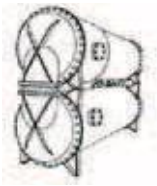
TRANE

CenTraVac® Chillers

The most efficient and reliable centrifugal chillers on the planet

Ingersoll Rand

CenTraVac continues to meet the latest cooling challenges



Right from the start, Trane fundamentally changed the way large buildings are air conditioned with the 1938 introduction of Turbovac™—the world's first direct drive, hermetic, multi-stage centrifugal water chiller.

Buildings account for nearly 40 percent of the total energy consumption in the United States, and 38 percent of carbon dioxide emissions.[1] As much as 50 percent of energy used by commercial buildings is attributable to HVAC systems.[2] Globally, the pressure is on to change heating and cooling practices to optimize the use of natural resources.

Building owners, engineers and architects are searching for answers that can minimize both immediate and long-term environmental impact. In reality, the decisions are almost always affected by financial requirements.

What if you could select a cooling system that is both environmentally preferable and reduces operating costs significantly enough to impress the chief financial officer? You can.

Trane CenTraVac® centrifugal chillers give building owners the lowest possible cooling costs, while delivering environmental benefits that are so significant, we earned awards from the Environmental Protection Agency – three times.

A leader from the start

Trane has been the leader in chiller innovation since 1938. Decade after decade, CenTraVac technology has advanced to meet a variety of challenges, and we will continue to lead the industry into the next generation of cooling.

Most efficient

Trane has seventy years invested in the low-pressure, multi-stage chiller designs that enable the most efficient HVAC systems in the world. Today's CenTraVac is the only chiller capable of sustaining operating temperatures down to 34°F, without energy-robbing anti-freeze.

CenTraVac full load efficiency levels are simply the best available, averaging at least 15 percent better than competitive chillers.

Proven performance

Studies clearly show that positive bottom lines for large tonnage chiller plants focus on the use of full-load efficiency ratings, not IPLV/NPLV.[3] Optimum system performance can only be determined through more thorough analysis. Trane evaluates chiller plant performance using computer modeling that takes into consideration a wide range of variables such as hour-by-hour energy analysis, building operating profiles and chiller plant performance characteristics.[4]

Based on Trane calculations, CenTraVac efficiency levels can produce energy-related cost savings equivalent to an investment that provides an annual ROI of better than 30 percent. Even in the best financial times, that's tough to beat.

Most reliable

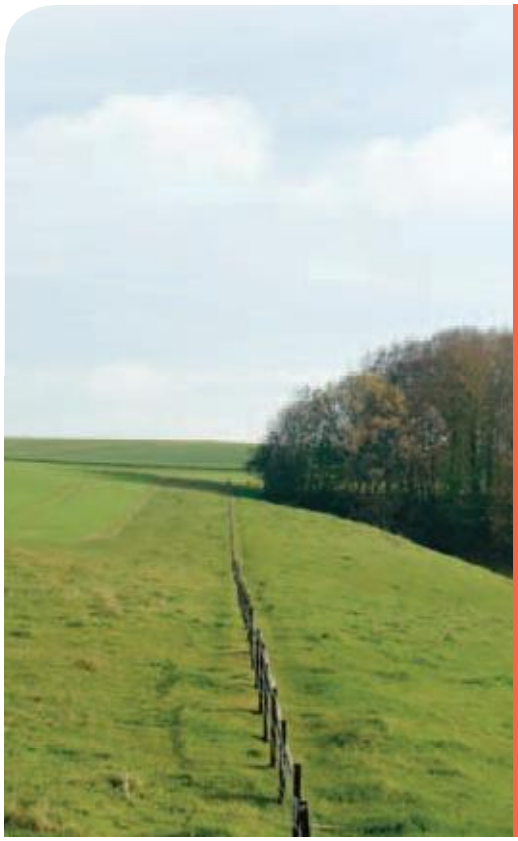
Through simplicity in design, Trane centrifugal compressors achieve the industry's highest design reliability rating of 99.7 percent.[5] CenTraVac is capable of sustaining the precise temperatures at extremely tight tolerances that are key to occupant comfort and crucial to many demanding mission-critical processes. Built to last for decades, and with the industry's fewest moving components, CenTraVac thrives under the most challenging cooling applications.

The financial benefits continue to add up as you calculate the cost avoidances that are attributable to CenTraVac's simplified maintenance and consistent operation that help maintain peak productivity.

