



Energy savings in Refrigeration using VAM

**Presented by
Rejith Ratnakaran
Thermax
On 12th March 2010**





Thermax



- More than 3 decades of Industry expertise
- Core business in Energy conservation & Environment preservation
- Total Energy solution provider
- Operating in more than 70 countries, worldwide
- Most modern ISO 9002 / ISO 14001 certified plant
- A Rs. 3300 Crore, Engineering and Environment major.





Thermax product portfolio



- Process Boilers
- Power Boilers
- Heat Recovery Boilers
- Vapour Absorption Chillers
- Waste Water Management
- Pollution & Environmental Control Equipments.
- Chemicals
- Captive Power Generation.





What is Vapour Absorption ?

- Vapour Absorption Technology is an alternative cooling technology that saves money and reduces the environmental impact of your cooling solution.
- Unlike conventional electricity driven Compression machines, Vapour Absorption Machines are driven by waste heat sources like Steam, hot water, natural gas, fuel oils, Agro waste and other similar fuels.
- Since heat is the source of energy, operating cost of VAMs is minimal leading to wide industry popularity





Why Vapour Absorption ?

- **Power Cost**
- **Power availability**
- **Alternative fuels cannot be utilized**
- **Low grade, waste energy needs to be utilized to reduce operating costs**
- **There is a need for CFC free technology**



DRAWBACKS OF CONVENTIONAL SYSTEMS

- ↘ Alternative Energy Source Cannot Be Used.
- ↘ Consumes Costly & Scarcely Electricity.
- ↘ Uses Harmful CFC / HCFC As Refrigerants
- ↘ High Operating & Maintenance Cost
- ↘ High Noise & Vibration





ADVANTAGES OF ABSORPTION COOLING SYSTEMS



World Leaders in Vapour Absorption Technology





CHEAP TO OPERATE...

Steam

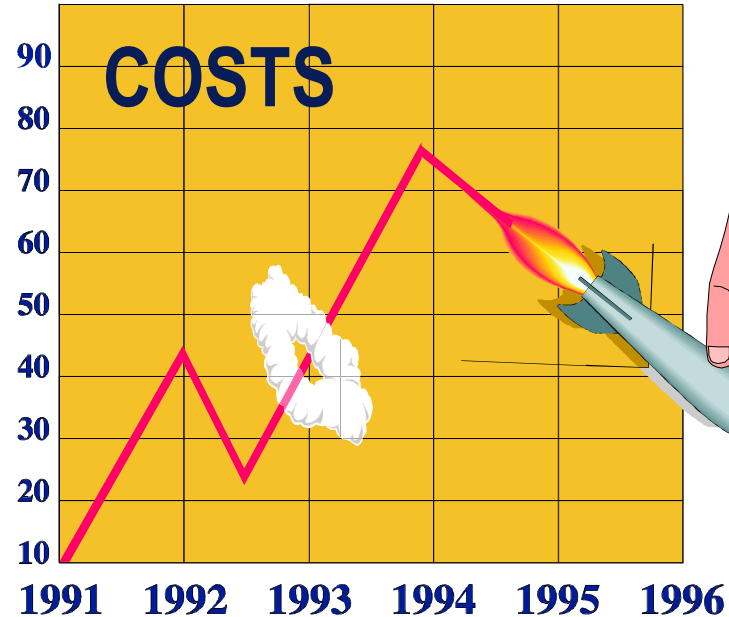
- Steam from Exhaust Gas Boiler
- Steam from Solid Fuel Boiler
- Back Pressure Steam from turbine
- Excess Steam available in plant
- Steam from Agro waste fired Boiler

Hot Water

- HT hot water from Gensets
- Hot water from process
- Any other source of Hot water

Fuels like Natural Gas, LPG, BioGas, SKO, HSD

Exhaust of Gas engines, Turbines, furnaces etc



NO DEPENDENCE ON ELECTRICITY...



Freedom From H. T. Power.



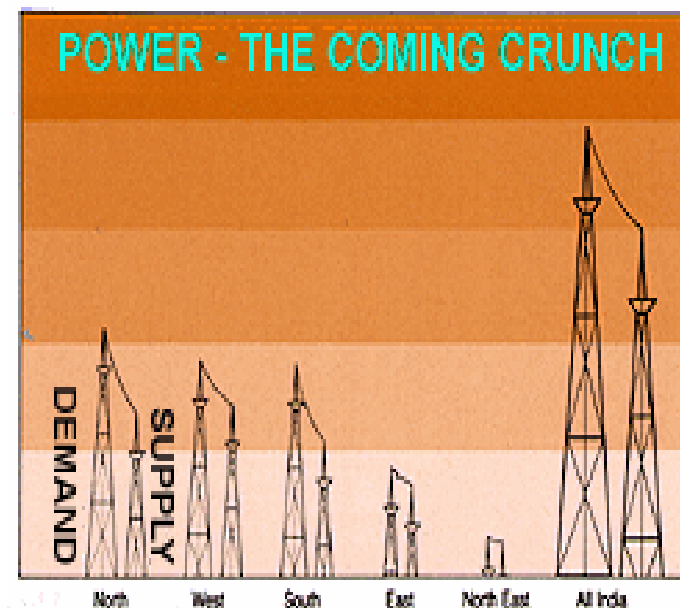
Transformer Becomes Redundant



Reduction in Electrical Accessories Such as Cabling, E B Deposit, MCC Etc.



DG Back-up is Considerably Reduced

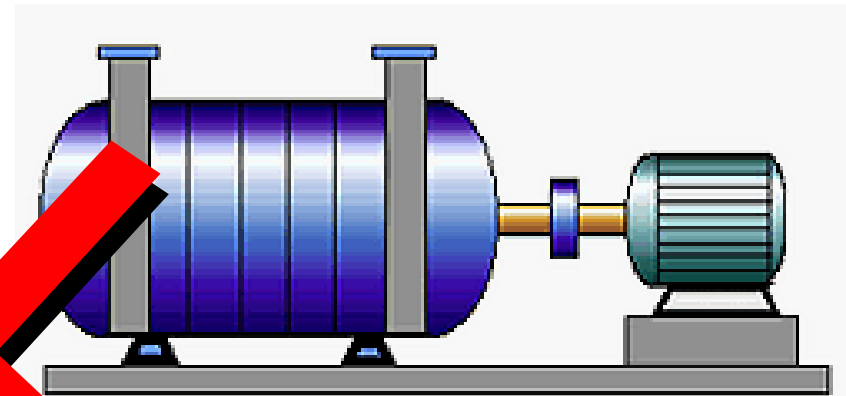


NO MOVING PARTS

VAPOUR ABSORPTION MACHINE DOES NOT USE BIG COMPRESSOR OR MOTOR FOR ITS OPERATING CYCLE.

↪ NO WEAR & TEAR

↪ LESS DOWN TIME





No

VIBRATION



NO DYNAMIC LOADING.



FLEXIBILITY OF INSTALLATION



ROOFTOP INSTALLATION
SAVING OF FLOOR SPACE
FOR COMMERCIAL USE.



SILENT OPERATION



NEGLIGIBLE MAINTENANCE



NO MOVING PARTS



NO REFRIGERANT LEAK



NO TOP-UP
REQUIREMENT




NEGLIGIBLE
MAINTENANCE





EFFICIENT PART LOAD PERFORMANCE

 Automatic & Step-less Modulation
from 10 % to 100% Load

 Same Efficiency In Part
Load Operation.

