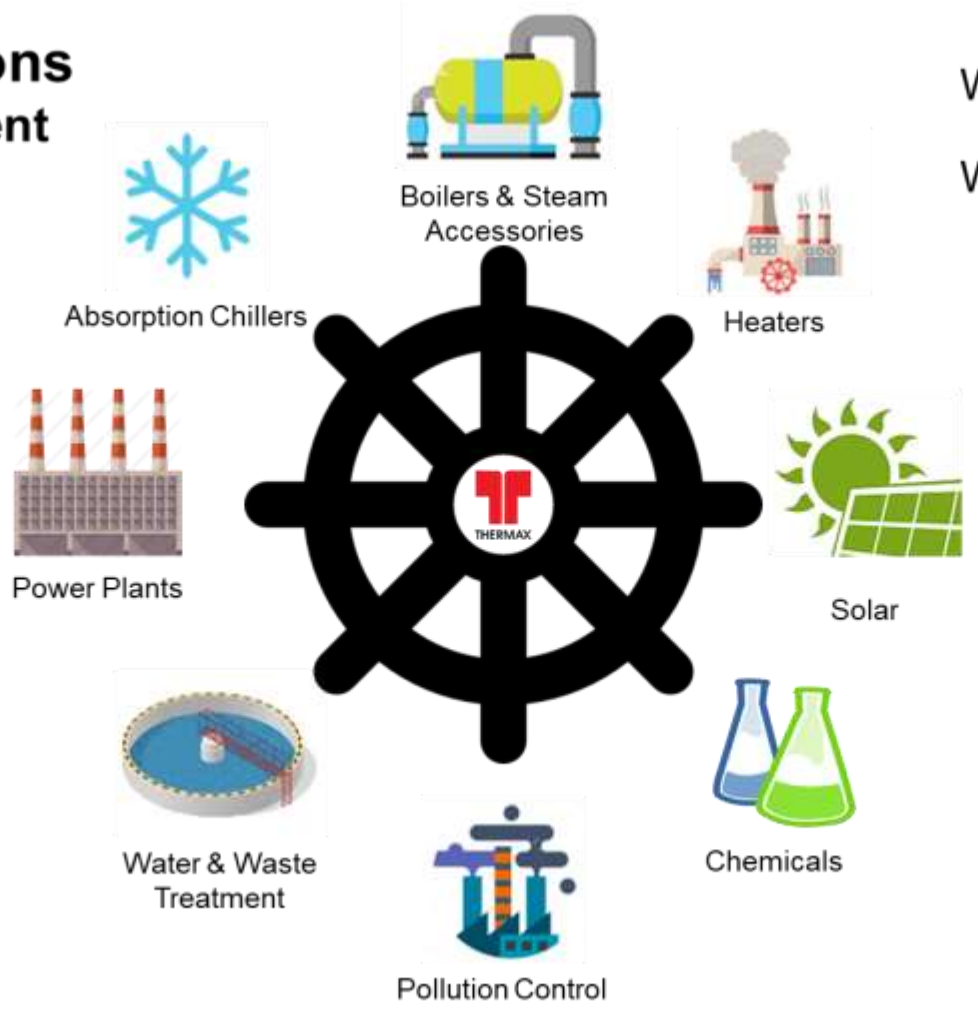
ENERGY EFFICIENT COOLING SOLUTIONS FOR API FROM THERMAX