Environmentally considerate

Semi-hermetic compressors, along with low-pressure refrigerant, produce the industry's lowest real-life, documented refrigerant emissions rate—less than 0.5 percent annually. The closest competitor claims a distant 2.0 percent.

And if every chiller could operate at CenTraVac's 0.45 kW/ton efficiency, power plant-generated greenhouse gas emissions would be reduced by more than 19 billion pounds of CO_2, 72 billion grams of SO_2 and 30 billion grams of NO_x over the life of the chiller.



Balanced approach

CenTraVac chillers take a balanced approach to multifaceted cooling challenges. Design simplicity, thoughtful refrigerant selection and innovation driven by time-tested engineering principles make CenTraVac the most reliable, cost-effective, energy-efficient and sustainable chillers on the market today.

1. U.S. Environmental Protection Agency, "Why Build Green," http://www.epa.gov/greenbuilding/pubs/whybuild.htm (accessed August 23, 2010).
2. U.S. Department of Energy.
3. W. Ryan Geister and Mike Thompson, "A Closer Look At Chiller Ratings," *ASHRAE Journal*, (December 2009).
4. W. Ryan Geister, Mike Thompson and Justin Wieman, "Chiller Plant Ratings: Why the Proper Evaluation Method Matters," *District Energy* magazine, (Fourth Quarter 2010).
5. Calculated according to the ASHRAE Applications Handbook "Operations and Maintenance Management."

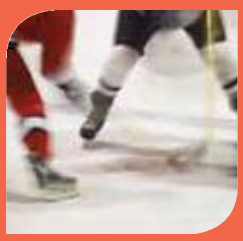
Built for a long and quiet chiller life

CenTraVac® chillers are a lesson in rugged simplicity. Direct-drive, centrifugal chillers by Trane are built without speed-increasing gears and shaft seals, which are both prone to failure and require constant attention to maintain.

Technology inspires continuous innovation, and hundreds of patents have been registered under the Trane name. Still, "reliability by design" remains the core philosophy behind every CenTraVac chiller.

Each CenTraVac chiller is custom-built individually, following rigorous quality control processes. Before the chiller leaves our manufacturing facility, it undergoes extensive testing to ensure it performs as predicted, and to provide a benchmark for testing during commissioning. As a CenTraVac customer, you are invited to personally witness the performance testing of your chiller at the Trane manufacturing facility in La Crosse, Wisconsin.

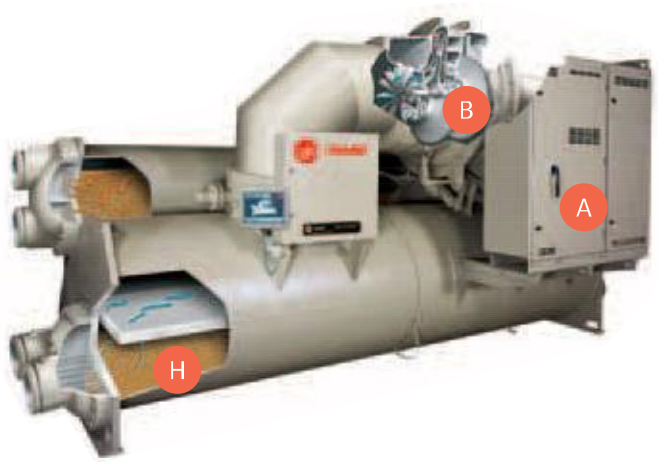
CenTraVac chillers stand up to rigorous industrial and commercial requirements



- Robust design reduces downtime for manufacturing operations, where minutes of lost production time cost dollars in lost revenue. In addition, uninterruptable power can be fed to the controller and the purge, so that critical monitoring functions can continue despite a loss of main power.
- Superior HVAC system efficiency (made possible by an unequalled 34°F sustainable operating temperature without glycol) reduces energy costs for district cooling applications such as office campuses, airports and universities.
- Integrated controls deliver precision cooling and humidity management for applications that demand uncompromising conditions for manufacturing and research, such as pharmaceuticals, bio-technology, genomes and medical devices.
- A selection of options fortify the CenTraVac design with additional electrical and construction features: wiring in seal-tight conduit, enclosed junction boxes, NEMA 4 protection, industrial-grade starters, special paint and coatings.