 You spend for what you
use



ENVIRONMENTAL SCENARIO



Rising concern over use of CFCs/HCFCs



Planned phase out of the CFC/HCFC based refrigerants



No proper substitute found



Costly



Scarce



Reduced Efficiency



Higher global warming potential



Growing concerns over *GLOBAL WARMING*



EFFECTS Of OZONE LAYER DEPLETION



HUMAN

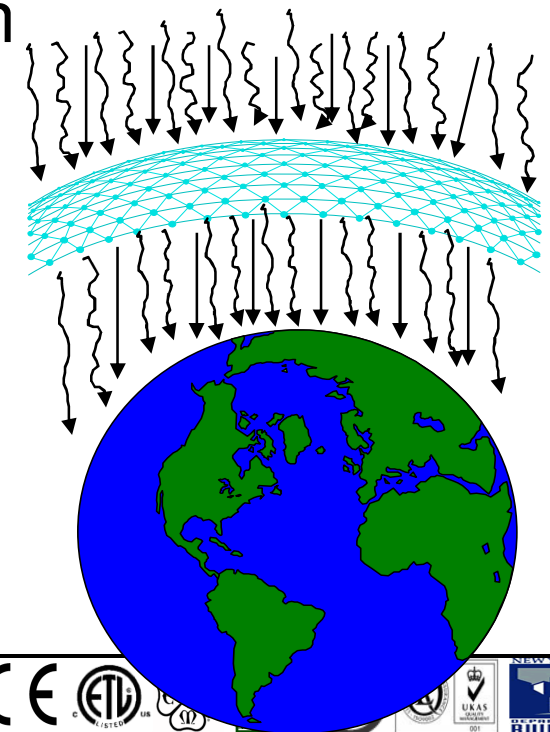
Cataracts, Accelerated Ageing,
Wrinkling & Skin cancers.
Reduced immune response
leading to susceptibility to
infectious diseases

MARINE LIFE

Effect on growth of phytoplankton, the
mainstay of the ocean food chain

PLANTS

Interference with photo synthesis
leading to lower crop yields





CFC FREE

USES WATER AS REFRIGERANT



Zero Ozone Depleting Potential



No Future Conversion Cost



LESS GLOBAL WARMING POTENTIAL



No Global Warming
Potential



Reduces Green House
Gas Emissions By 50 %

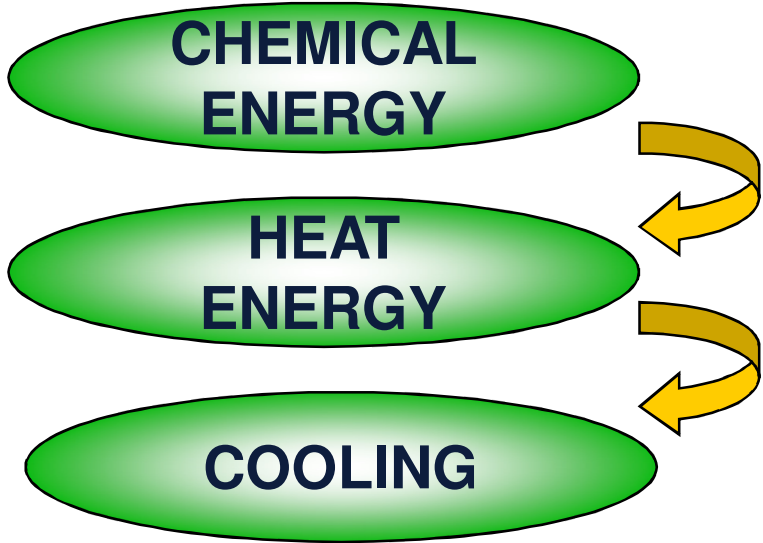
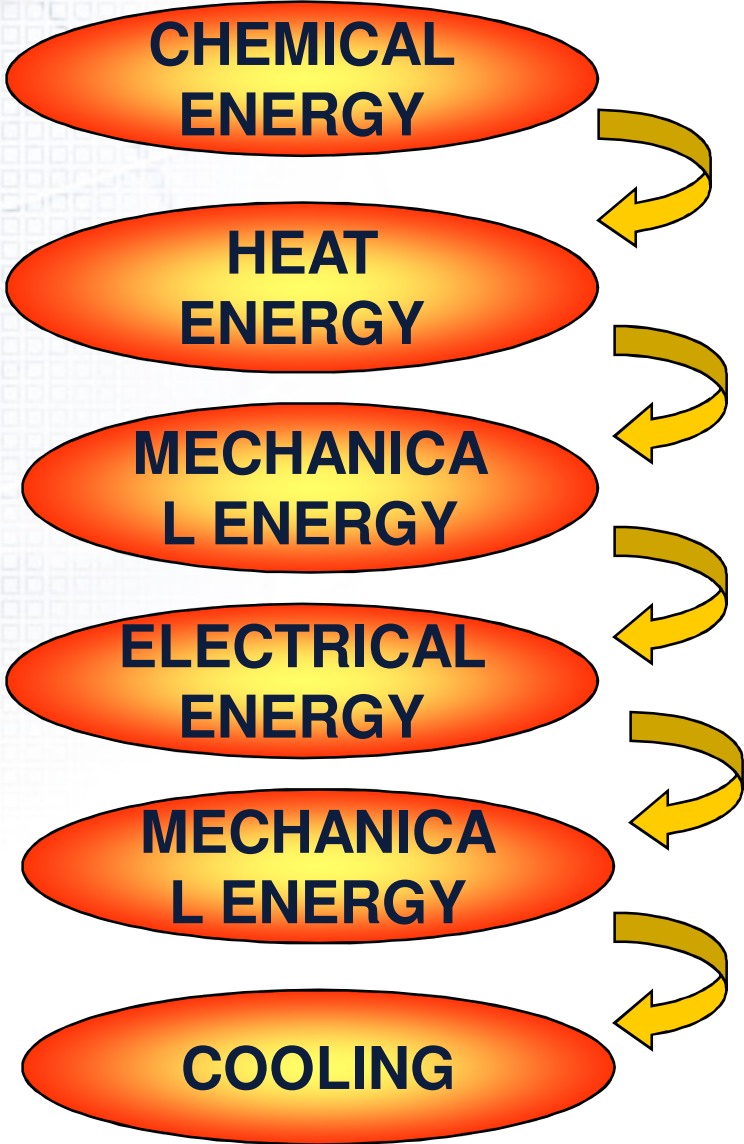




