UNITED HEAT EXCHANGERS PVT. LTD.

ASME U-STAMP & R-STAMP CERTIFIED

Est. 1989 · Coimbatore, India

SHELL & TUBE HEAT EXCHANGERS

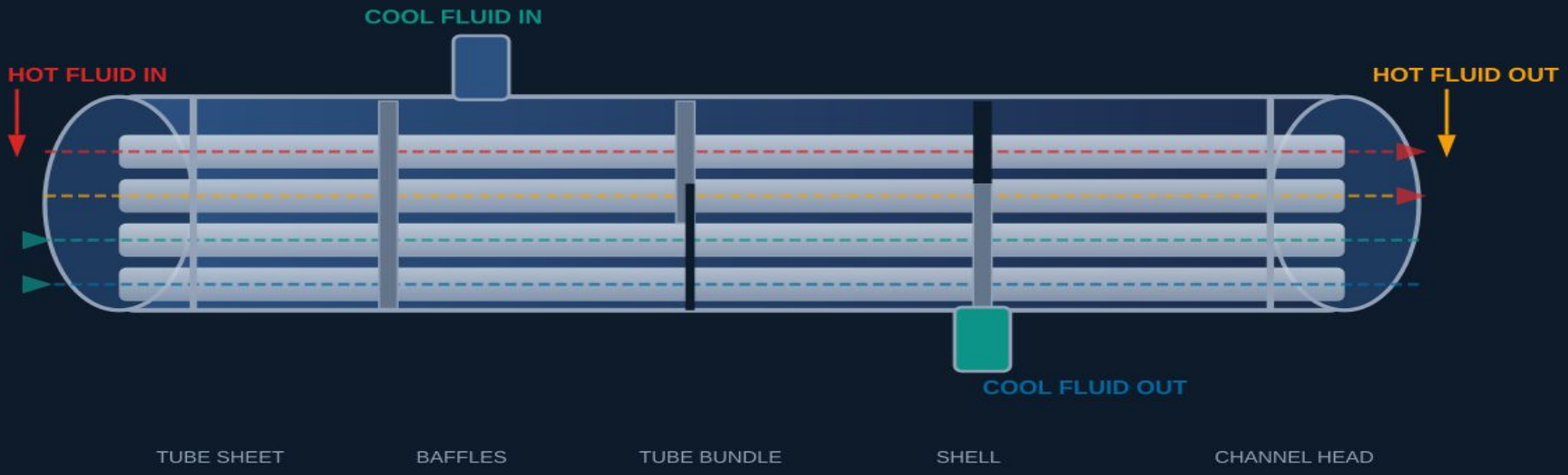
Comprehensive Guide for Oil & Gas and Mining Industries

- Oil & Gas Refining
- Mining Cooling Systems
- TEMA Standards
- ASME Compliance

Confidential Technical Presentation · 2025

WHAT IS A SHELL & TUBE HEAT EXCHANGER?

SHELL & TUBE HEAT EXCHANGER — CROSS-SECTION VIEW



30–650°C
Operating Range

Up to 300 bar
Design Pressure

TEMA / ASME
Standards

Millions of Units
Global Install Base

The most widely used heat transfer equipment in heavy industry — transferring thermal energy between two fluid streams through a bundle of tubes enclosed within a cylindrical shell.

KEY COMPONENTS & CONSTRUCTION

KEY COMPONENTS OF A SHELL & TUBE HEAT EXCHANGER

S — SHELL
- Cylindrical pressure vessel
- CS, SS, alloy or clad options
- Designed to ASME Sec. VIII
- Shell-side fluid containment
- Flanged or welded nozzles

T — TUBE BUNDLE
- U-tube or straight tube designs
- Fin tubes for extended surface
- OD: 15.9 mm to 50.8 mm typical
- High-pressure tube-side service
- Removable for cleaning

B — BAFFLES
- Directs shell-side flow
- Segmental or helical types
- Increases turbulence & efficiency
- Supports tube bundle structure
- 20–45% baffle cut typical

TS — TUBE SHEETS
- Separates shell & tube fluids
- Fixed or floating design
- Tubes rolled, welded or both
- Heavy plate: 25–100 mm thick
- Corrosion-resistant alloys used

C — CHANNEL HEAD
- Houses tube-side connections
- Bonnet or channel with cover
- Multi-pass partition plates
- Easy access for maintenance
- Inlet/outlet nozzle flanges