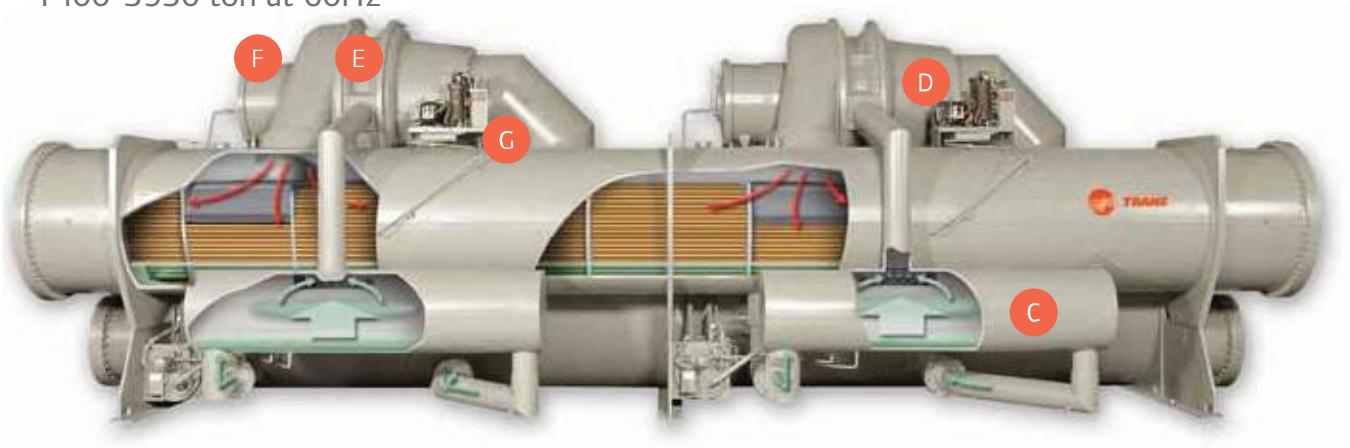
Simplex

120-1300 ton at 50Hz
120-2000 ton at 60Hz



Duplex™

1200-2500 ton at 50Hz
1400-3950 ton at 60Hz



A **Drive performance:** Adaptive Frequency™ drives are the industry's most capable variable speed drives, optimizing compressor speed control to reduce energy usage.

B **Surge resistance:** Multiple stages of compression provide surge resistance and overcome high head-pressure conditions, assuring more consistent comfort levels.

C **Better cycle efficiency:** An integrated flash economizer improves cycle efficiency by 5 to 7 percent, further reducing energy use.

D **One moving part:** Exclusive centrifugal compressor design is built with only one moving part that needs just two bearings for support, resulting in the most reliable chiller available.

E **Quiet, vibration-free operation:** Low-speed, direct-drive design gives CenTraVac the industry's lowest sound and vibration levels. It eliminates the need for costly jacketing and energy-wasting liquid-refrigerant sound attenuation, too.

F **Improved motor efficiency:** Semi-hermetic motor design, along with low-pressure refrigerant, provides the lowest refrigerant leak rates and assures clean and cool motor operation for maximum performance.

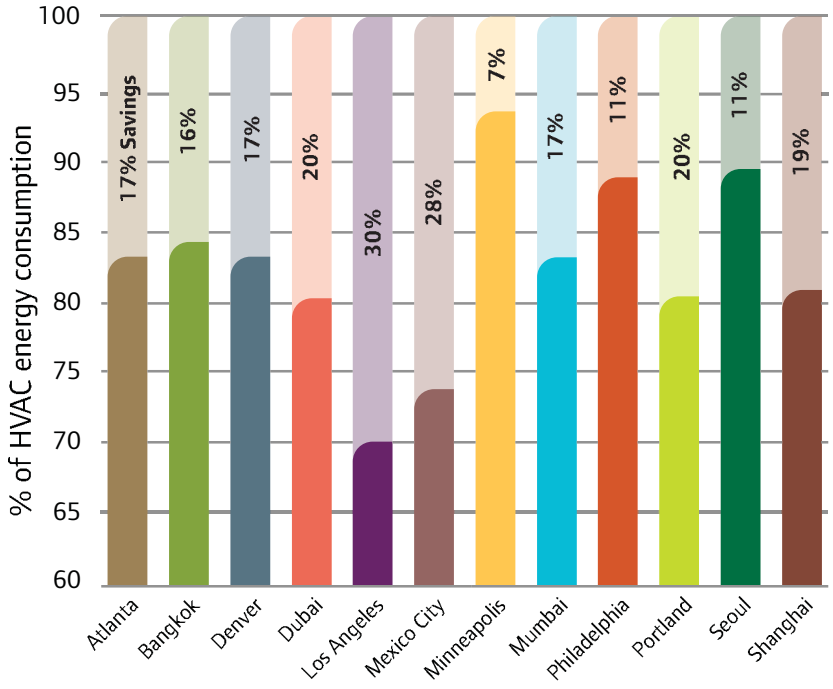
G **Refrigerant leak detection and reclamation:** Patented EarthWise™ purge system doubles as an early-warning emissions detector. Even a slight increase in run time indicates that a leak may be present. The CenTraVac auto-regeneration cycle reclaims lost refrigerant and returns it to the chiller.

