

SEPTEMBER 2008

Carrier
TRANSICOLD

ContainerLINE



environmental solutions

special edition

ECOSM
DRIVEN

Delivering Environmentally Sound Solutions



In this special edition of ContainerLINE, we highlight the market acceptance of our new PrimeLINE® unit, and we introduce our new EcoDrivenSM logo, a symbol that reflects Carrier's continuing legacy of providing environmentally sound solutions.

To us, EcoDriven is more than a theme – driving ecologically smart solutions is a way of doing business. Today's customers require solutions that can minimize their environmental footprint. That means consuming less fossil fuel and reducing emissions.

Many suppliers claim to have solutions, but Carrier is truly delivering on its commitment to the environment. Being "EcoDriven" is in our DNA as a part of United Technologies Corporation, which in 2008 again has been named one of the "Global 100" Most Sustainable Corporations by the World Economic Forum.

The PrimeLINE unit featured in this issue is a terrific example of Carrier's EcoDriven innovation. Already making waves in the container shipping and leasing industries, it pushes performance and efficiency to new limits and, at the same time, helps shipping lines reduce related atmospheric emissions. Simultaneously cutting fuel costs and emissions, the PrimeLINE unit proves you truly *can* have it both ways.

Other EcoDriven examples are the QUEST power-saving mode, which improves efficiency even further for certain applications, and our leadership in bringing non-ozone-depleting R-134a to the container refrigeration industry.

On another note, as I transition to Director of Sales – Americas, please join me in welcoming Kartik Kumar to Carrier Transicold as Director of Marketing and Strategic Planning, a position that I've had the pleasure of holding for the last five years. Kartik brings excellent credentials to the position, and will continue to build on our strong tradition of customer focus and delivering EcoDriven solutions. Please join me in welcoming Kartik to Carrier Transicold.

Scott A. Pallotta

Director of Sales – Americas

Leading Customers Enhance Fleets with PrimeLINE® Units

The PrimeLINE® container refrigeration unit is making a splash with a number of important customers, including the banana trade!

Carrier has received orders from major shipping and leasing lines for more than 6,000 PrimeLINE units, the most energy-efficient container refrigeration unit ever offered.

"Customers are consistently choosing the PrimeLINE unit first and foremost for its lower energy consumption," said Anton Van Rooij, Carrier's regional sales manager for Europe. "The additional benefit is the higher capacity of the unit."

Among those making purchases is Maersk Line, the world's largest container shipping company.

All PrimeLINE units acquired by Maersk Line will include the QUEST power-saving mode. Maersk has previously reported on its plans to reduce its carbon dioxide emissions by 325,000 tons annually using QUEST mode technology. The PrimeLINE unit, which delivers the greatest cooling capacity of any R-134a unit on the market, was designed specifically to reduce environmental impact and lifecycle cost through exceptional energy efficiency.

The PrimeLINE unit's low power consumption and fast pull down make it most appealing to the banana trade. "For a high respiring fruit such as bananas, it's all about providing greater capacity and airflow," said Jim Taeckens, senior product manager, Container Products Group. "Quick pull-down for banana transport calls for power, and the PrimeLINE unit's power consumption in a 100 percent perishable scenario is at least eight percent better than its nearest competitor." (see chart, page 5)

Personnel Update



Kartik Kumar has joined the Container Products Group as Director of Marketing and Strategic Planning, Global Container Refrigeration. Based in Singapore, Kumar succeeds Scott Pallotta, who now serves as Director of Sales – Americas. Charles Cailliau plans to retire in the coming months.

In his new position, Kumar oversees product marketing and works closely with global sales and service engineering to drive growth and customer satisfaction. He also focuses on identifying and capitalizing on new business opportunities that complement current products and aftermarket service programs.

Previously, Kumar was with Honeywell Process Solutions, based in Switzerland, where he served as Director of Global Strategy. Before that, he held sales, engineering and project management roles with Invensys in Australia, India and Europe.

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PRIMELINE

PrimeLINE[®] Unit Takes On the World

Carrier's new PrimeLINE[®] container refrigeration unit provides shipping lines with a hedge against rising energy costs like no other unit on the market today. Designed with both the ecologist and economist in mind, it's an "EcoDrivenSM" solution.