COMPRESSION

Vs

ABSORPTION





THERMAX LITHIUM BROMIDE BASED VAPOUR ABSORPTION CHILLERS

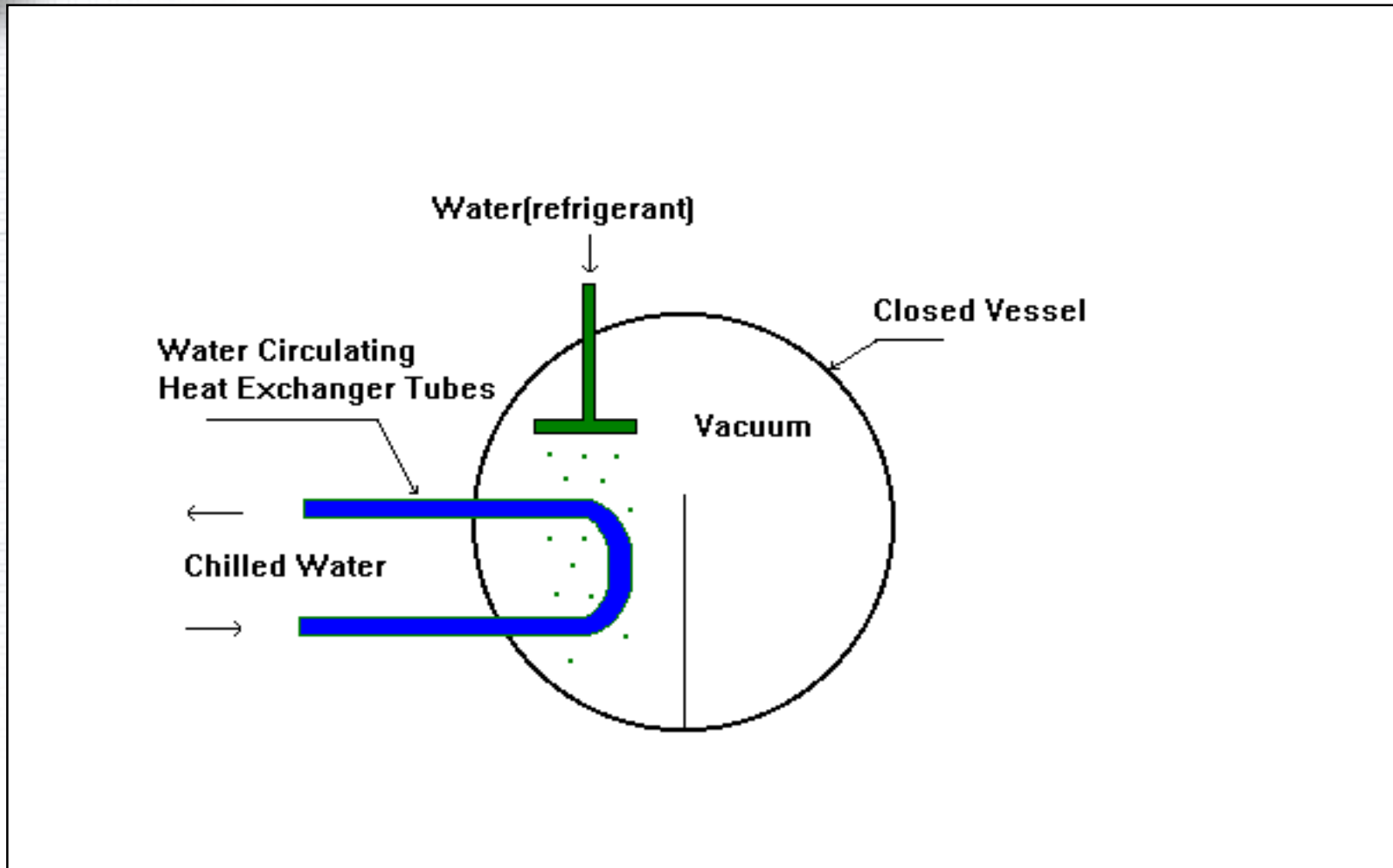


World Leaders in Vapour Absorption Technology



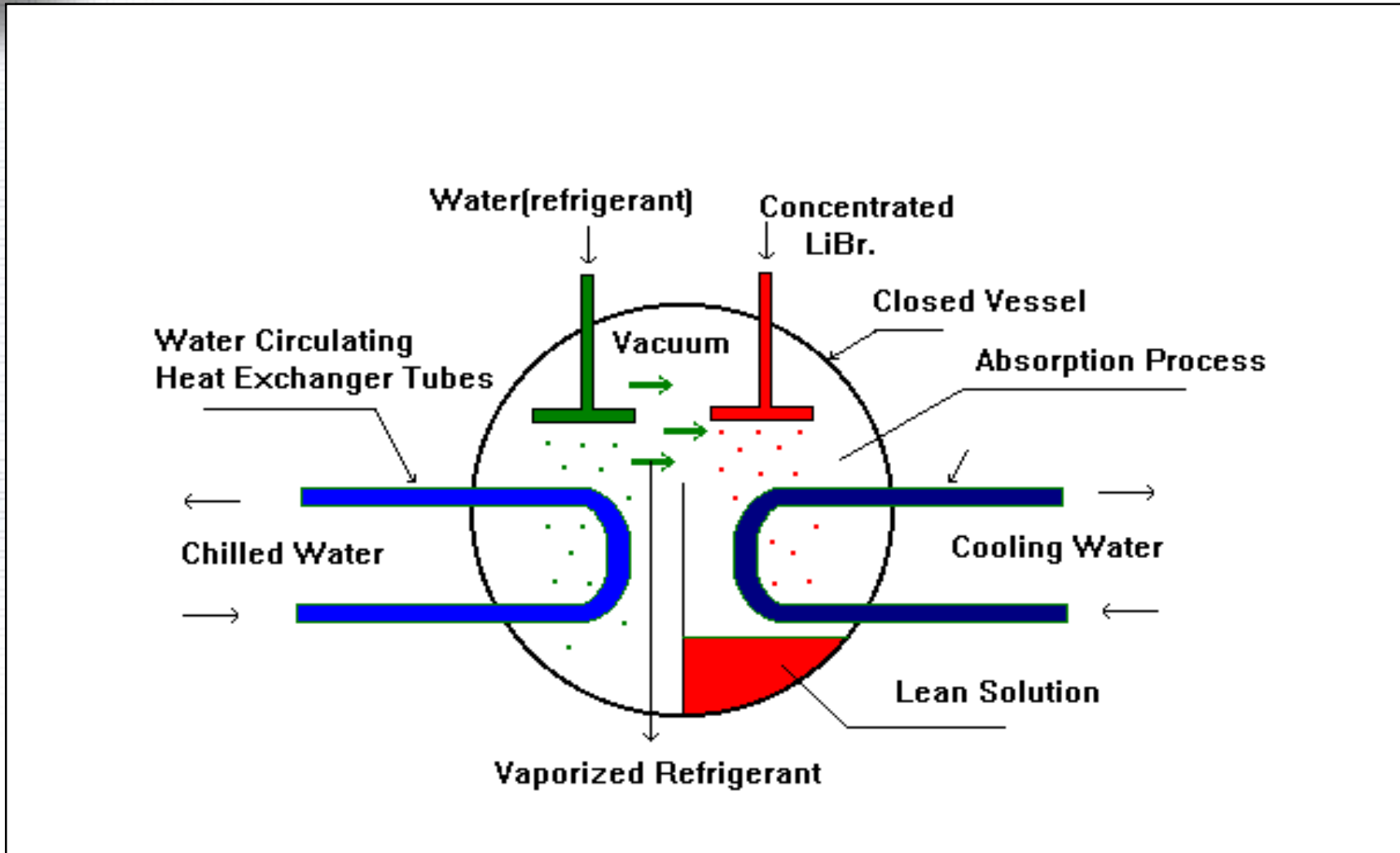


How Absorption Chillers work?



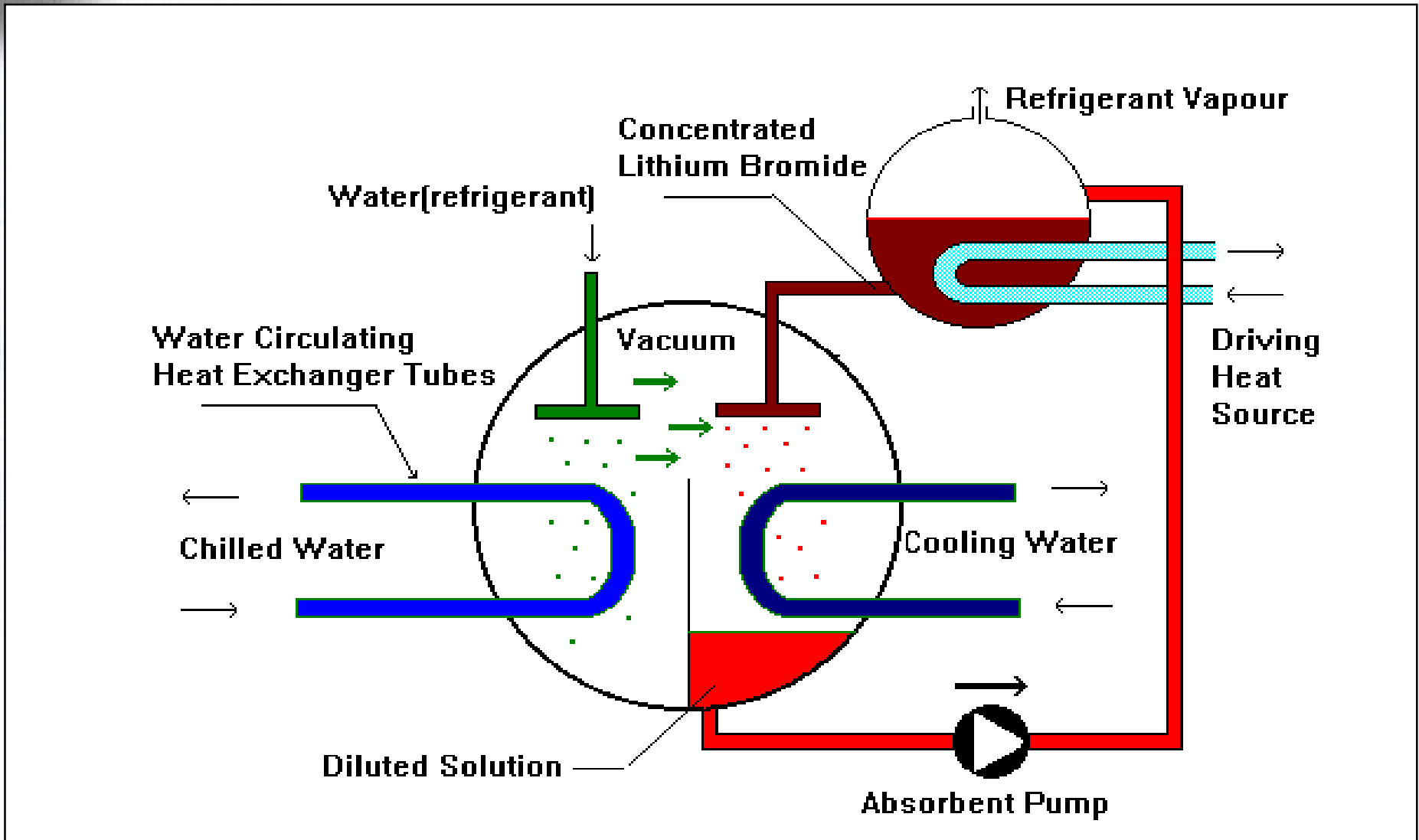


How Absorption Chillers work?