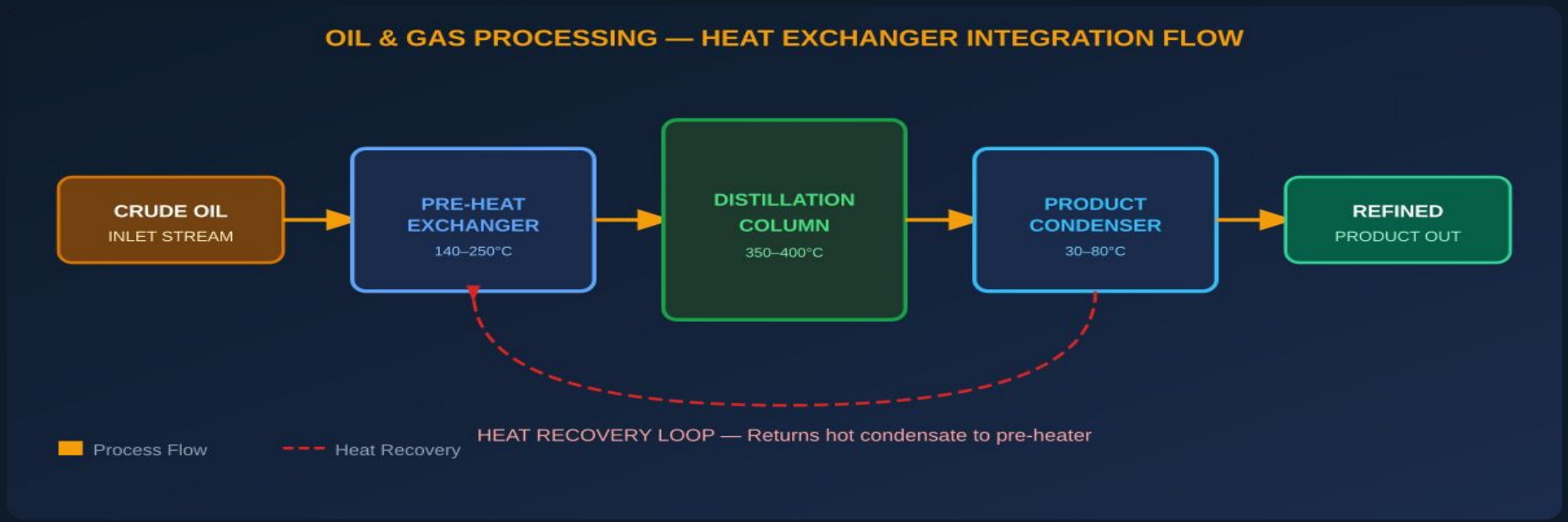
R — RODS & SPACERS
- Maintain baffle spacing
- Prevent bundle vibration
- Threaded tie-rod assembly
- Spacer tubes between baffles
- Critical for tube protection

TYPES & INDUSTRY SELECTION GUIDE

TYPES OF S&T HEAT EXCHANGERS — INDUSTRY SELECTION GUIDE

CRITERIA	FIXED TUBE SHEET TYPE	U-TUBE TYPE	FLOATING HEAD TYPE	DOUBLE-PIPE TYPE
Thermal Expansion	Limited — expansion joints	Excellent — free end	Excellent — floating end	Good
Cleaning (Tube)	Mechanical and chemical	Chemical only (U-bend)	Mechanical and chemical	Easy mechanical
Cleaning (Shell)	Difficult if fouling	Accessible	Best accessibility	Easy access
Operating Pressure	Up to 300 bar	Up to 700 bar	Up to 300 bar	Up to 700 bar
Cost	Low — simple build	Low to medium	Medium to high	Low for small duty
Oil and Gas Use	★★★★☆ Preheaters	★★★★★ High temp	★★★★★ Refineries	★★☆☆☆ Small units
Mining Use	★★★★★ Compressors	★★★☆☆ Process	★★★★☆ Slurry	★★★☆☆ Auxiliaries

