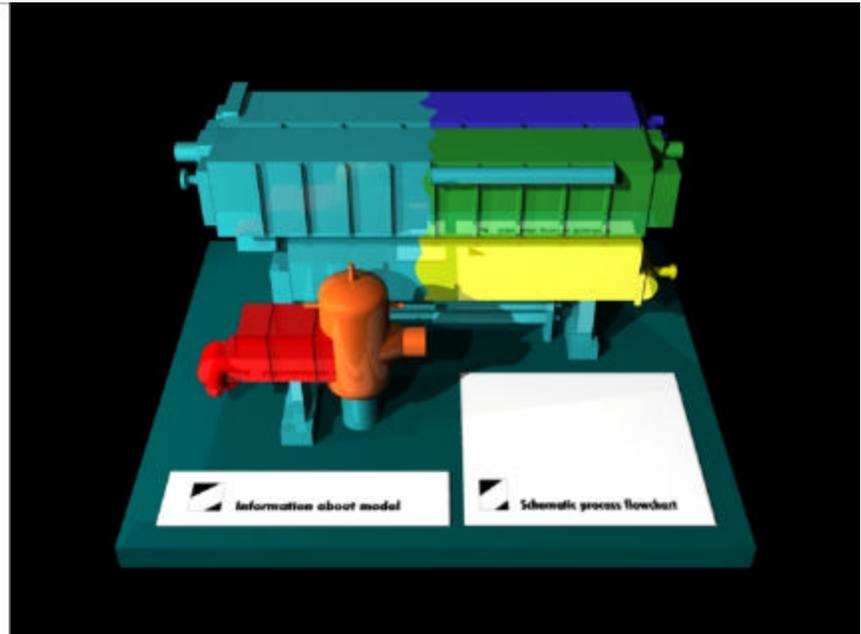
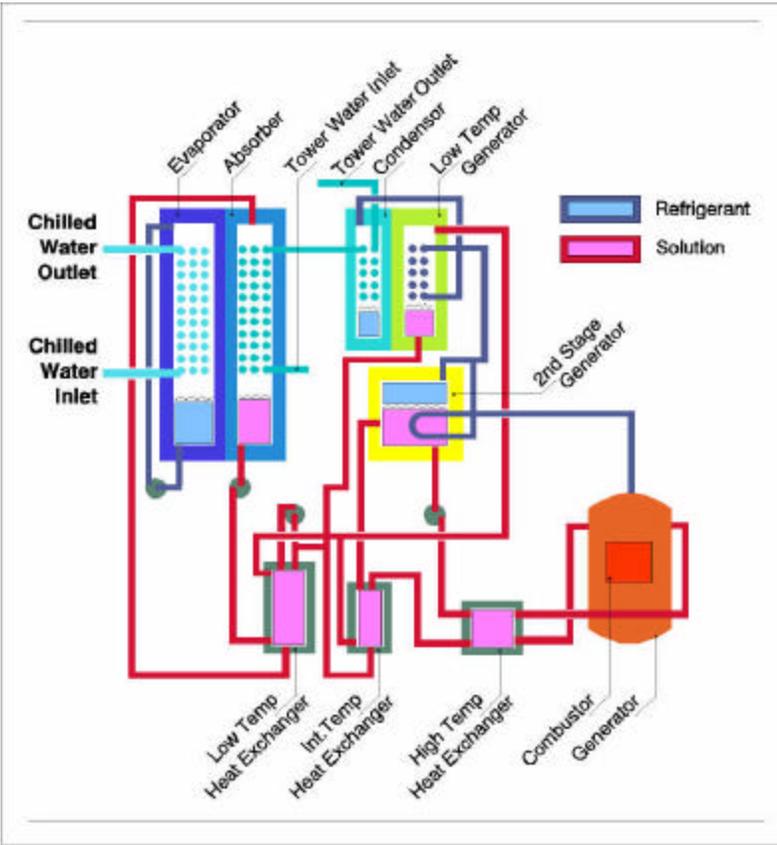
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- **Indirect-Fired Chiller Test results**