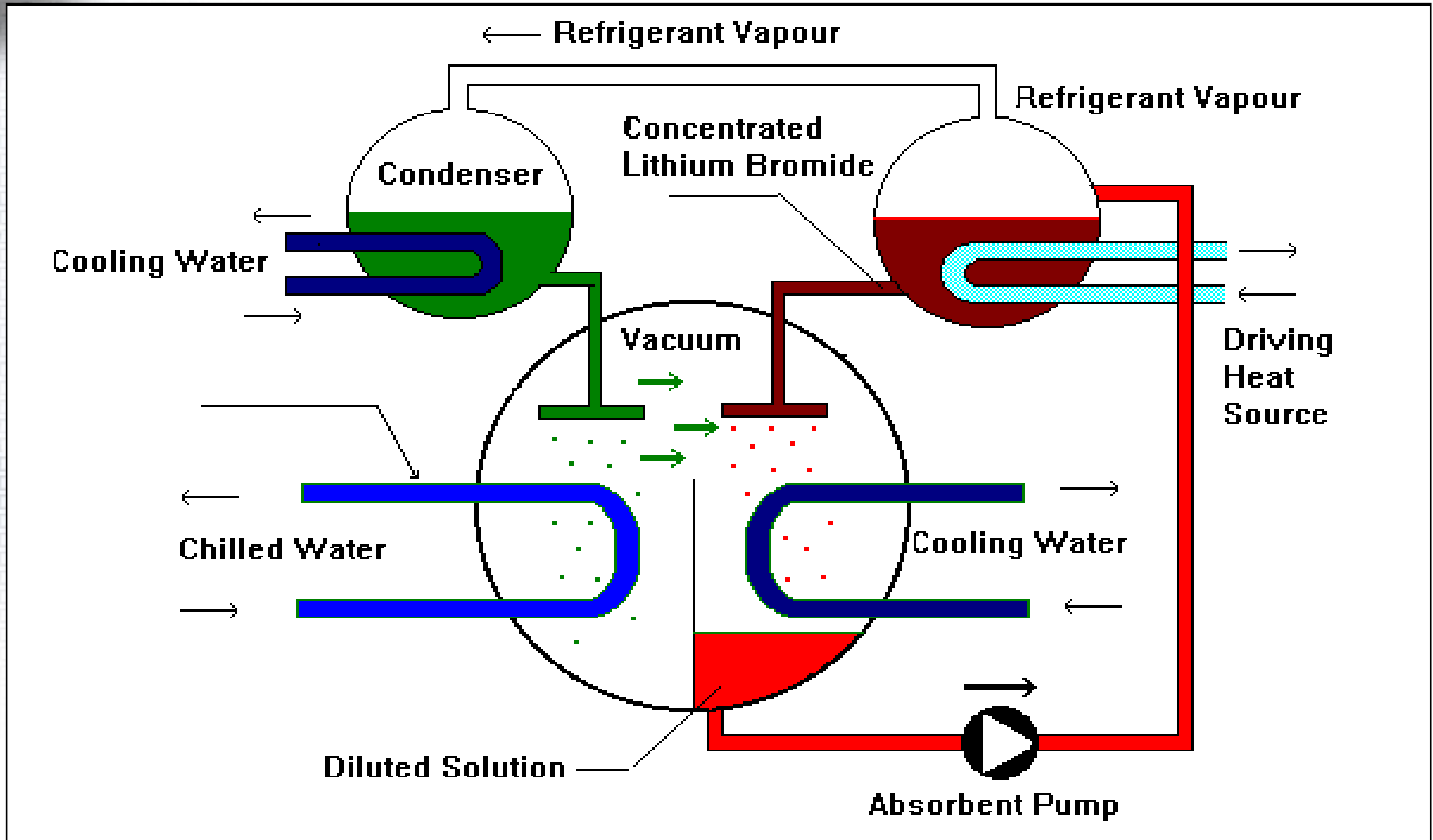


How Absorption Chillers work?





How Absorption Chillers work?





Hot Water Driven Chillers



ProChill

**CHILLED WATER
TEMP. UPTO
3.5 DEG C and
GLYCOL AND WATER
AT 0 DEG C**



**HIGHEST
EFFICIENCY
CHILLERS**

<u>Type</u>	<u>Temperature</u>	<u>Capacity</u>
Low Temperature (LT)	70°C - 110°C	100 - 650 NTR
Medium Temperature (MT)	110°C - 150°C	100 - 1400 NTR
High Temperature (HT)	150°C - 200°C	100 - 1400 NTR



World Leaders in Vapour Absorption Technology





Steam Fired Chiller



THERMAX ProChill™ **B4k**



**PRODUCES
CHILLED
WATER AT 3.5
DEG C AND
GLYCOL AND
WATER AT 0
DEG C**

**CRYSTALLIZATION
FREE**

**CONSUMES LESS THAN
4 Kg STEAM/TR**



Direct Fired Chiller



EcoChill *Next*



**10 – 100 %
STEPLESS
MODULATION**

COP of 1.3

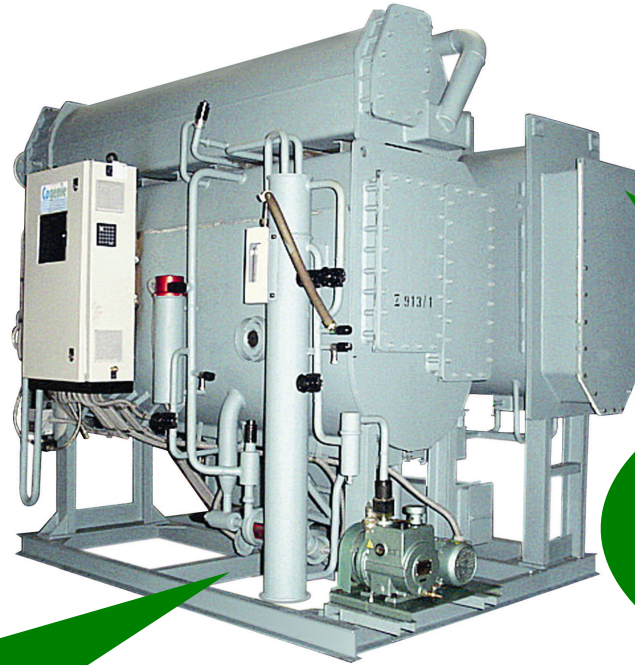
**CONSUMES
LESS FUEL
THAN
COMPETITION**

COMPETITION





Direct Exhaust Gas Fired Chiller



COMPACT DESIGN

CAN WORK ON EXHAUST OF ENGINE, DG, TURBINE etc.