H **Reduced refrigerant charge:** Trane evaporator technology reduces the refrigerant charge to nearly half that of most competitors. Lower charge means the chiller requires less refrigerant to operate, and when it comes to refrigerant, less is definitely better in terms of both cost and environmental impact.

A range of options . . . and a CenTraVac to meet your needs

CenTraVac® chillers are available in a wide range of cooling capacities and with features that can be optimized to suit the building's size and function. Specialized chillers fulfill specific needs for large-space cooling and lowest environmental impact. Your Trane sales engineer can help you select the right CenTraVac chiller based on your specific performance criteria.

EarthWise Systems[1] savings as compared to Conventional Systems[2] operating at 100% energy consumption



EarthWise Systems[1]
Waterside: 12°F ΔT across evaporator, 15°F ΔT across condenser, high-efficiency chiller.
Airside: 48°F design supply-air temperature, 76°F zone cooling setpoint (due to lower indoor RH driven by lower supply air-temperatures, per ASHRAE Cold Air System Design Guide defining indoor comfort), supply-air-temperature reset (from 48°F up to 60°F) at mild outdoor conditions, comparative enthalpy economizer, parallel fan-powered VAV terminals, optimized supply duct static pressure control (fan-pressure optimization).

Conventional Systems[2]
Waterside: 10°F ΔT across evaporator, 10°F ΔT across condenser, minimum ASHRAE 90.1 chiller efficiency.
Airside: 55°F design supply-air temperature, 75°F zone cooling setpoint, fixed dry-bulb economizer, VAV with reheat terminals, fixed supply duct static pressure control.

EarthWise CenTraVac Chiller

Good for the environment, great for the bottom line

For building owners who want to improve their environmental profile without sacrificing profitability, EarthWise™ CenTraVac chillers cool without compromise.

EarthWise CenTraVac chillers offer efficiencies as low as 0.45 kW/ton at full-load conditions and IPLVs as low as 0.305 kW/ton at AHRI-ratings. That is a 15 percent improvement over even the best competitive chillers in the 0.55 kW/ton range using alternative refrigerants. And they deliver energy efficiency levels that significantly exceed ASHRAE 90.1 building energy standards, which require chillers to meet specific standards for both demand charge (kW) and consumption rate charges (kWh).

Additionally, these unique EarthWise capabilities are incorporated into low-temperature, low-flow systems to produce the highest levels of efficiency and lowest cost of operation as compared to conventional systems. Overall, EarthWise Systems use smaller fans and ductwork, fewer pumps and less piping… reducing both initial materials costs and long-term operational costs.

Duplex CenTraVac Chiller

High capacity, low complexity

For larger cooling capacities, the Duplex™ centrifugal chiller extends the proven Trane CenTraVac design to nearly 4,000 ton.

Duplex chillers with a series counterflow design and dual independent refrigerant circuits leverage thermo-dynamic staging to deliver unmatched efficiency. Duplex designs reduce energy consumption by 13 percent over a single compressor unit; and when paired in a series configuration, increase the energy savings to 19 percent.