OIL & GAS INDUSTRY APPLICATIONS



Crude Preheating

Preheat crude oil 140–280°C before atmospheric distillation column entry

Overhead Condensers

Cool and condense distillation column overhead vapours to liquid products

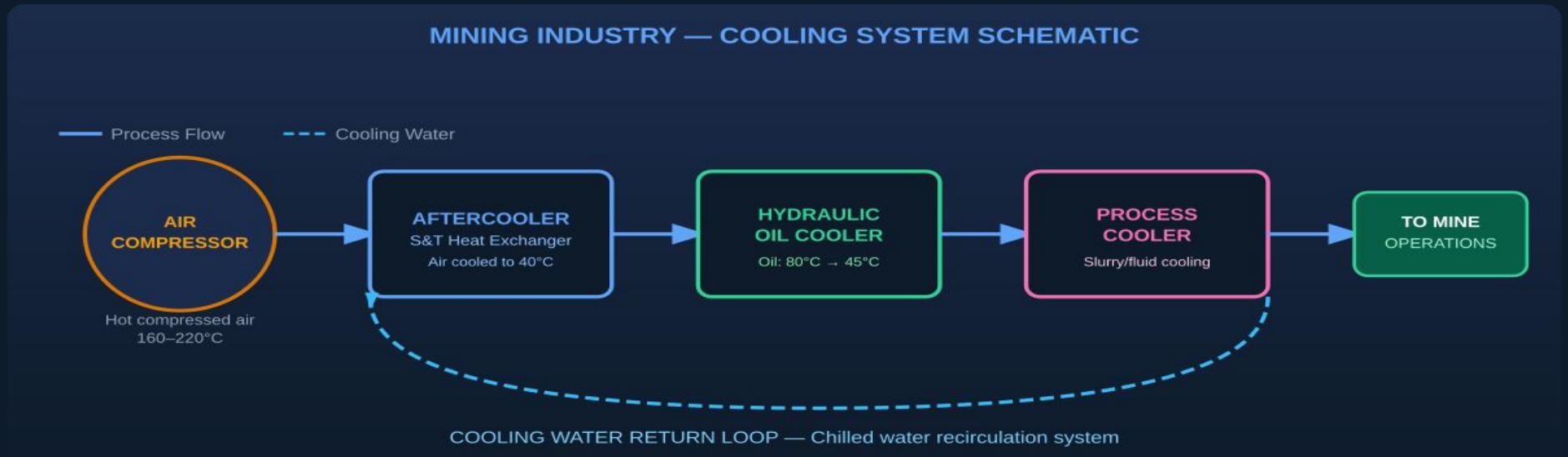
Product Coolers

Bring refined products to safe storage/transfer temperatures ≤50°C

Heat Recovery

Recover waste heat from process streams — up to 30% energy savings

MINING INDUSTRY APPLICATIONS



Compressor Aftercoolers

Cool high-pressure compressed air from 160°C+ down to 35–45°C for safe mine ventilation

Hydraulic Oil Coolers

Maintain hydraulic system temperatures for mining machinery and drilling rigs

Process Fluid Cooling

Cool leach solutions, slurries and process chemicals in mineral extraction operations

Lube Oil Systems

Temper lubricating oil in conveyor, crusher, and mill drive gear systems

DESIGN PARAMETERS & ENGINEERING SPECIFICATIONS

THERMAL & MECHANICAL DESIGN

Parameter	Typical Range / Standard
Design Code	ASME Sec. VIII Div.1 / TEMA
Shell Diameter	150 mm to 2500 mm
Tube OD	15.9 mm, 19.05 mm, 25.4 mm
Tube Length	1.8 m, 2.4 m, 3.6 m, 6.0 m
Design Pressure	Full vacuum to 300 bar
Design Temperature	-196°C to +650°C
Heat Duty	1 kW to 300+ MW
LMTD Correction	0.75 – 0.95 typical
Overall HTC (U)	250–1500 W/m²K (liquids)

MATERIAL SELECTION GUIDE

Service	Shell Material	Tube Material
General Process	Carbon Steel (SA-516)	Carbon Steel / Cu-Ni
H_2S / Sour Gas	Carbon Steel + PWHT	Duplex SS 2205
Crude Oil	Carbon Steel	Admiralty Brass / SS
High Temp >450°C	Chrome-Moly P11/P22	Incoloy 800
Seawater Cooling	SS 316L / Duplex	Titanium Gr.2
Acidic Mine Fluid	SS 316L	Hastelloy C-276

