



Heat Exchanger Keynote

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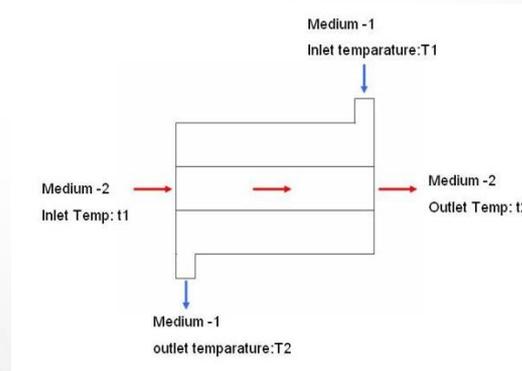
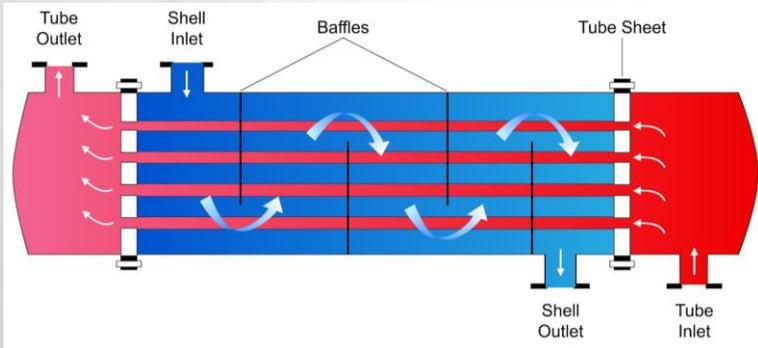
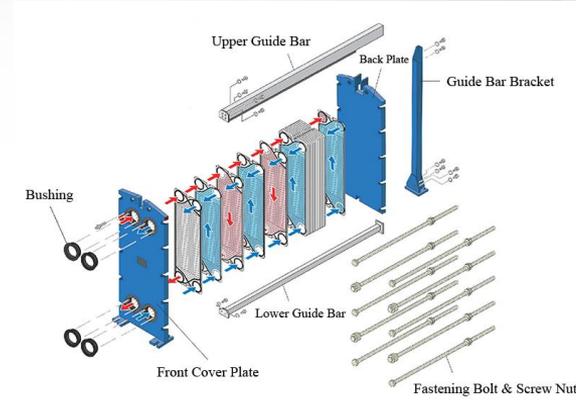
Welcome

- Attendees and exhibitors
- Panel Members
- Presenters
- And especially KCI



Agenda

- Market trends
- Applications and growth
- Where are we going
- Summary



Global Market Drivers/Growth

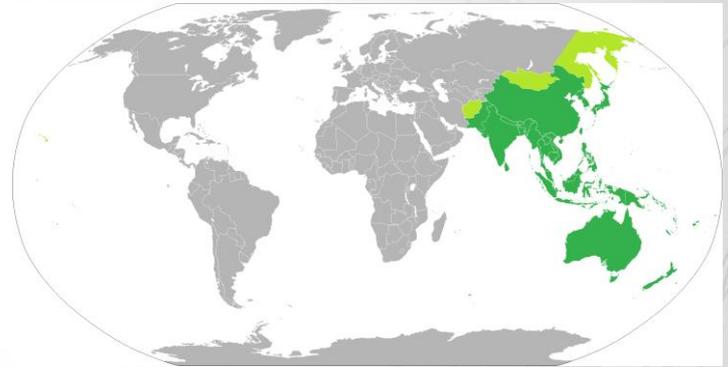
- HVAC Deployment
- Electrification
- Technical Advances – replacement
- From ~\$15BB to ~\$20BB in 5 years
 - CAGR 6-8%



Pre-COVID

Market and Geography

- Perhaps unsurprisingly, APAC is projected to be the highest growth region.
- Power Generation, Industrialization,
 - China
 - India
- Europe and USA
 - Modernization and investment in technology
 - Clean energy