THERMAX'S VISION

THERMAX AT A GLANCE

THERMAX

Sustainable Solutions
in Energy & Environment



We **Heat,** We **Cool,**
We **Power,** We **Clean**

750mn USD
Revenue

15 Manufacturing facilities spread across **7** Countries

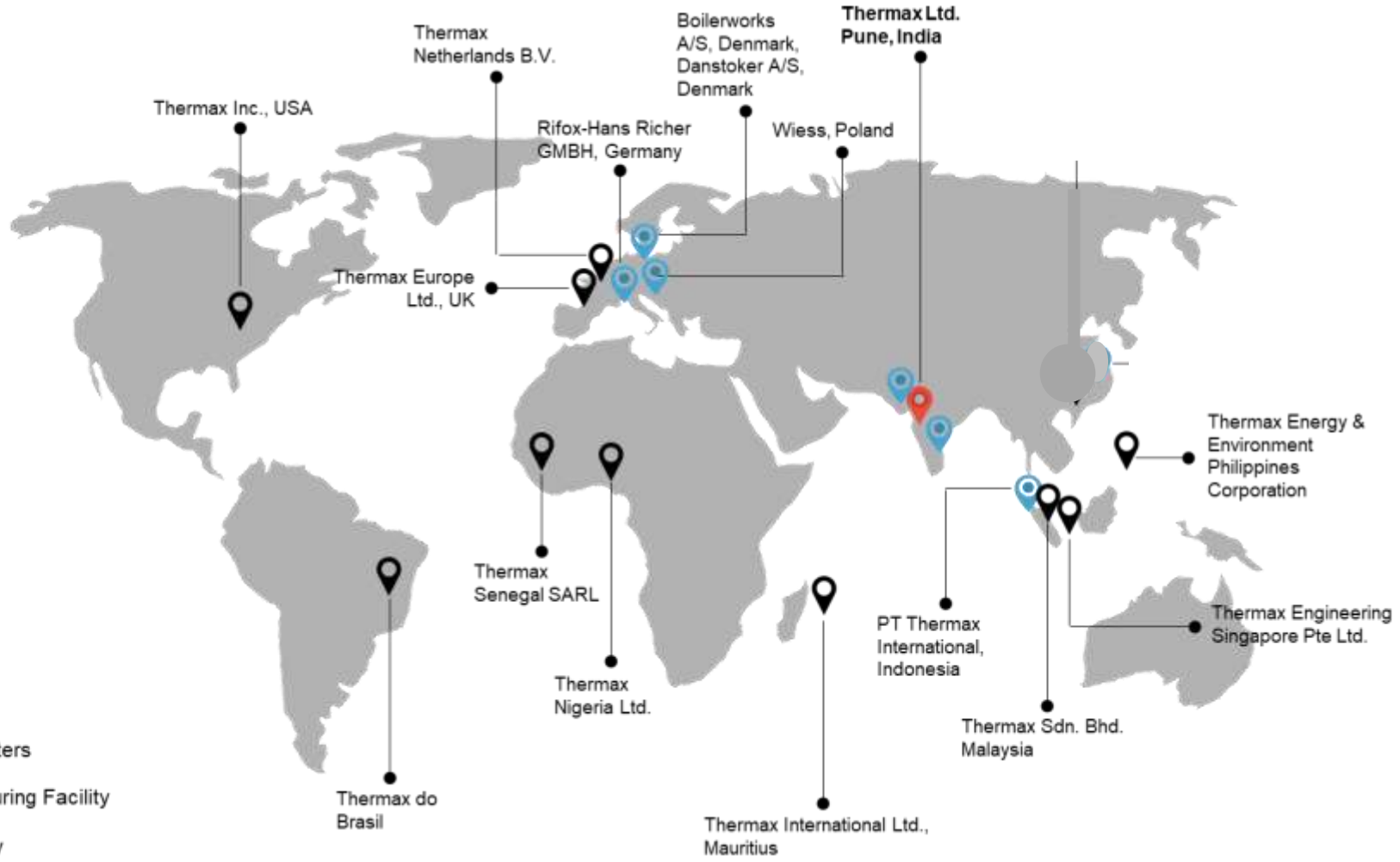
4500+
Employees Globally

50 Years of Expertise in **Conserving Resources & Preserving Environment**

THERMAX GLOBAL PRESENCE

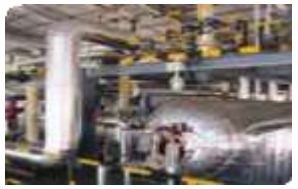
5 wholly owned
Domestic Subsidiaries

20 wholly owned
Overseas Subsidiaries



THERMAX PORTFOLIO

Power



Heating

Cooling

Water

Chemicals

Utilities

Raw Material

Desired Products

Waste

Air Pollution Control

Wastewater Treatment

Hazardous Waste Treatment

Waste to Energy Generation

ABSORPTION COOLING SOLUTIONS

THERMAX




-40 -5 35 90 160

Composite Chiller

LiBr VAM

Heat Pump (Type I)

Heat Pump (Type II)