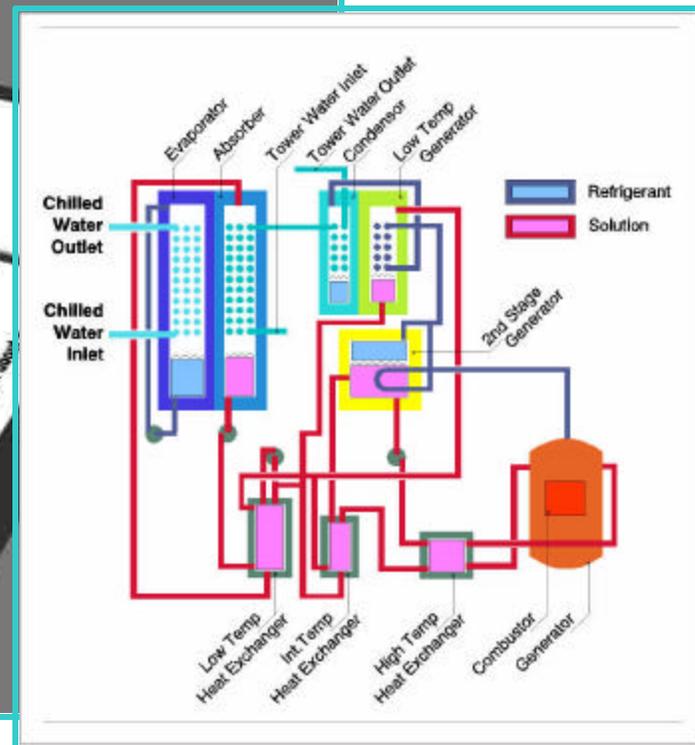
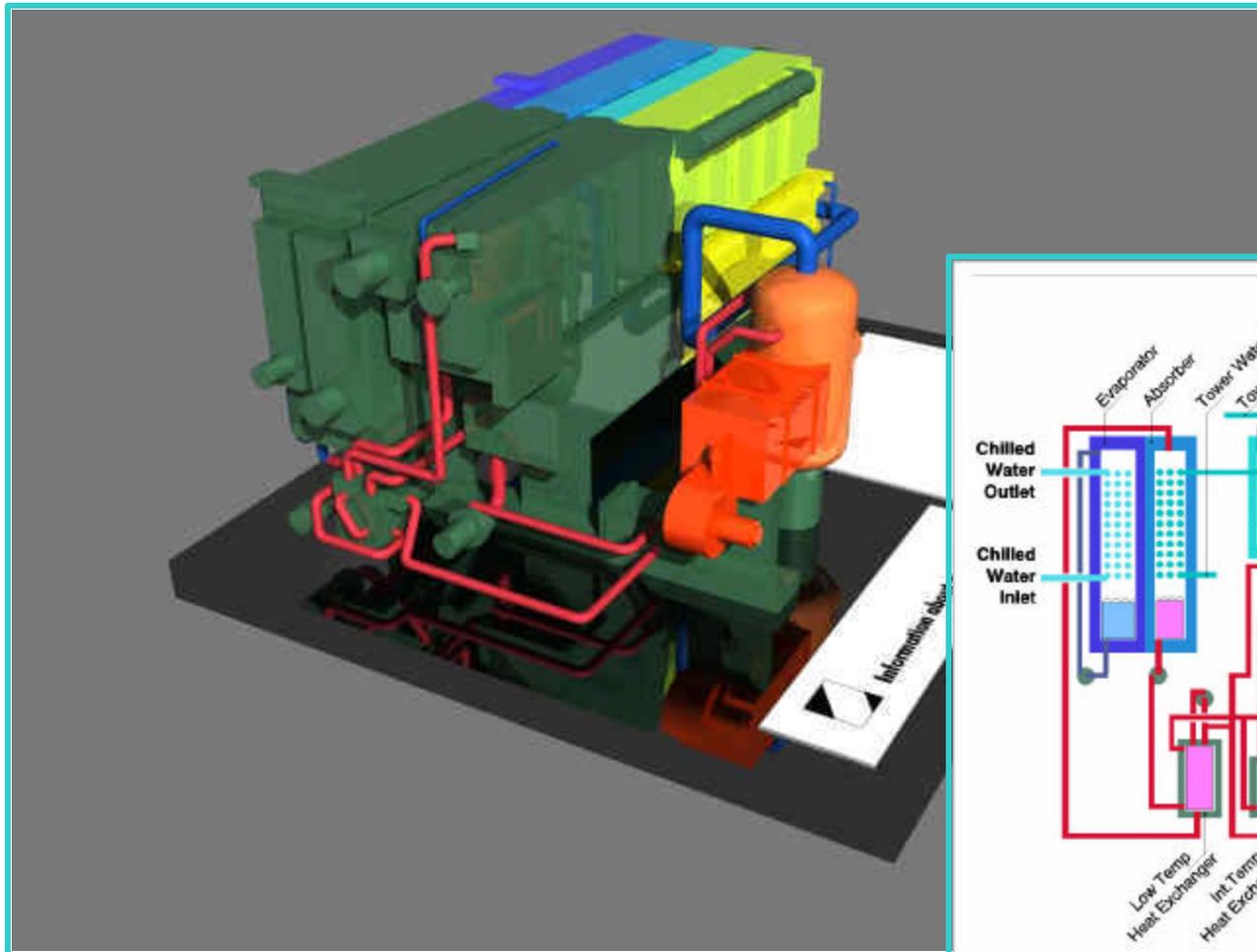
- The triple effect chiller is based on York's double effect absorption chiller
- Capacity: 400+ tons (based on the double effect chiller rating)
- Chiller was operated for a total of about 2000 hours
- No unusual accumulation of non-condensibles in continuous operation at different loads
- COP very close to goal (only a few percent lower than predicted)