OPERATING ENVELOPE — PRESSURE vs. TEMPERATURE

THERMAL PERFORMANCE & ANALYSIS

Q = U × A × ΔTlm

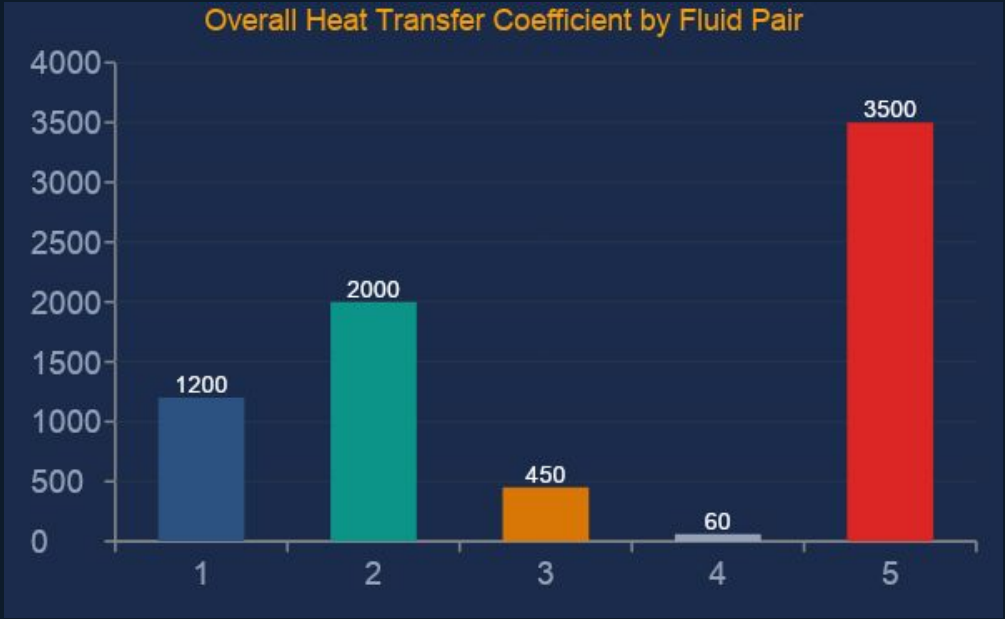
Fundamental Heat Transfer Equation

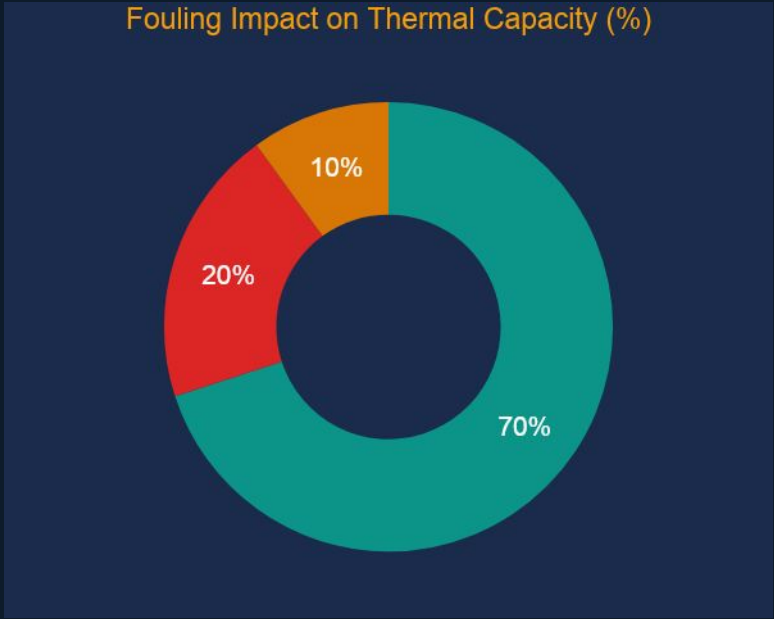
85–95%

Typical Thermal Efficiency

30%+

Energy Recovery Potential





MAINTENANCE, INSPECTION & RELIABILITY

01
Pre-Inspection
Pressure test, visual survey, baseline performance check against design data

02
Tube Inspection
Eddy current / ultrasonic testing (UT) of tubes. Identify corrosion, pitting, erosion

03
Mechanical Clean
Hydro-jetting or brush cleaning of tube bore. Shell-side water jet or chemical soak

04
Bundle Removal
Pull and inspect tube bundle — retube if >20% plugged. Re-roll or re-weld tube sheets

05
Reassembly & Test
Hydrostatic or pneumatic pressure test. Verify gasket integrity. Log performance data

COMMON FAILURE MODES & REMEDIATION

Tube Corrosion
→ Material upgrade — Titanium or Duplex SS

Flow-Induced Vibration
→ Add anti-vibration baffles, reduce shell-side velocity

Fouling / Scaling
→ CIP chemical clean, increase velocity, install filters upstream

Gasket Leakage
→ Upgrade to spiral wound or kammprofile gaskets

Under-Deposit Corrosion
→ Improve water treatment, pH control, biocide dosing

STANDARDS, SAFETY & REGULATORY COMPLIANCE

ASME STANDARDS

- ASME Sec. VIII Div.1 — Pressure Vessel Code
- ASME Sec. VIII Div.2 — Alternative Rules
- ASME Sec. II — Material Specifications
- ASME Sec. V — Non-Destructive Examination
- ASME Sec. IX — Welding Qualifications
- U-Stamp: Unfired pressure vessels
- R-Stamp: Repair & alteration