Ammonia VAM

Chiller - Heater

-40 0 160

Temperature Scale



ABSORPTION COOLING & HEATING PRODUCT RANGE

S1 – SERIES
SINGLE EFFECT
STEAM FIRED

S2 – SERIES
DOUBLE EFFECT
STEAM FIRED

L5 – SERIES
SINGLE EFFECT LT
HOT WATER DRIVEN
CHILLER

H2 – SERIES
DOUBLE EFFECT
HOT WATER CHILLER

G2 – SERIES
DOUBLE EFFECT
DIRECT FIRED
CHILLER

E7 – SERIES
MULTI ENERGY
CHILLER

E2 – SERIES
DOUBLE EFFECT
EXHAUST FIRED
CHILLER

ENERGY SAVING INNOVATIONS FROM THERMAX

THERMAX

ULTRA LOW-PRESSURE VAPOR DRIVEN

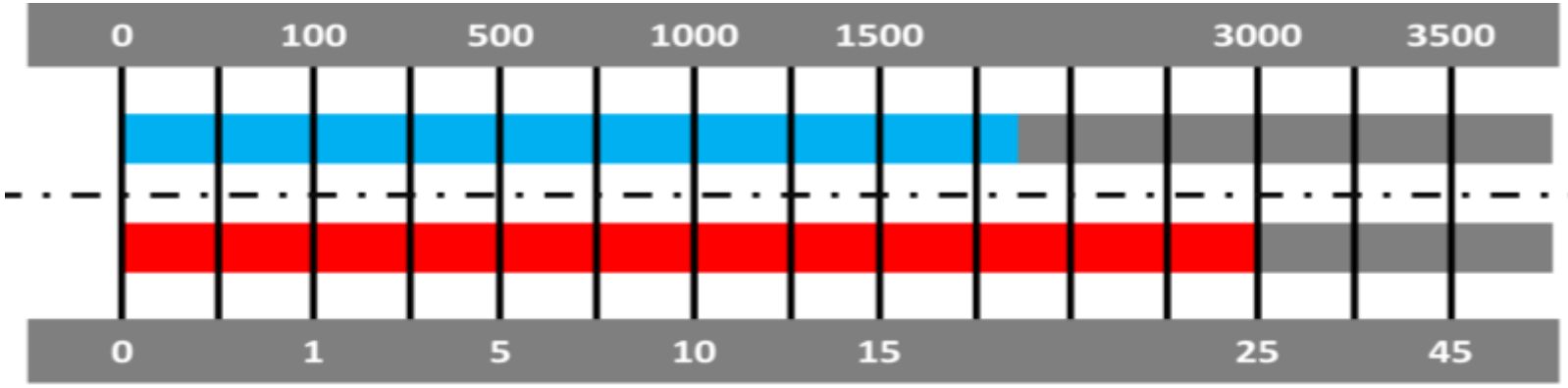
TRIPLE EFFECT CHILLER

HEAT PUMP TYPE 1

HEAT TRANSFORMER

HIGH EFFICIENCY CHILLER-HEATER

HYBRID CHILLER



Standard products

Customized products

SUB-ZERO ABSORPTION CHILLER

WET COOLING SOLUTIONS

EVAPORATIVE CONDENSER

CLOSED LOOP COOLING TOWER

ADIABATIC COOLER

DRY COOLER

AIR COOLED HEAT EXCHANGER

AIR COOLED CONDENSER

INDUSTRIES SERVED


Refinery & Petrochemicals


Oil & Gas


Cement


Fertilizer


Power Plants


Chemicals


Paints & Pigments


Urbanization


Minerals & Metals


Renewables


Automobiles


Rubber


Textiles


Pulp & Paper


Packaging


Food Processing


Dairy Products


Drugs & Pharmaceuticals


Beverages


Edible Oil

THERMAX

COOLING SOLUTIONS FOR PHARMA

ENERGY OPTIMISATION IN PHARMACEUTICAL INDUSTRY

- In light of the rising energy costs and need for sustainability, energy optimisation remains the priority of Pharmaceutical industry.

- Hence, employing energy-efficient utilities for processing and storage of medicines is now more important than ever.

- Pharma manufacturers heavily rely on cooling solutions for humidity control and process cooling.

- Conventional cooling utilities are energy-intensive and hence account for a huge portion of the industry's energy use.

- **Thermax's cooling solutions can meet the cooling requirements effectively at lower energy costs and reduce the associated emissions.**

COOLING REQUIREMENT IN PHARMACEUTICAL MANUFACTURING

APPLICATIONS

1. Bulk Drug Production
2. Reactor Cooling
3. HVAC / AHU Application
4. Primary Condenser of Distillation Column
5. Secondary Condenser of Distillation Column
6. Solvent Recovery

APPLICATIONS OF COOLING SOLUTIONS IN PHARMACEUTICAL MANUFACTURING

- Cooling Tower Water is used for all process cooling applications.

- **Air Handling Unit**

Pharma facilities have Air Handling Units (AHU) for dehumidification of ambient air.
Chilled water pumped into the AHU enables heat exchange and helps in maintaining humidity and temperature within the facility.