In slashing energy requirements, the technologically advanced PrimeLINE unit helps shippers reduce their impact on the environment. Additionally, like other units in Carrier's container refrigeration family, the PrimeLINE unit is designed to keep long-term maintenance and repair (M&R) costs low.

Most container refrigeration unit manufacturers make similar claims about energy efficiency and performance. On these pages we show why the PrimeLINE unit is in a class by itself.

Total Cost of Ownership

"In assessing container refrigeration performance, total cost of ownership (TCO)

is key," said James Taeckens, senior product manager. "TCO combines acquisition cost, energy costs, and M&R costs over the life of the unit. The PrimeLINE unit is designed to have the lowest TCO of any unit on the market."

Not long ago, acquisition cost was the single biggest component of TCO. As recently as 2003, when bunker fuel costs were in the vicinity of \$150 a tonne, energy costs comprised just over one-fourth of a refrigeration unit's TCO over a typical 12-year ownership period. That portion has gradually grown, and with bunker fuel prices recently surging to \$700 a tonne and beyond, energy now accounts for two-thirds of the TCO.

"With some competitive units, a lower acquisition cost can quickly turn into a higher operating cost, on a TCO basis, because their power consumption is substantially higher than the Carrier unit, thus negating any upfront savings," Taeckens explained.

"Based on price trends, energy will account for an even larger proportion of TCO in the future," Taeckens said. "So when making the initial investment in refrigeration equipment, one needs to look at the total picture, paying particular attention to the anticipated energy cost over the life of ownership."

Environmental Impact

In the transportation sector, there is a direct link between energy production and atmospheric emissions.

The more energy that is required, the greater the level of emissions. It follows that when you reduce energy requirements, you reduce power generation and, hence, related emissions of greenhouse gases, such as carbon dioxide (CO₂) and particulates.

Shippers seeking to minimize the global warming impact from power generation should select products with the lowest energy demand. Here, the efficient PrimeLINE unit excels.

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"The PrimeLINE[®] unit is designed to have the lowest TCO of any unit on the market."



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Greenhouse gas emissions related to energy production for PrimeLINE units are lower than all competitors. For one competitive unit with higher energy needs, power generation results in 69 percent more CO₂ emissions. Replacing such a unit with a PrimeLINE unit reduces CO₂ emissions by about 5,100 kg a year, or about the same as removing one passenger vehicle from the road.

Another environmental advantage of the PrimeLINE unit is its use of R-134a, a Carrier-standard refrigerant with the lowest Global Warming Potential of all contemporary container refrigeration unit refrigerants. The PrimeLINE unit pushes R-134a to new levels of performance, demonstrating even better pulldown capacity than units using R-404A, a

refrigerant blend with significantly longer atmospheric life, higher operating pressures and higher leak rates.

Plan for M&R Costs

When considering unit life cycle factors, less obvious, but no less important, are long-term service and M&R requirements.

The PrimeLINE unit was engineered to minimize long-term costs for maintenance, repair and consumables. For example, Carrier's patented electro-coated condenser coils perform well beyond the six- to seven-year lifespan of conventional coils. And Carrier's modular MicroLink™ 3 controller provides time-tested reliability, accuracy and interchangeability with other Carrier units.

When it comes to compressor technology, the PrimeLINE unit delivers exceptional efficiency with the simplicity and reliability of a digital scroll compressor.

"Some variable-speed technologies developed by competitors to save energy actually add complexity, come at a much higher cost, and can be expensive to maintain or replace," Taeckens said. "Technology for the sake of technology means nothing. Carrier's time-tested reliability delivers energy-saving performance with lower maintenance costs in the long run."