Market Share by Type

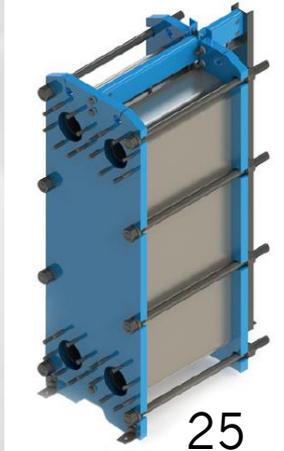


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Growing Applications

- Energy
 - Up and Downstream
 - Power Generation
- HVACR
 - Residential and Commercial
- Petrochemical
- Food
 - Beverage

COVID-19 has pushed much expansion/new project (and growth) targets back by many months

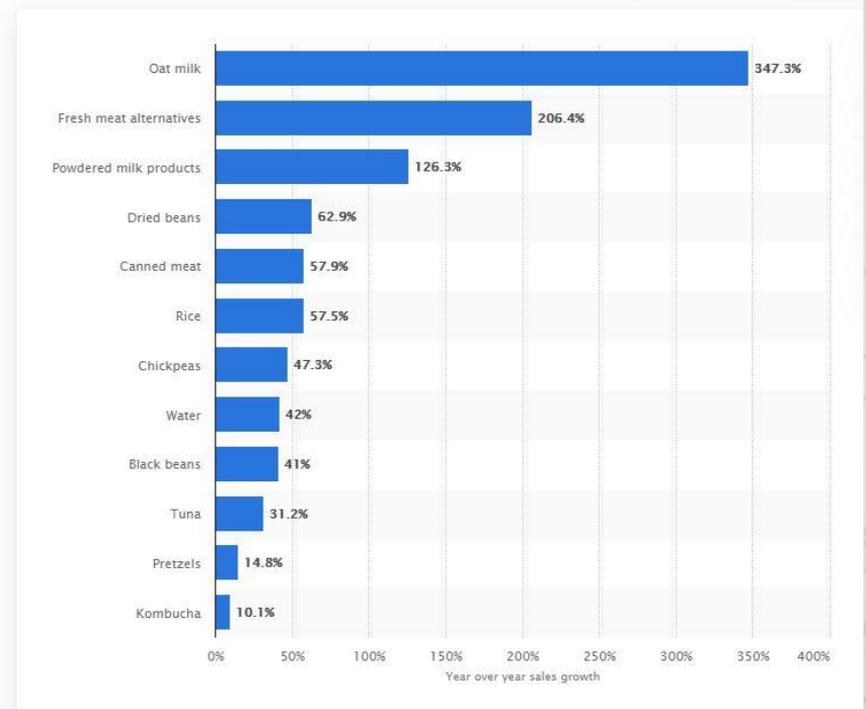


Energy/Petrochem

- COVID really hurt.
- Lowered demands in developed countries
 - Refined product
 - Specialty and commodity chemicals
 - Automotive, etc.
- Electrification and other infrastructure in less-developed areas still moving forward (somewhat slowly)

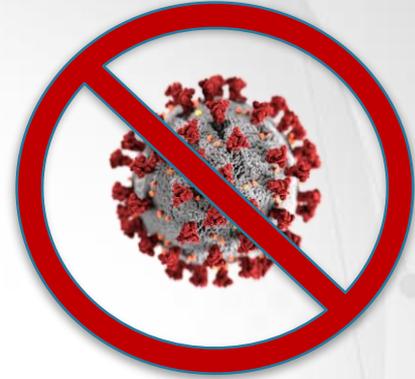
Non-industrial

- Somewhat less pandemic pain in this area, and some growth
- HVACR
 - People are staying home!
- Food has shifted, not necessarily grown
 - Grocery sales are up ~15%, and beverages are way up
 - Tempered by significant losses from restaurants
- Packaging
 - Medical/Pharma
 - Food