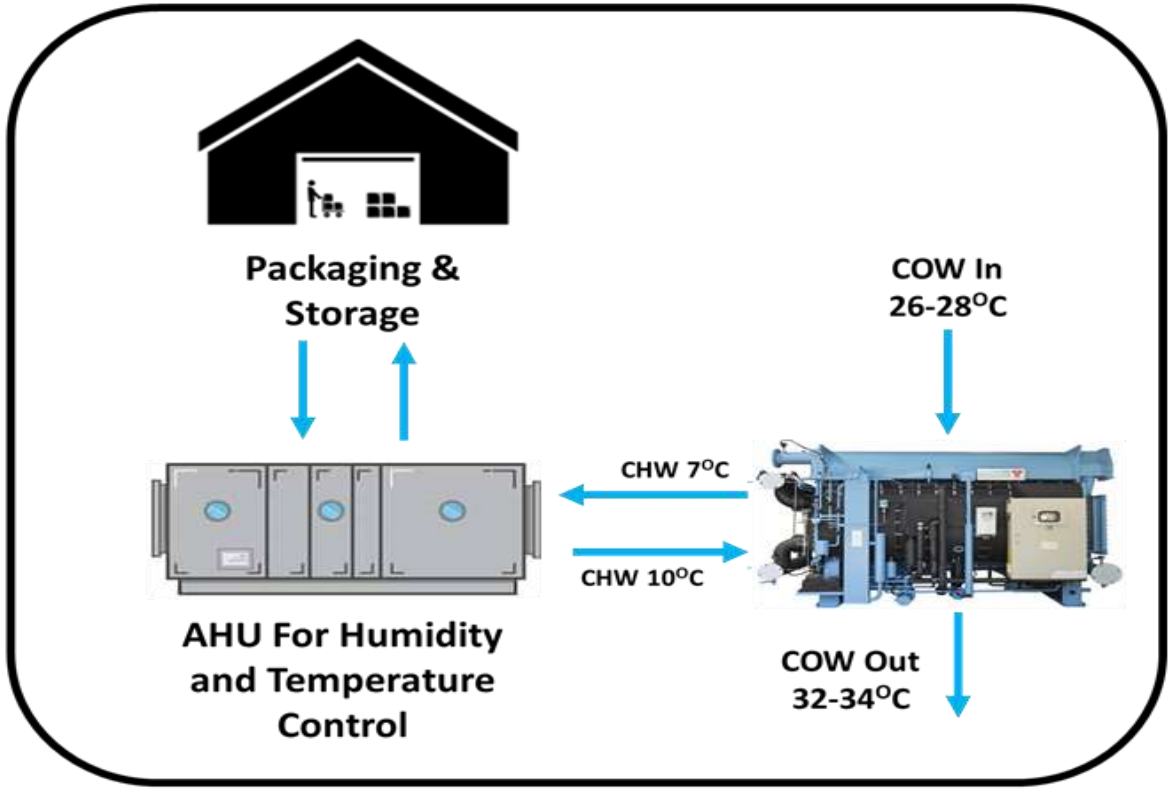
- **Solvent Recovery**

Cooling Tower water or Chilled Water condenses vapours in solvent recovery units and hence facilitate higher recovery rates of the pharmaceutical product.

- **Clean Rooms**

Clean Rooms in pharma require optimal temperature and humidity in to avoid bacterial growth. Chilled water aids in keeping the room sterile.

APPLICATION OF ABSORPTION CHILLERS IN PHARMACEUTICAL MANUFACTURING



PHARMA COLD ROOM

WASTE HEAT RECOVERY FOR COOLING

Distillation Columns in pharmaceutical plants separate the dissolved solid phases or the gases present in a liquid mixture, by means of vapourisation and condensation.

Waste heat from the column is recovered and utilised for the plant's dehumidification unit.

On-site sources like hot water or exhaust gases, available in plenty in pharma plants also are potential sources of our cooling solutions.

By repurposing waste heat, Thermax's cooling solutions

1. Improve energy efficiency of the cooling utility
2. Reduce operational costs
3. Conserve resources
4. Lower emissions

DISTILLATION COLUMN

THERMAX

PRODUCT DESCRIPTION

Absorption Cooling & Heating

STEAM FIRED CHILLER

Technical Features:

Steam Pressure: 3 to 10 bar

COP: 1.45 to 1.5

Capacity Range: 50 to 3000 TR