HIGHEST EFFICIENT CHILLERS – COP 1.3

EXHAUST ALONG WITH AUXILLIARY FIRING & HOT WATER RECOVERY





Advantages of Vapour Absorption



- **Runs on low grade heat, giving savings on operating cost**
- **Saves on investments on Genset backup**
- **Efficient part load performance with automatic control**
- **No moving parts, thus no noise and vibrations**
- **Low maintenance equipment**
- **CFC free, eco-friendly technology**



Refrigeration System in Dairies





Where do Dairies require cooling -



- Raw Milk Cooling
- Pasteurizer
- Cream section
 - Cream Cooling
 - Cream Pasteurizer
 - Cream Ripening Tank
 - Butter Churn / CBM Machine
- Ghee Cold Room
- Air Dehumidification
- Others - UHT Plants + Aseptic Packing
- Comfort AC (if required)





Types of Dairies based on product manufactured



- Pouch Milk, Butter & Ghee
(Small Dairies - 10,000 ltrs/day to 1,00,000 ltrs/day)
- Milk Derivatives - Cheese, Yogurt, Flavoured Milk, Butter, Tetra Pak, etc
(Medium Dairies - 1,00,000 ltrs/day to 3,00,000 ltrs/day)
- Milk Powder & Ghee
(Medium to Large Dairies - 2,50,000 ltrs/day to 10,00,000 ltrs/day)





Refrigeration Load of Dairies



- Depends on Milk Collection
 - Can Milk
 - Road Milk Tankers
- Products Manufactured





Where can VAM fit in???

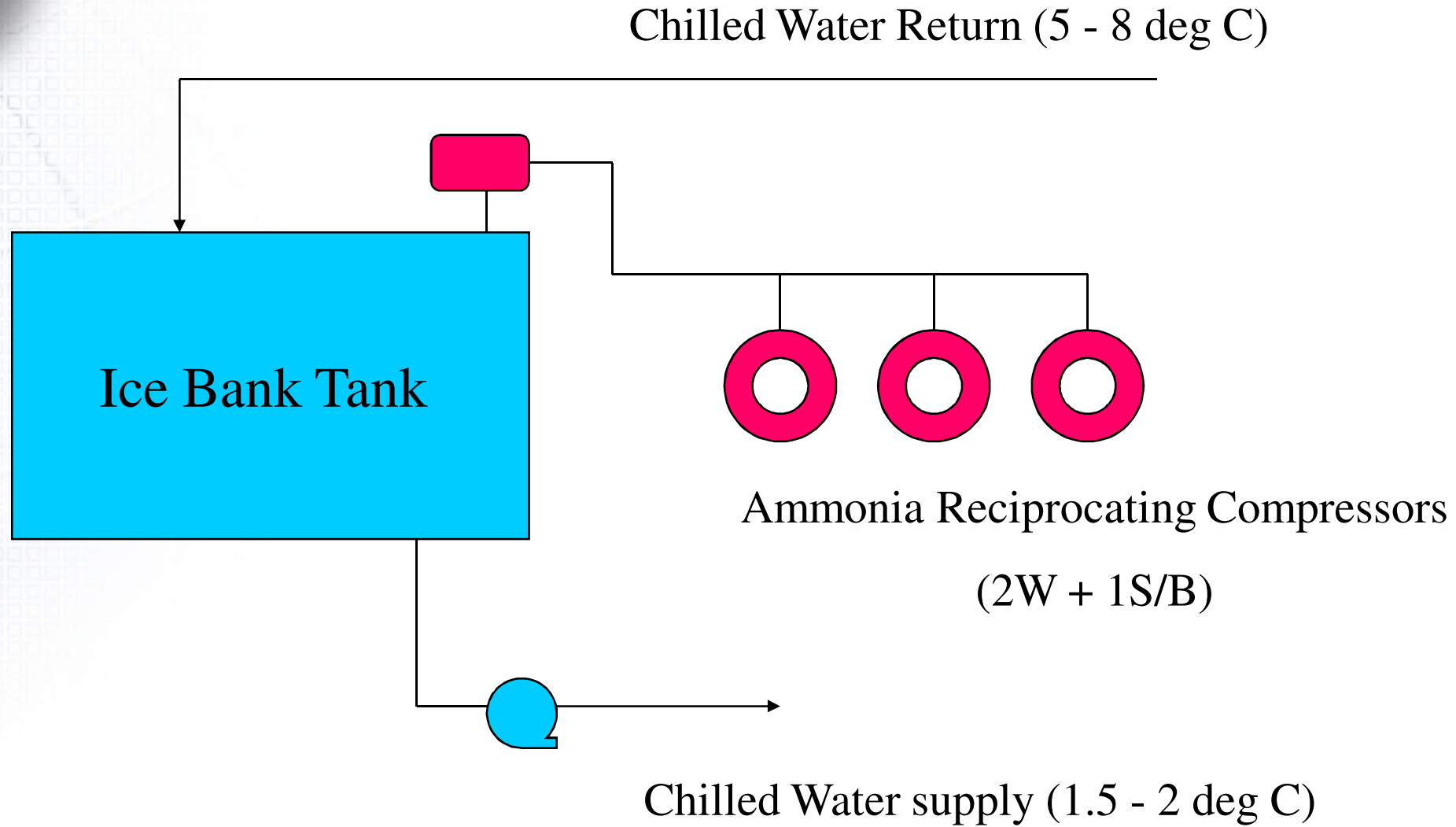


- Steam is from solid fuel fired boiler
- GRID power is unreliable & costly
- COGEN - back pressure steam is available
- Engine is running on base load – both jacket water and exhaust can be used .