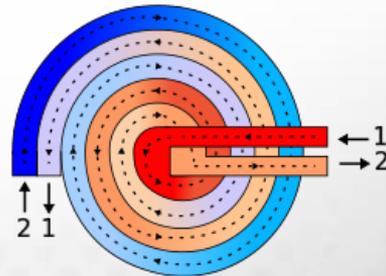
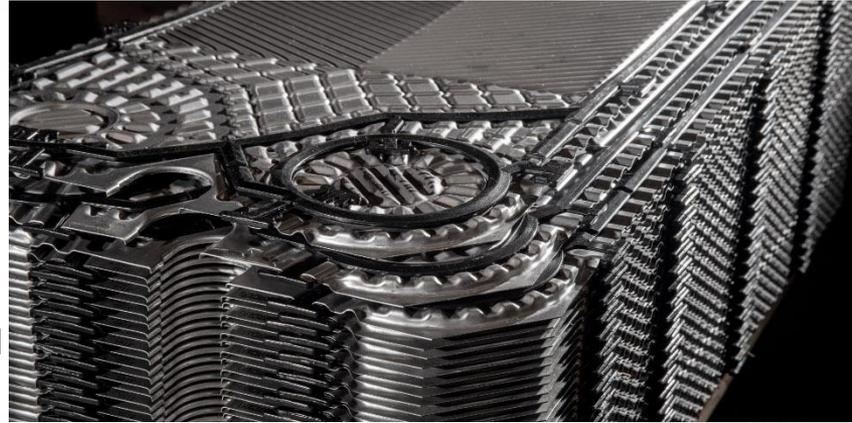
Post Covid?

- When there is a real solution at hand!
- 12-18 months of cautious recovery
- Back on a slightly flatter CAGR curve



Where are we going?

- Design
 - Tubes, Baffles, & etc
- Materials
 - Surface treatments, anti-fouling
- Cleaning
- Efficiency
 - Size and heat transfer



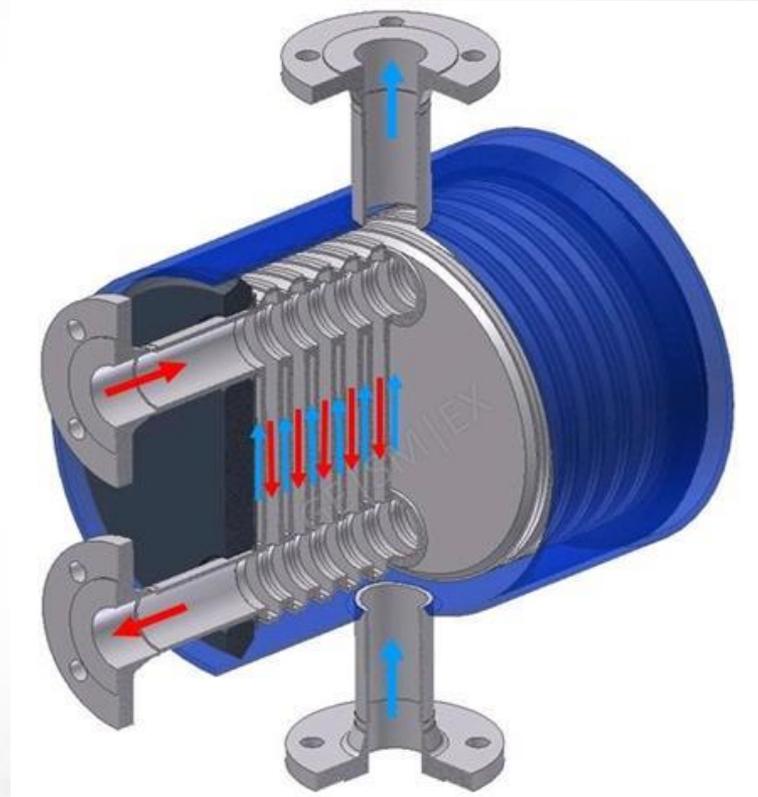
Design

- Shell and Plate vs Shell and Tube
 - Generally more efficient and/or smaller footprint
- Tube design
- Baffles
 - Low pressure loss
 - Boundary layer control