Major Advantages:

1. High COP – About 1.5
2. Low Steam Consumption – About 3.5 kg/hr-TR
3. Negligible Electricity Consumption
4. No vibrating parts
5. No requirement for LiBr / DM Water top-up
6. Crystallization-free design

HOT WATER DRIVEN CHILLER

Technical Features:

Capacities: From 10 to 200 TR (35 to 700 kW)

Capacities: From 200 to 1380 TR (700 to 4850 kW)

Chilled water temperature: Up to 1ºC and -2ºC with brine

Hot Water temperature: From 75ºC to 120ºC

COP: 0.75 – 0.8

DIRECT / FUEL FIRED CHILLER

Technical Features:

CHW temperature: Up to 1ºC and -2ºC (for brine)

Capacities: From 50 to 1550 TR (175-5450kW)

Heat source: Natural gas, Liquid Petroleum Gas (LPG), Compressed Natural Gas (CNG), Propane, Kerosene, Biogas & High Speed Diesel (HSD)

COP: 1.45-1.5

CHILLER HEATER

Salient Features

1. Heating is obtained by partly using the hot refrigerant vapour. Thus, achieving about 40% savings
2. Can be operated as a chiller or a heater or both simultaneously
3. Since, part of heat rejection is in hot water, cooling tower heat rejection is reduced
4. Reduced CO_2 emissions
5. Heating capacity is about 80% of cooling load in sim mode and 100% in case of heating mode
6. Reduced scope of utilities being handled as one product takes care of both heating and cooling