Triple-Effect Chiller Prototype
 Model Scale 1:12

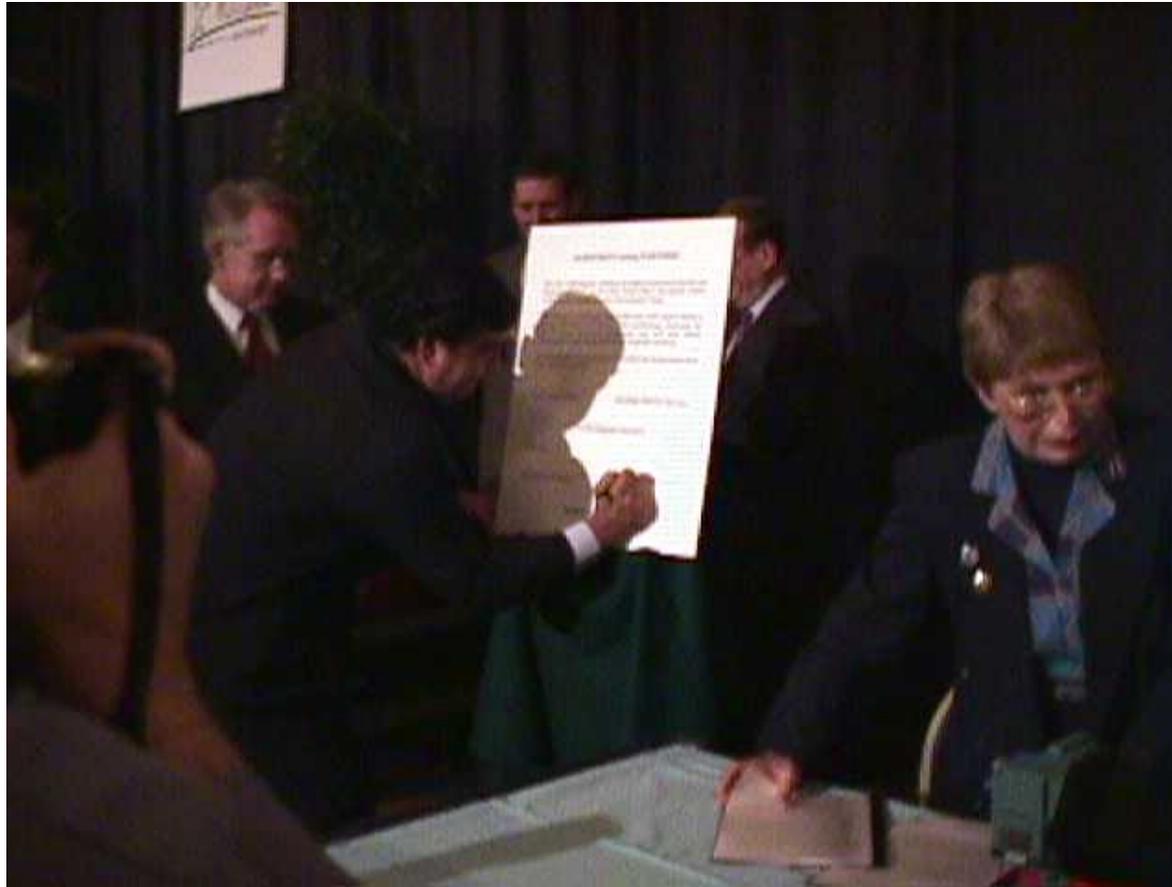
The caption area contains three logos: the University of Tennessee seal on the left, the ORNL logo in the center, and the YORK logo on the right.