Duplex chiller features include:

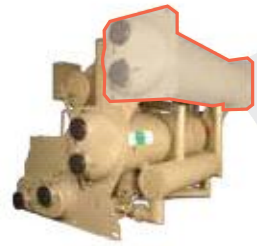
- Series-counterflow for highest efficiency
  – Very low water-pressure drop
- Multiple compressors with multiple stages for unloading stability and efficiency
  – Versatile for ambient applications
- Proven CenTraVac compressors and ancillaries
- 380–13,800 volts

Add options to enhance energy management

Chiller options conserve energy and save money. Your CenTraVac® chiller can be configured in hundreds of different ways to deliver the performance you need. Energy management features are designed, factory-installed and tested to provide seamless integration with chiller operation.

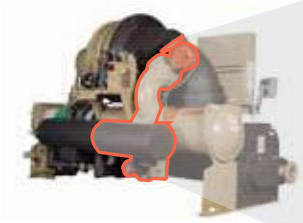
Adaptive Frequency Drives (AFD)

Adaptive Frequency™ Drives control the operating speed of the chiller compressor motor by regulating output voltage in proportion to output frequency. Varying the speed to optimize the performance of the compressor can take advantage of part lift conditions that translate into significant energy savings.



Heat recovery

Use of the heat recovery CenTraVac can significantly reduce the energy operating costs of many buildings by using heat which normally is rejected into the atmosphere. Typical uses for this are tempering supply air and preheating domestic hot water. Any building with a simultaneous heating and cooling load is a potential candidate.



Free cooling options

A refrigerant migration feature can provide up to 45 percent of the nominal chiller capacity, without running the compressor. Under the right conditions, it can produce significant cost savings. Examples include climates with cooler wetbulb temperatures where a cooling load is present, applications with elevated leaving chiller water temperatures, and settings where heat is rejected into a river, lake or pond.

Thermal energy/ ice storage

A thermal storage system uses a dual-duty chiller to make ice at night when utilities charge less for electricity. The ice supplements or even replaces mechanical cooling during the day when utility rates are at their peak. Reducing mechanical cooling results in big utility cost savings.

High efficiency tubing

Enhanced tubes have greater surface area where heat can be transferred from one side of the tube to the other, and they provide more fluid turbulence. External enhancements suit the refrigerant properties and the application (boiling or condensing), while internal enhancements improve fluid flow.

Tracer AdaptiView chiller controls: It's how facility managers keep their cool

Tracer AdaptiView™ chiller controls let building operating staff take command of the chiller plant. With a full color touch-screen display and interactive animated graphics, they can view, access and control chiller operations and functions and gain insight into the operating patterns, energy use and system performance.

Algorithms embedded within the controller work with the unique capabilities of the CenTraVac chiller to keep buildings operational, even during the most challenging conditions when other chillers would shut down.

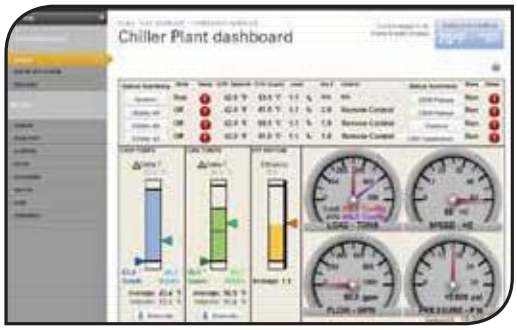
Trane customers directed the design of the Tracer AdaptiView user interface, which provides a practical approach to chiller management.

Manage multiple chillers from any location with the Tracer SC controller

Adding the Tracer™ SC controller to a system provides a flexible, cost-effective solution for managing your HVAC system that can extend to lighting and energy consumption. Its simplified, web-based management tools help improve efficiencies, increase tenant comfort and reduce energy costs.

- Chiller sequencing routines optimize chiller plant energy efficiency by rotating individual chiller operation to equalize runtime, and by matching capacity to the building cooling load
- Coordinates pumps and cooling towers with the chiller operation for greater energy efficiency and reduced costs
- Alarms and diagnostic messages provide easier monitoring and troubleshooting

Tracer SC controller provides an easy-to-use interface via the web to monitor and control a chiller plant from any location.



Tracer SC dashboard uses an easy-to-interpret, graphical display to report current operating conditions and energy usage.

Straight talk on refrigerants

No chiller discussion would be complete without some straight talk about refrigerants. First and foremost, Trane selects refrigerants based on the overall impact on the environment that takes Ozone Depletion (ODP), Global Warming Potential (GWP) and energy efficiency into consideration.