HEAT PUMP

Technical Features

Capacities: 0.25 – 40 MW
Hot water temperature: Up to 90ºC (194ºF)
High Grade Heat Source: Exhaust gas, steam, hot water & liquid/gas fuels (individually or in combination)
COP: 1.65 – 1.75
Steam Pressure: 4 – 10 bar.g

PROCESS COOLING SOLUTIONS FOR PHARMACEUTICAL MANUFACTURING

THERMAX

- **Refrigeration**

Given the extremely high value of pharmaceutical raw materials, intermediates and finished products, refrigeration systems in their plants are vital. E***vaporative condenser*** fits in as precise cold storage system for pharma with very high reliability.

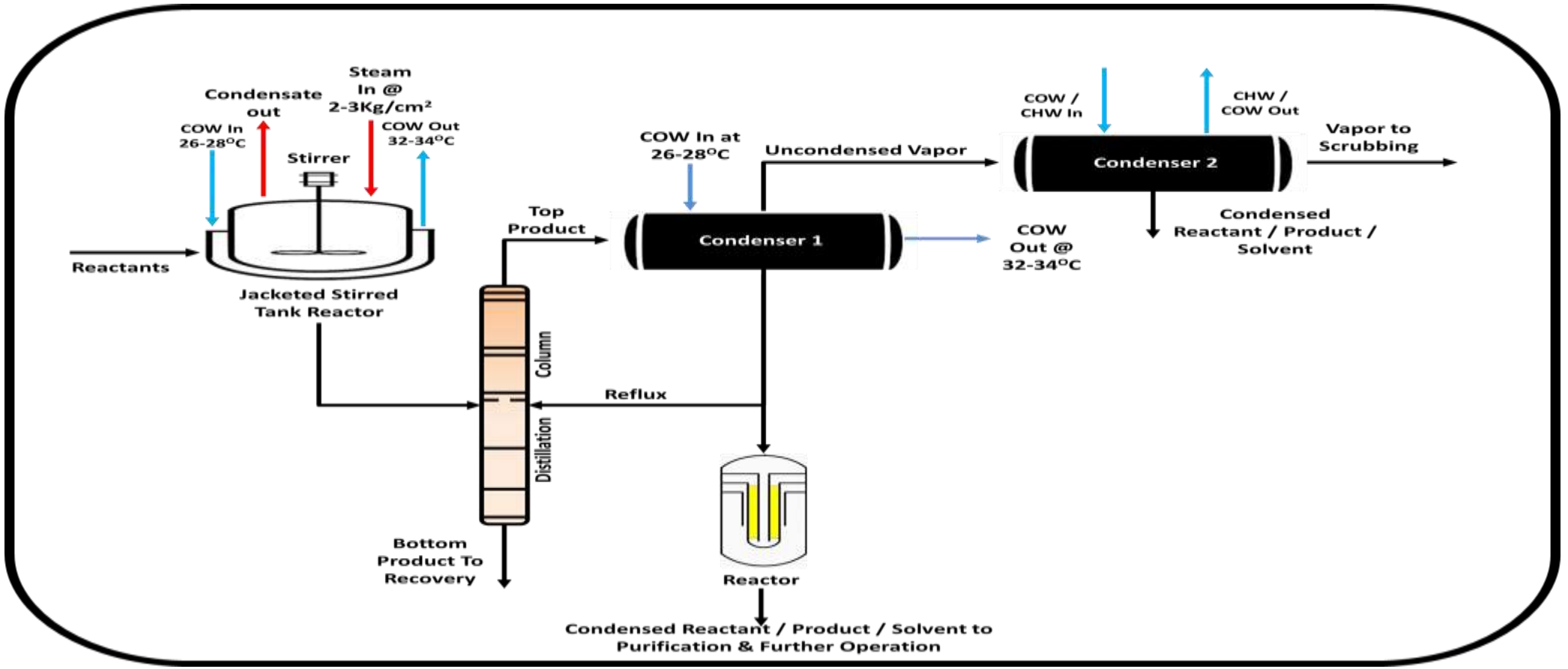
- **Vapour Condensation**

Vapour Condensation forms a significant part of Solvent Recovery in pharma plants. Heat exchange equipment like ***Air Cooled Condenser*** efficiently condenses the hot vapour of the distillation column, eliminating the use of water for cooling.