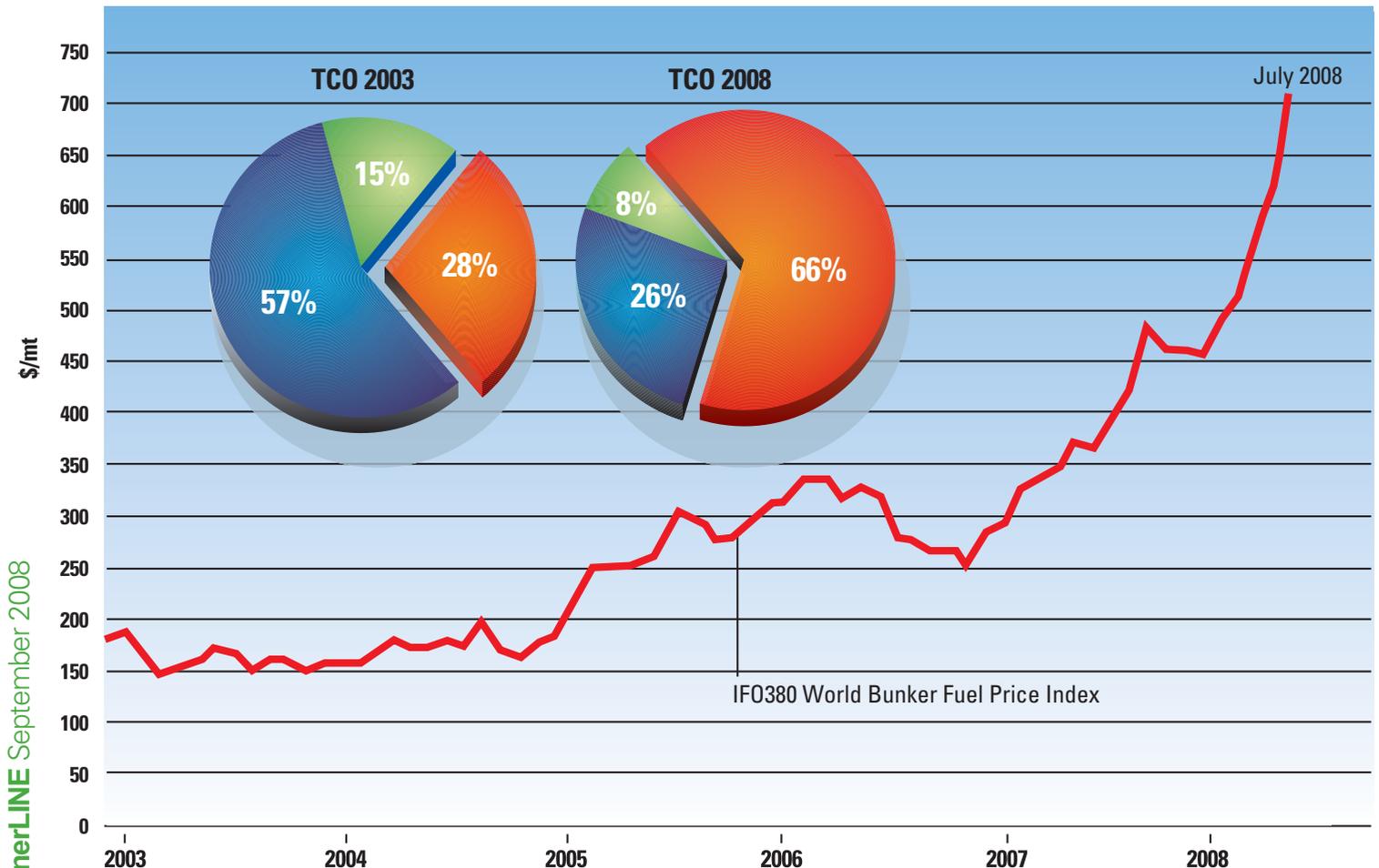
The Bottom Line

For fleets evaluating a purchase of new container refrigeration equipment, there are many criteria to consider.

A Chilling Comparison: Energy's Influence on Total Cost of Ownership (TCO)

Over the past 5 years, energy's contribution to the total cost of ownership of a container refrigeration unit has grown from less than one third to nearly two thirds.

- Energy Cost
- Acquisition
- M+R Cost



ContainerLINE September 2008

Fuel Price Source: Bunkerworld. Index comprised of fuel prices in Singapore, Rotterdam, Houston, and Fujairah. TCO based on industry averages and a 12-year product life.