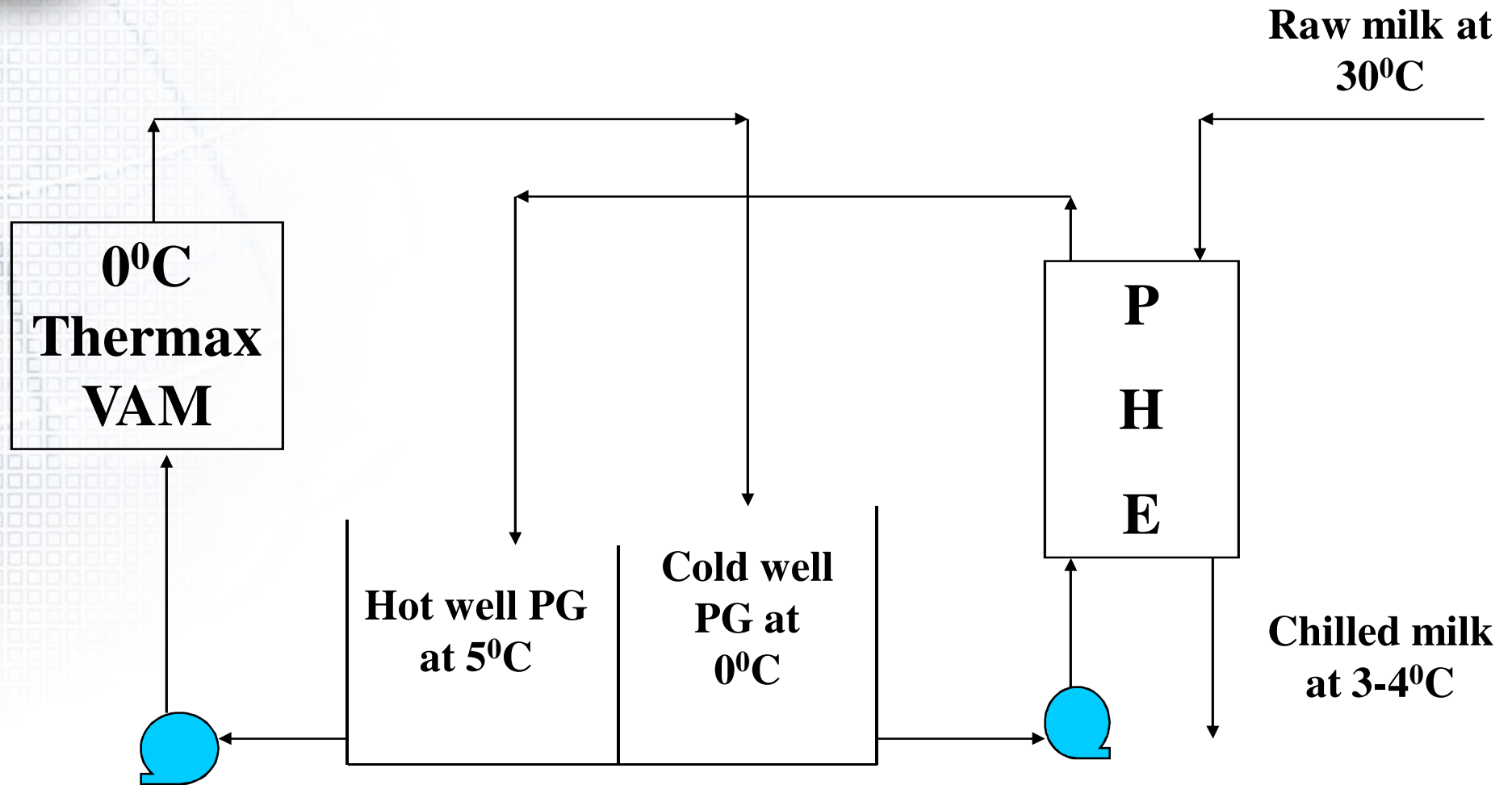


Typical Refrigeration System in Dairies -



OPTION USING 0°C VAM

Scenario - 1 : Raw milk Chilling without IBT





VAM Chilling capacity



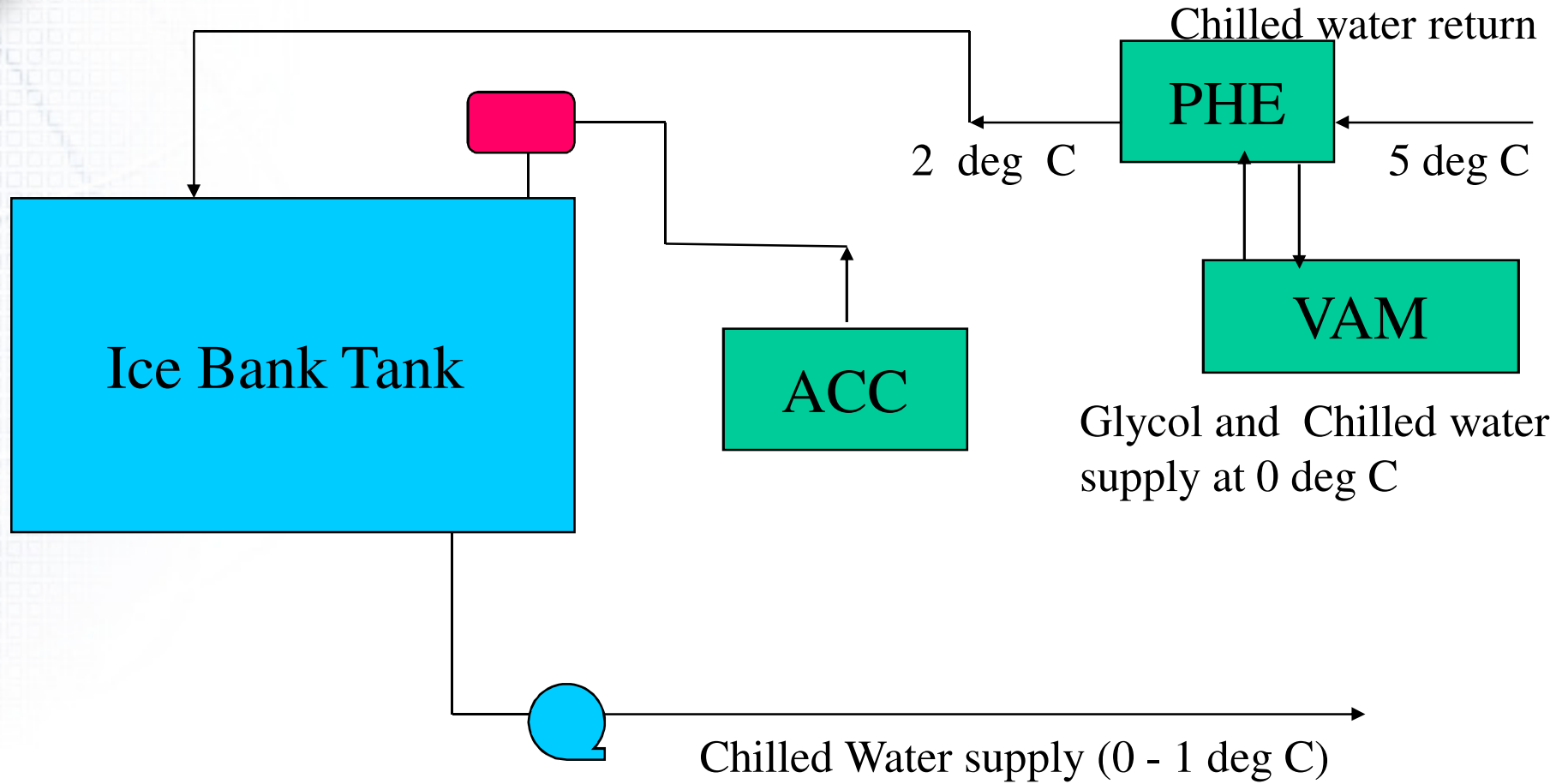
- What is the need for IBT?
- No need to run ammonia compressor for 24 hours
- Considering 80,000 liters of raw milk to be chilled from 30°C to 4°C in 6 hours, Chilling load = 112 TR
- Reference installations in MMD, Erode & SNP Dairy, Madurai





OPTIONS USING VAM

Scenario - 3 : Chilled Water returns at 5 deg C





Advantages of VAM vs. Conventional System



- Lower operating Cost
- Steam is mostly available & sparing 800 - 1000 kg/hr should not be a problem
- Dairies generally come up for expansion and getting additional power could be a problem
- Maintenance cost would be considerably lower





VAM/AVAM users in Dairy industry



- Milk Food, Patiala 180TR VAM + 120 TR AVAM
- Milk Food, Moradabad 180TR VAM + 120TR AVAM
- Chitale Dairy, Sangli 250 TR & 200 TR DESF VAM
- Parag Dairy, Pune 150 TR DESF VAM
- Shivamrut Dairy, Sholapur 200 TR DESF VAM
- Amul dairy, Anand 350 TR Exhaust VAM
- Mother Dairy, Gandhinagar 200 TR x 2 Hot water VAM
- Modern Dairy, Punjab 250 TR x 2 DESF VAM
- Sterling Agro, Kasganj 315TR SESF VAM
- Ved Ram & Sons 250TR DESF VAM
- Cadbury, Pune 250 TR DESF VAM
- Cadbury, K'taka 250 TR DESF VAM
- Cadbury Nigeria 3x600TR DESF VAM
- Nestle India 100 TR HWF VAM
- Nestle Phillippines 2x1400TR DESF VAM



Founder :- Late Sahakar Maharshi Shankarrao Mohite-Patil

Reg. No. S.U.R. / M.K.T.
Dairy 104 / 1976
Date 27-1-1976



SHIVAMRUT

Dudh Utpadak
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522126, 522915

Shankarnagar Office :- 522426, Chairman Resi. - 522590
Managing Director :- 522914, Resi. - 522426, 522614
Fax No. - (0218) 522617

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Po. Yeshwanthnagar (413 118)
Tal. Malshiras, Dist. Solapur (Maharashtra)

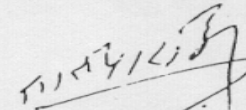
Outward No. / Shivamrut /

Date :- 1/8/1998

// TO WHOMSOEVER IT MAY CONCERN //

This is to Certify that M/S. DELTA ENGINEERING CORPORATION have successfully completed the Erection and Commissioning of THERMAX make Vapour Absorption Machine Model B 213 on a Turnkey basis in June 1996.

The system is used for Milk Chilling and is Operating continusly without any problems since June 1996.