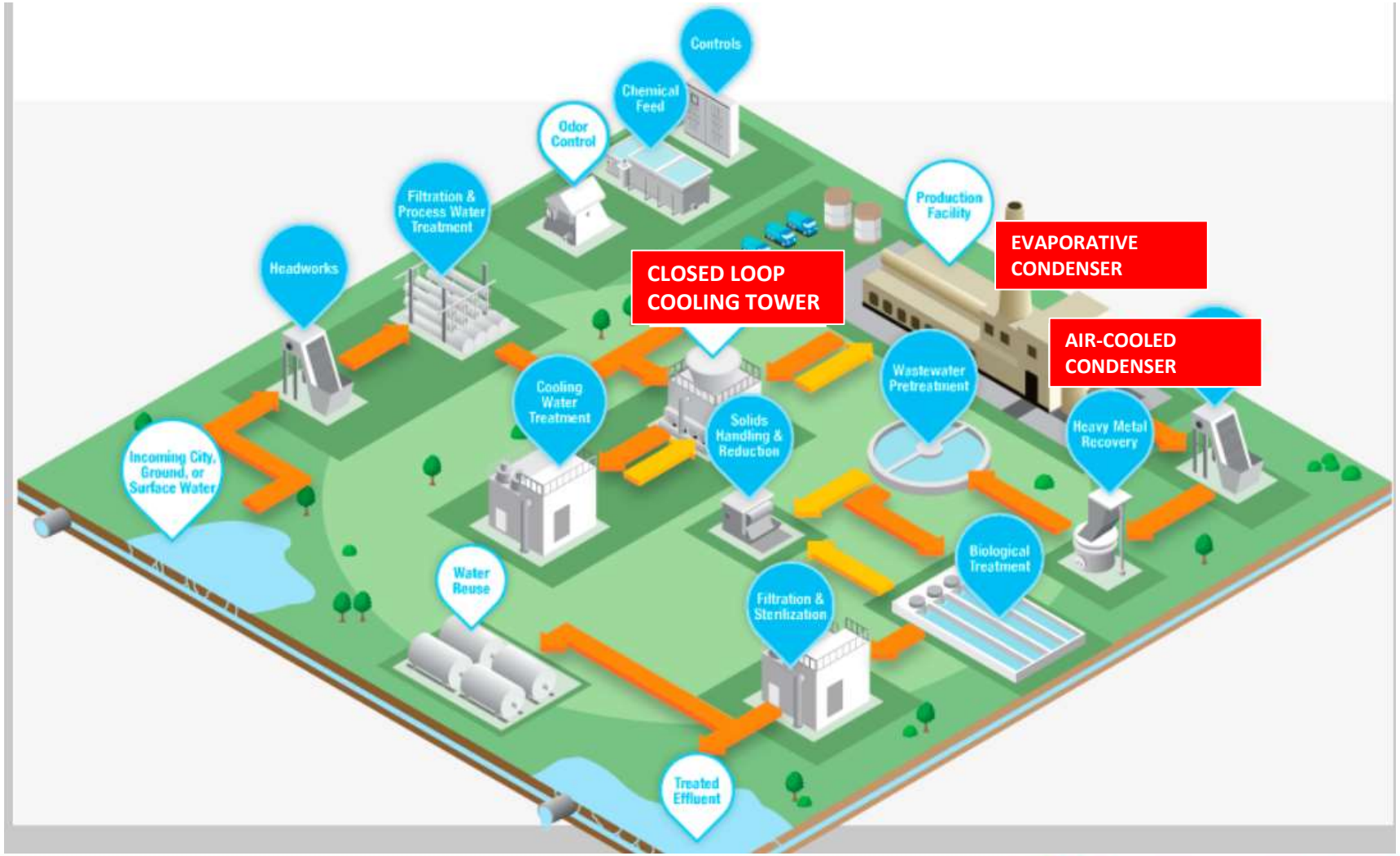
- **Water Treatment**

Conventional cooling tower uses evaporation to reduce process water temperature. ***Closed-loop Cooling Tower (CLCT)*** uses ambient air to cool the water resulting in reduced water consumption and energy costs.