TEMA CLASSES

- TEMA Class R — Petroleum & related industries
- TEMA Class C — Commercial & process
- TEMA Class B — Chemical process
- Defines baffle tolerances & tube bundle fit
- Shell & nozzle thickness minimums
- Tube-to-tubesheet joint requirements
- Corrosion allowance specifications

API & INDUSTRY SPECS

- API 660 — Shell & Tube HE for Petroleum
- API 661 — Air-Cooled HE (upstream reference)
- NACE MR0175 — H_2S sour service materials
- PED 2014/68/EU — Europe pressure equipment
- IS 4503 — Indian Standard for S&T HE
- IBR (India) — Steam/boiler service vessels
- ISO 9001:2015 — Quality management system

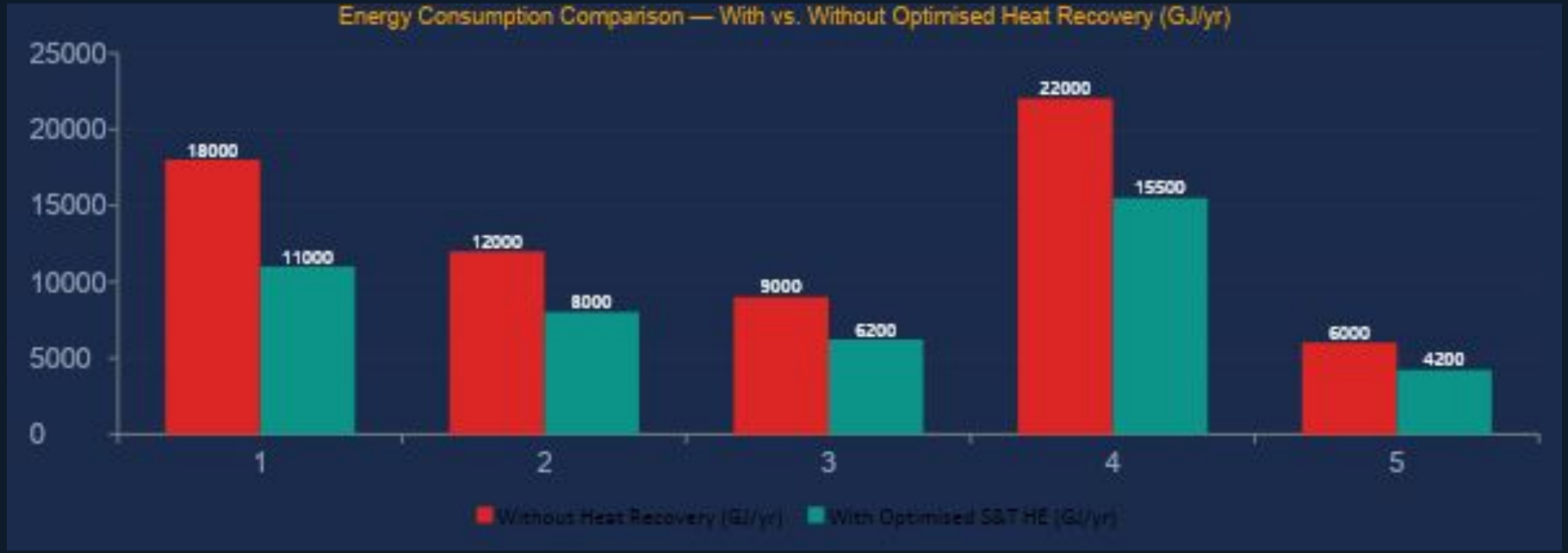
COST, ENERGY SAVINGS & ROI ANALYSIS

2–4 Years
Typical ROI Payback

25–35%
Fuel Cost Reduction via Heat Recovery

₹5–50 Cr
Capex Range (Typical India Projects)

15–30 yr
Design Service Life



UNITED HEAT EXCHANGERS PVT. LTD.

WHY CHOOSE US

- ASME U-Stamp & R-Stamp certified since 1989
- Full in-house design, fabrication & testing
- TEMA R/C/B class — Oil, Gas & Mining specialists
- Thermal design using HTRI / HTFS software
- Field service, re-tubing & performance audits

GET IN TOUCH

Request a Technical Quotation

Website:	www.unitedheatexchangers.com
Location:	Coimbatore, Tamil Nadu, India
Certifications:	ASME U-Stamp | R-Stamp | ISO 9001
Experience:	35+ Years | 1000+ Projects Delivered
Industry:	Oil & Gas | Petrochemical | Mining | Power

"Engineering Excellence in Heat Transfer — Trusted by Industry Leaders Across India"