“Now and in the future, key considerations will continue to be long-term energy costs, environmental factors, refrigeration unit performance, M&R costs, widespread availability of service and technical support,” said Taeckens. “Together, all point to the PrimeLINE unit.

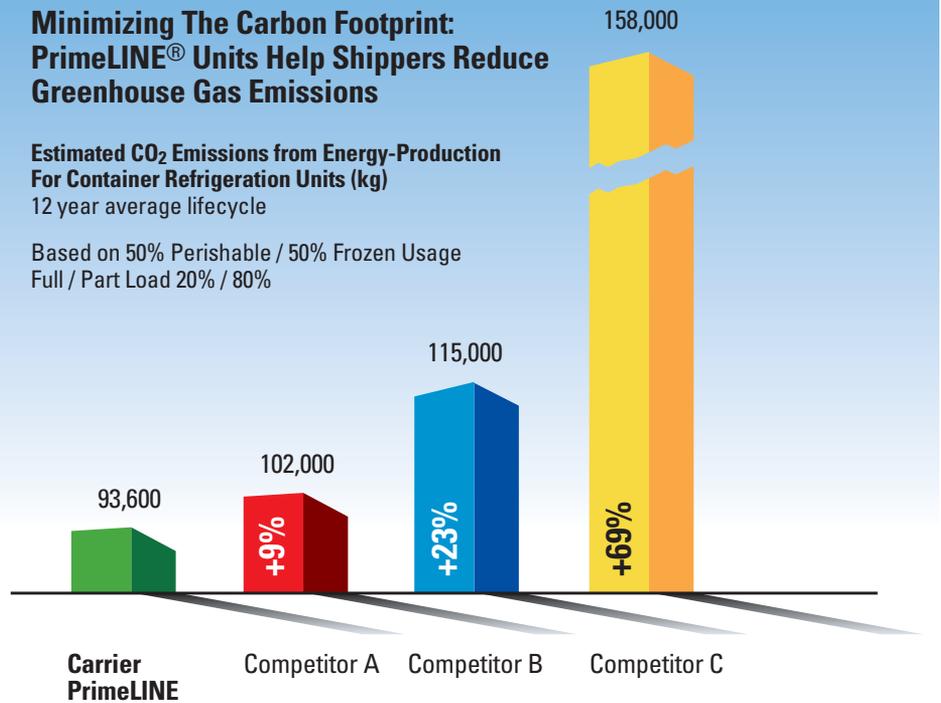
“Prime means top quality, or number ones. The name suits this unit perfectly, because the PrimeLINE unit delivers in all the important areas – efficiency, the environment, performance and reliability.

“When you do the math, no matter which measure you consider, the sum of the PrimeLINE unit’s components add up to a whole lot of long-term savings!”

Minimizing The Carbon Footprint: PrimeLINE® Units Help Shippers Reduce Greenhouse Gas Emissions

Estimated CO₂ Emissions from Energy-Production For Container Refrigeration Units (kg)
12 year average lifecycle

Based on 50% Perishable / 50% Frozen Usage
Full / Part Load 20% / 80%



Fundamentals of Container Refrigeration Energy Consumption

The recent surge in bunker fuel costs has rocked the global shipping industry like a tidal wave. Fuel has become the biggest operating expense in container shipping, and it’s no less the case for energy needs to support container refrigeration.

“Energy requirements vary both by container unit manufacturer and according to specific demand circumstances,” said James Taeckens, senior product manager.