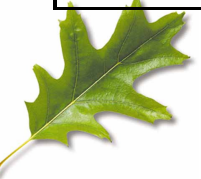
(S. S. PATIL)
MANAGING DIRECTOR
SHIVAMRUT-VIJAYNAGAR



Operational cost analysis



DESCRIPTION	UNIT	Electrical	VAM
Chilling Output	TR	100	100
System type		Reciprocating	Steam fired
Power consumption	KW/hr	150	3
Power cost per unit	Rs/KWH	4.5	4.5
Power cost per hour	Rs/hr	675	14
Steam consumption	Kg/hr	NA	461
Steam cost per Kg	Rs/kg	NA	0.9
Steam cost per hour	Rs/hr	NA	414.9
Total Operational Cost per hour	Rs/hr	675	428
Operational Savings per hour	Rs/hr		247
Operational hours per year	Hrs		8000
Operational Savings per year	Rs/year		1,972,800





THERMAX's Worldwide



World Leaders in Vapour Absorption Technology





Worldwide Subsidiaries & Representative Offices



World Leaders in Vapour Absorption Technology





Nestle, Philippines



Process cooling for the Nestle facility



3 MW CAT Engine



Exhaust Gas Fired Boiler

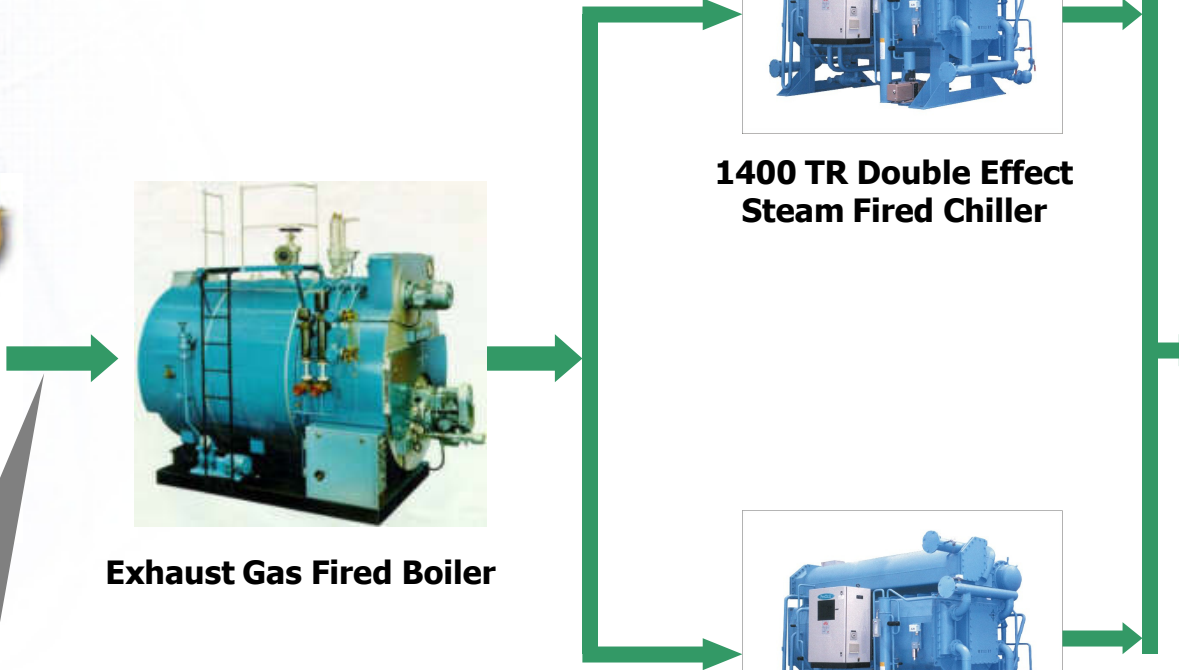


1400 TR Double Effect Steam Fired Chiller



1400 TR Double Effect Steam Fired Chiller

Exhaust Gas

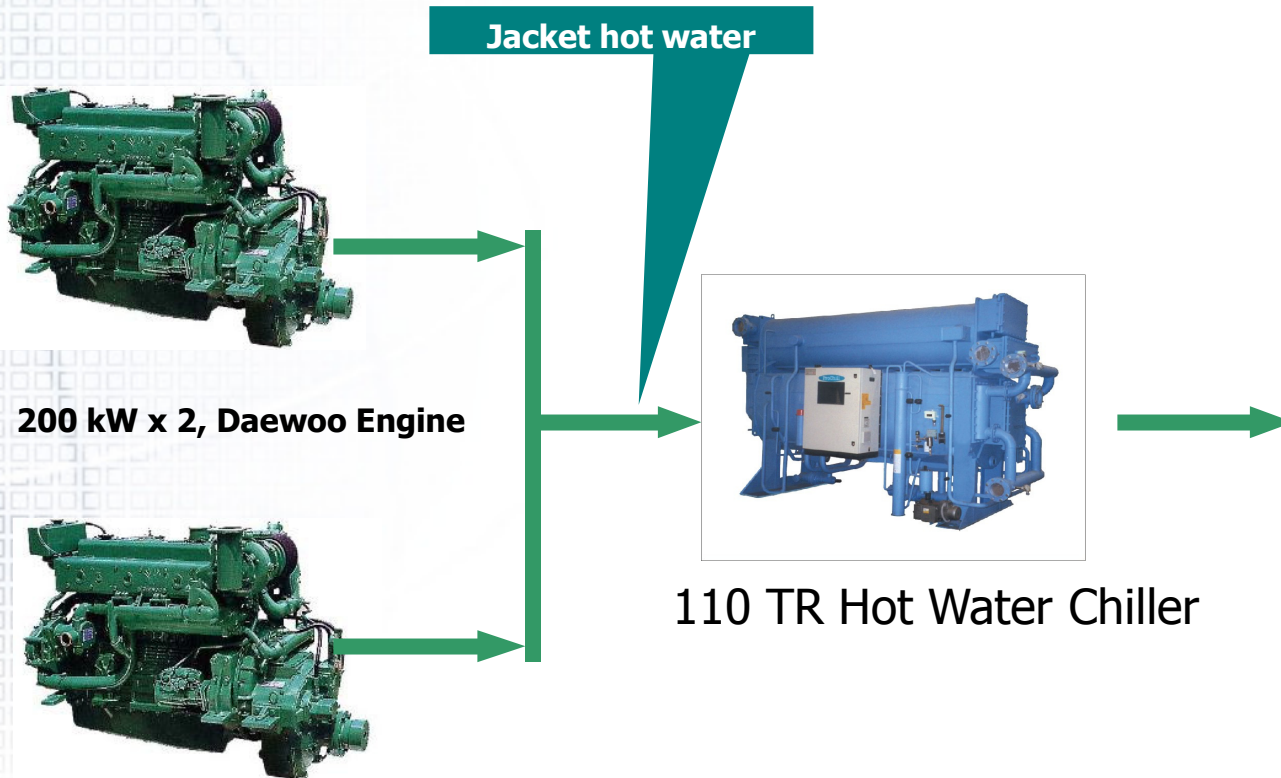


World Leaders in Vapour Absorption Technology





Hotel Marriott, Fremont, USA



Comfort Air conditioning

Fremont, USA

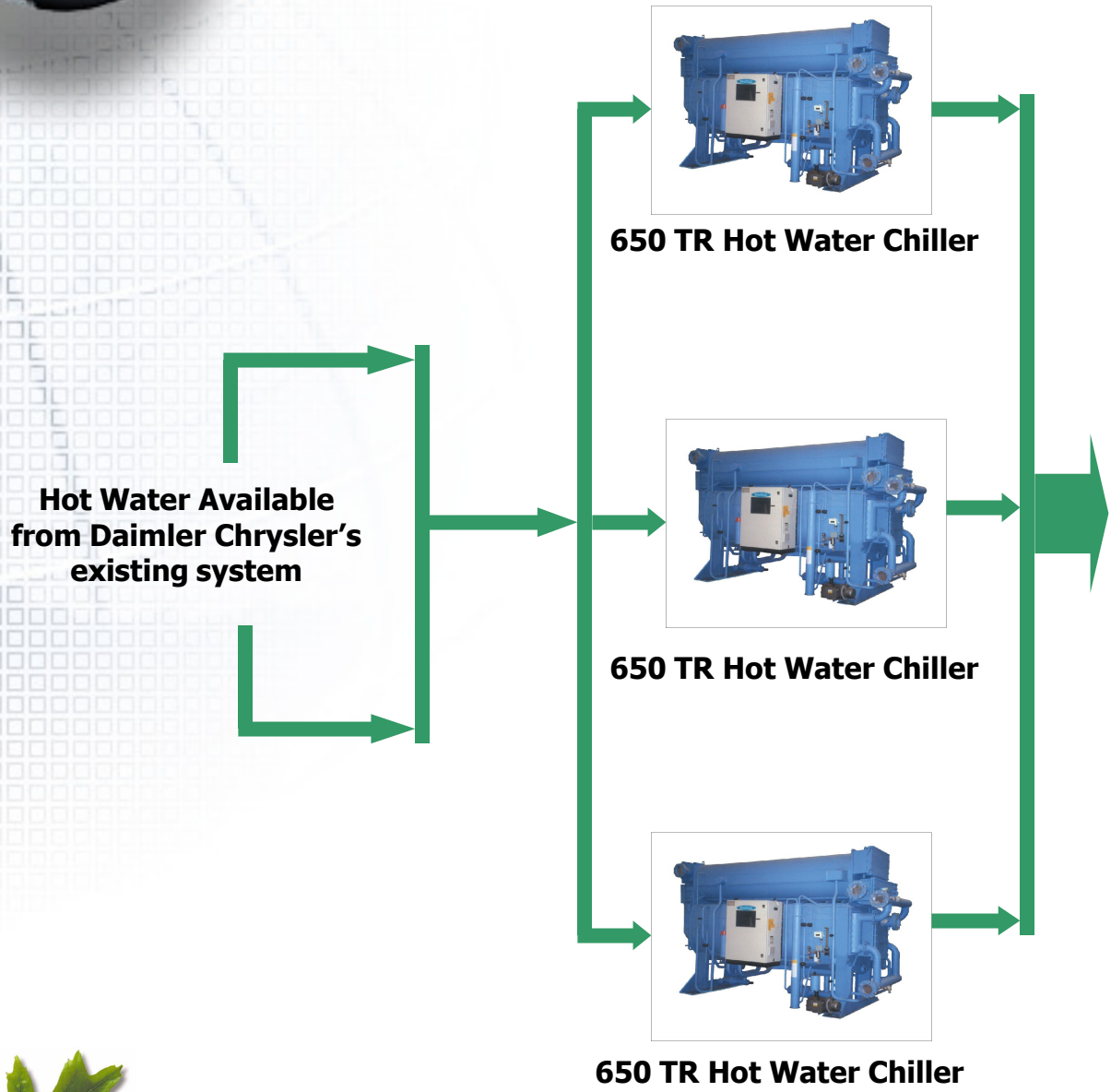


World Leaders in Vapour Absorption Technology





Daimler Chrysler, Germany



Mercedes-Benz



Paint Booth Air conditioning



World Leaders in Vapour Absorption Technology





Sectors – Comfort Cooling



Hotels –

- Marriott Freemont - USA
- P T Bali Nirvana - Indonesia
- Sheraton Towers - Brazil



Educational Institutes –