Shell and Plate Example

- Smaller footprint
- Higher efficiency



Tube Design

- Various ways to get better transfer, and/or less pressure loss
 - Twisted tubes
 - Fins
 - Special layouts/patterns

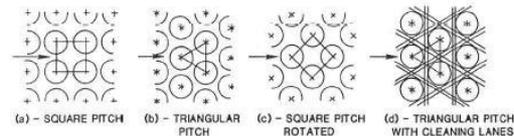
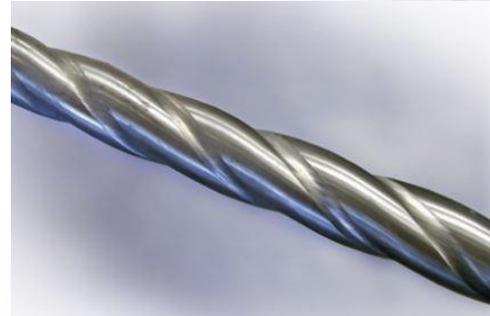
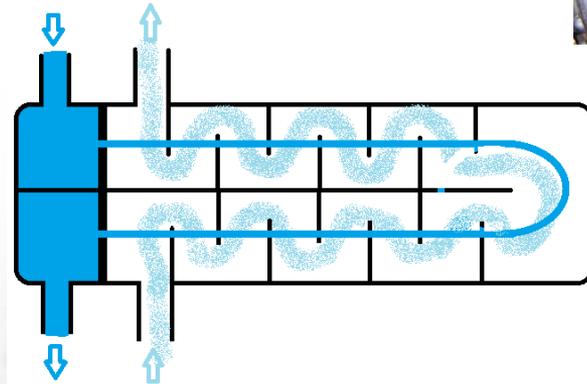
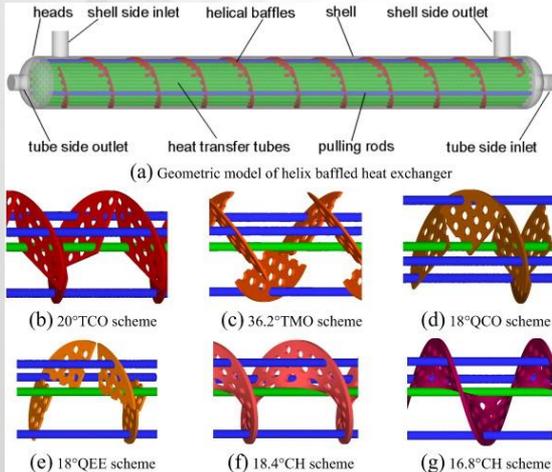


Figure 3-5. Common tube layouts for shell-and-tube heat exchangers.

Baffles/supports

- Direct the fluid flow, but minimize pressure loss
- Support tubes, minimize vibration
- Helicals, expanded metal



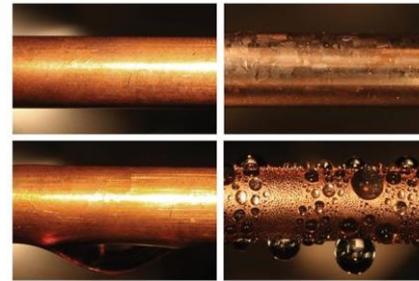
Manufacturing

- Additive manufacturing very appealing for HX efficiency
- Customize materials, in some cases by layer
- Extremely complex geometries
- Compact, one-piece design possible