APPLICATION OF PROCESS COOLING IN PHARMACEUTICAL MANUFACTURING



PROCESS COOLING SOLUTIONS FOR PHARMACEUTICAL MANUFACTURING



PRODUCT DESCRIPTION

Process Cooling

CLOSED LOOP COOLING TOWER

Salient Features

- Can be operated for higher temperature difference (Δ T)
- Zero contamination due to closed loop
- Capacity: 20 m3/h onwards
- 100% Water savings in exhaust steam condensing
- Low Maintenance Costs
- Lesser environmental impact due to the elimination of water loss

EVAPORATIVE CONDENSER

Salient Features

- For ammonia/freon/other latest refrigerant's condensation at lower temperature
- Retrofit & Replacement – Easy to integrate into existing system
- Ideal for various refrigeration systems & climatic conditions
- Capacity: 30 TR (100KW) onwards
- Achieves energy savings in industrial refrigeration

AIR-COOLED CONDENSER

Salient Features

- Huge water savings
- Long term mechanical and thermal performance
- Good resistance to corrosion
- Reliable operation and low maintenance
- Flexibility in power plant site selection
- Less environmental impact due to reduced water loss

APPLICATIONS AND PRODUCTS POSITIONING

Products Positioned	Chiller Chiller-Heater Evaporative Condenser Air-Cooled Condenser Closed Loop Cooling Tower
Applications Catered to	Reactor Cooling Reactor Heating HVAC/AHU Application Solvent Recovery Refrigeration Vapour Condensation Secondary Condenser of Distillation Column

THERMAX

GLOBAL REFERENCES

Pharmaceutical Industries

REFERENCE INSTALLATIONS

Steril Gene Life Sciences (India)

2 x 500TR Steam fired Chiller

Unique Pharmaceuticals (Nigeria)

1 x 400TR Direct fired Chiller

REFERENCE INSTALLATIONS

THERMAX

Pfizer (Ireland)

1 x 274TR Hot Water Driven Chiller

AMIPHARMA LABORATORIES LIMITED

Ami Pharma Laboratories (Sudan)

1 x 400TR Steam Fired Chiller

REFERENCE INSTALLATIONS

THERMAX

SANOFI

Sanofi India Ltd. (India)

1 x 123TR Hot Water Driven Chiller

KARMAN PHARMA

Karman Pharmaceuticals (Egypt)

1 x 319TR Steam Fired Chiller

REFERENCE INSTALLATIONS

Biotest

From Nature for Life

THERMAX

Biotest AG (Germany)

1 x 114TR Hot Water Driven Chiller

AUROBINDO

Aurobindo Pharma Ltd. (India)

1 x 500TR Direct Fired Chiller

Biogen

Biogen Inc. (United States)

1 x 600TR Steam Driven Chiller

REFERENCE INSTALLATIONS

THERMAX

Dr.Reddy's

Dr.Reddy's (Hyderabad)

2 x Evaporative Condenser

1 x Closed Loop Cooling Tower

Everest Organics Limited
The way to provide

Everest Organics (Hyderabad)

1 x Evaporative Condenser

HETERO

Hetero Drugs (Vishakhapatnam)

7 x Evaporative Condenser

PAR PHARMACEUTICAL
an endo international company

PAR Formulation (Chennai)

1 x Closed Loop Cooling Tower

THERMAX

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THANK YOU