- State University of NY - USA
- Bloomsburg University - USA
- Roosevelt Magnet School - USA



Commercial Centers –

- BBC Studio - UK
- Henry Ford Museum - USA
- Bicycle Casino - USA



Super Market –

- Mundial Super market - Brazil
- Raleys Deptt. Store - Brazil
- Prezunic Super Market - Brazil



Medical Centers –

- Royal free hospital - UK
- VA Medical Center - USA
- Gemilli Hospital - Italy





Sectors – Others



Dairy & Confectionary –

- Nestle - Philippines
- Cadbury - Nigeria
- Chitale Dairy - India



Textiles –

- Kangwal Polyesters - Thailand
- Carolina Textiles - UAE
- Square Textiles - Bangladesh



Pharmaceuticals –

- AstraZeneca - UK
- Johnson & Johnson -USA
- Pfizer - India



Paper & Pulp –

- Phoenix papers - Thailand
- Maul Belser - Germany
- BILT -India





Sectors – Others



Edible Oils –

- Lipico - Thailand
- Marico Industries – India
- Parakh Foods - India



Refineries & Petrochemicals –

- Exxon Mobil – Saudi Arabia
- Reliance Industries Ltd. - India
- Gas Authority of India Ltd. - India

Chemicals –

- BASF - Mexico
- Asian Paints - India
- Nirma Ltd. - India



Steel –

- United Gulf Steel – UAE
- Bhilai Steel Plant – India
- Rourkela Steel Plant - India





Sectors – Others



Electronics –

- Bosch -Germany
- Moser Baer - India
- Temic Heilbronn - Germany



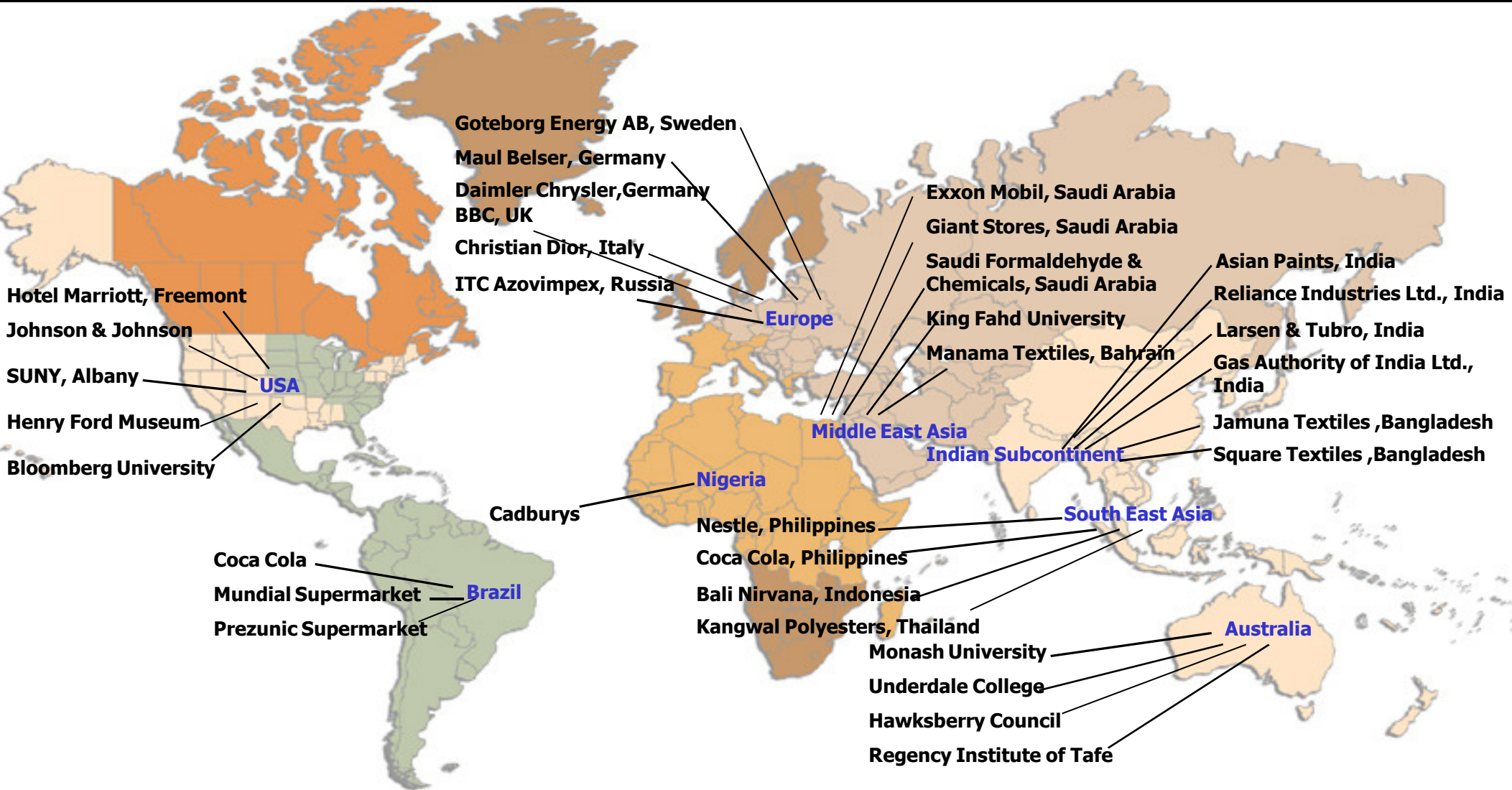
Engineering –

- Daimler Chrysler - Germany
- Larsen & Tubro -India
- Medway Plastics - USA





Installations around the world



World Leaders in Vapour Absorption Technology





World Leaders in Vapour Absorption Technology