Direct-drive CenTraVac® chillers are designed to use a low-pressure refrigerant. This means the product operates in a vacuum, which virtually eliminates leaks and enables near-zero emissions throughout its operational life. That's a "win" in the direct environmental effect from the refrigerant-minimizing ODP and GWP.

Trane engineers continue to weigh the options. Unfortunately, there is no perfect refrigerant. Through the decades, scientists have invented, advocated—and then banned—a progressive list of agents used for refrigeration and air conditioning. Trane embraced each advancement that made our products better for people and safer for the environment. Bottom line: Trane CenTraVac is the chiller with the world's lowest carbon footprint.

Refrigerants come and go. CenTraVac customers can be confident that no matter how long the chiller is in operation, Trane will be able to sustain its operation with a suitable refrigerant.

CenTraVac defines the industry

First in chiller innovation

1938—Trane introduces the world's first direct-drive, hermetic, multi-stage, centrifugal water chiller

1955—Trane announces automatic operation on CenTraVac chillers

1964—Trane announces the first packaged centrifugal chiller, easing installation and improving reliability

1982—Trane introduces the first 3-stage, direct-drive centrifugal chiller

1994—Trane introduces the EarthWise™ CenTraVac, the world's most efficient, lowest-emissions chiller

1996—Trane introduces the Duplex™ chiller, extending the proven design to nearly 4,000 ton

2008–Trane announces unit-mounted variable speed solutions up to 3,200 ton

Rated "Best of the Best" by the EPA

CenTraVac chillers have received U.S. Environmental Protection Agency awards three times, including "Best of the Best" environmental solutions in 2007.

Here's what the EPA has to say . . .

"Trane has led the industry in technical innovation and performance that has defined superior environmental performance. Through both managerial leadership and technological innovation, Trane has drastically minimized the environmental impact of its centrifugal chillers by developing numerous technologies to detect and prevent refrigerant emissions and to maximize the energy efficiency of centrifugal chillers."[6]

—U.S. Environmental Protection Agency

Ready to take on the world . . .

Trane is the global leader in centrifugal chillers. Around the world, our presence is strong and we will continue to take on future cooling challenges with CenTraVac, the most efficient and reliable chiller on the planet.

2007 Best-of-the-Best Stratospheric Ozone Protection Award Trane: For Superior Environmental Performance of Centrifugal Chillers

1998 EPA Climate Protection Award

1992 EPA Stratospheric Ozone Protection Award

6. U.S. Environmental Protection Agency, "2007 Best of the Best," www.epa.gov/Ozone/awards/bestofthebest/2007_ botb_winners.html (Accessed 2007).

Trane Building Services: maintain peak HVAC performance year after year

Long-term support

The local Trane team can provide comprehensive support throughout the life of your chiller:

- Available extended service warranties and regular maintenance protect the chiller investment and add value to your CenTraVac® purchase by sustaining its peak operating efficiency
- Remote monitoring by Trane is available to safeguard and enhance system performance
- Emergency technical service provides fast resolution to minimize downtime
- A full line of replacement parts is available in local inventory
- Training in proper chiller operation and maintenance is available at several Trane training facilities, or on-site at the chiller location

Local support: we've got your back

Trane fully supports HVAC systems through a network of sales offices located around the world. We have the industry's most knowledgeable engineers, HVAC systems specialists and technical professionals on staff. Currently, over 700 Trane employees have earned LEED® certification from the U.S. Green Building Council.

Of course, what's most important to you is that your local Trane sales engineers and technical team will see you through the entire chiller purchase process, from building analysis to equipment specification, through installation and commissioning.

The average lifespan of a CenTraVac chiller is over thirty years—a full five years longer than competitive chillers.[7] Trane offers support to help sustain peak performance throughout the equipment's full life expectancy.

7. "Comparison of Service Life Estimates," ASHRAE HVAC Applications Handbook, (2007 edition): Chapter 36, page 36.3, table 4.

Ingersoll Rand

Ingersoll Rand (NYSE:IR) is a world leader in creating and sustaining safe, comfortable and efficient environments in commercial, residential and industrial markets. Our people and our family of brands—including Club Car®, Hussmann®, Ingersoll Rand®, Schlage®, Thermo King® and Trane®—work together to enhance the quality and comfort of air in homes and buildings, transport and protect food and perishables, secure homes and commercial properties, and increase industrial productivity and efficiency. We are a $13 billion global business committed to sustainable business practices within our company and for our customers.

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