Model of Triple-Effect Chiller



Flow Schematic for Triple-Effect Chiller

Secretary Richardson Signs Triple-Effect Chiller Demonstration Letter of Intent





Global Energy Futures Exchange October 27, 1998

Bill Richardson Remarks:

...I am proud to announce the upcoming demonstration--at the Government Center here in Clark County, Nevada --of the world's first Triple-Effect Absorption Chiller, a technology designed for cooling commercial buildings.



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Agreement among Partners set the stage for project initiation. Currently, ORNL is working with Clark County to get formal approvals for test site.

Field test to begin this year.



Clark County Government Center



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Gas Turbine



Solid Oxide Fuel Cell



Micro-turbine



Commercial Phosphoric Acid Fuel Cell



I.C. Engine



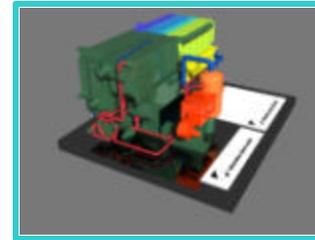
Residential PEM Fuel Cell

900°F

600°F

360°F

180°F



Triple-Effect Absorption Chiller



Double-Effect Absorption Air-Cooled Chiller



Single-Effect Absorption Chiller



Double-Effect Absorption Chiller



Desiccant Technology

Advanced Absorption Technology Offers Benefits for BCHP Applications

- **BCHP offers significant opportunities for maximizing fuel efficiency with the help of existing or easily modified absorption equipment for larger commercial applications.**
 - Single-Effect and Double-Effect Absorption Chillers
- **Advanced absorption technology can offer additional advantages for BCHP applications beyond those achievable with the currently manufactured single-effect and double-effect absorption chiller products.**
 - Triple-Effect chillers
 - Air-Cooled technology
 - GAX technology

BCHP Development Opportunities for Advanced Absorption Technologies

- **Recently developed triple-effect chillers can add significant additional cooling capacity.**
 - Compared to single & double-effect chillers in same BCHP applications using recovered heat for large commercial buildings.
- **Development of smaller air-cooled absorption chillers (10 RT to 150 RT sizes) would expand BCHP opportunities.**
 - Eliminating need for cooling towers.
- **Development of small GAX absorption heat pumps specifically adapted to BCHP applications is possible.**
 - Potential for residential and small commercial BCHP systems at the highest possible energy efficiency levels.