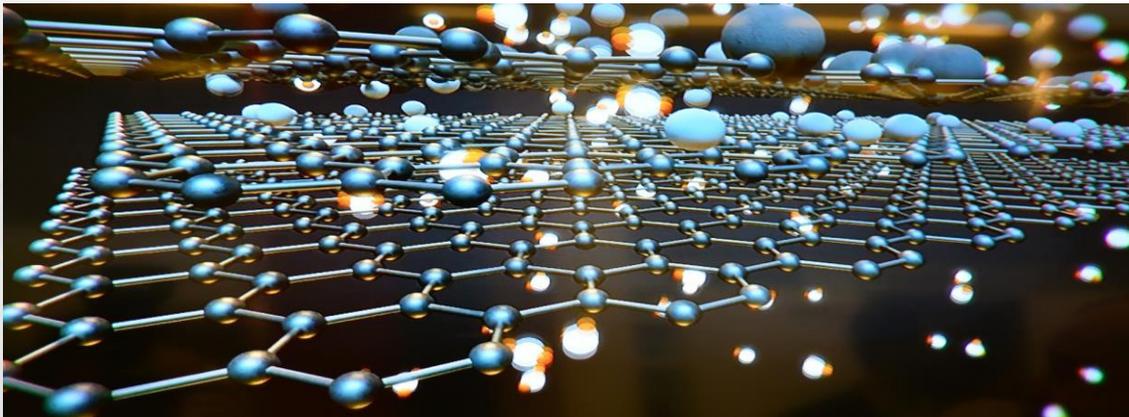


Materials

- Tube coatings
 - Graphene, for example (R&D at this point)
 - Thin-Film
 - Various resins and epoxies
 - Ceramics
- Stronger (lighter/thinner) components
 - Better heat transfer



Film vs
Droplets



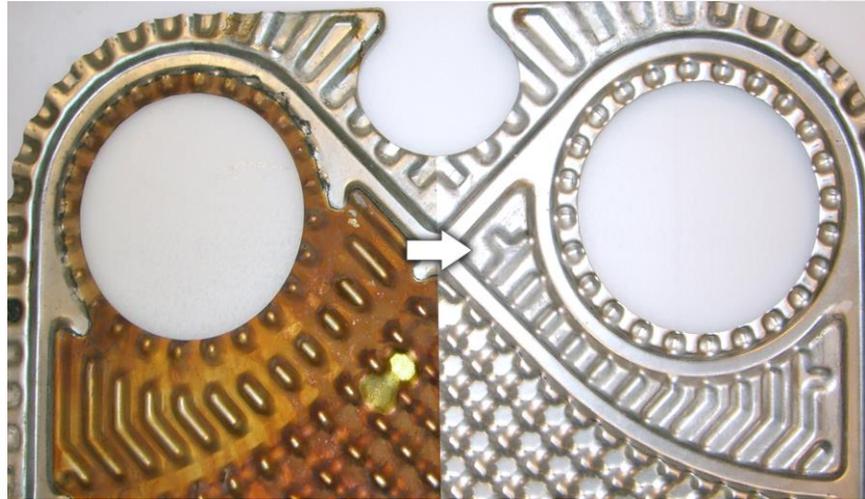
Materials

- Duplex/Super Duplex
- CuNi
- Titanium
- Ceramics
- Composites/Plastics



Cleaning

- Many chemical methods
 - Acid
 - Solvent
 - Water blasting
- New(er) techniques
 - Ultrasound
 - Dry Ice blasting
 - Liquid Nitrogen



What about COVID?

- We see a number of delays in growth projects, TAR
- Regardless, the asset will need to be replaced, COVID or not.
- New facilities will be built, sooner rather than later
- Specialty exchangers will always be needed
 - BAHX?

Post COVID

- Business will come back to normal
- Technology implementation will happen
 - Delayed?
- When we do come back, it will could be shockingly busy, or pretty slow.
 - Nobody KNOWS!
- Climate friendly solutions will be part of the recovery

In Closing

- Look to take advantage of they new designs, materials, cleaning methods when projects do get approved.
- When an existing asset reaches EOL, put in the more modern device
- Continue your R&D efforts, they will be rewarded!

Questions?