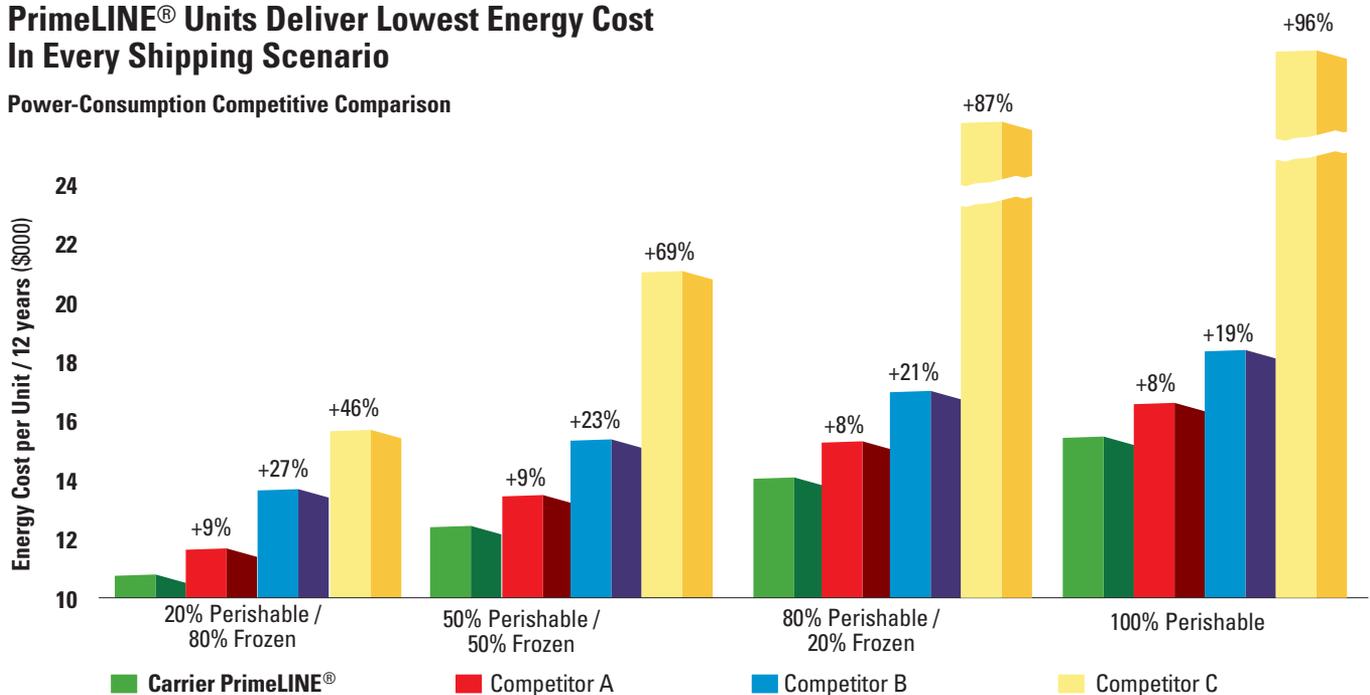
“For example, some refrigeration technologies do reasonably well in handling deep frozen, but consume a great deal of energy when protecting perishables.

“Yet in the real world, most fleets run a mix of both perishable and frozen cargo – the exception being the segment dedicated to transporting bananas, which only operates in the perishable mode. Therefore, energy efficiency in *all* situations is key.”

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PrimeLINE® Units Deliver Lowest Energy Cost In Every Shipping Scenario

Power-Consumption Competitive Comparison



Fuel cost: U.S. \$700 / metric tonne (as of July 2008)

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Among the major makes of container refrigeration units on the market today, the PrimeLINE® container refrigeration unit stands alone in its ability to offer the lowest energy consumption in the most common scenarios, ranging from 100 percent perishable to a mix of 20 percent perishable and 80 percent frozen.

“In a situation where a fleet averages 50 percent perishable and 50 percent frozen, a PrimeLINE unit’s 12-year energy cost, based on \$700/tonne bunker fuel, will be about \$12,500,” Taeckens explained. “Under identical circumstances, competitor energy requirements will be as high as \$21,120, or nearly 70 percent more than the PrimeLINE unit.”

“In many situations, a PrimeLINE® unit in standard mode outperforms competitive units operating in their power-saving modes.”

In a strictly perishable situation such as a banana fleet, the contrast is far more dramatic. A PrimeLINE unit’s 12-year energy cost is projected at about \$15,400. The least efficient competitive unit’s energy cost is projected at nearly \$30,150, nearly double the PrimeLINE unit. Even the most competitive unit in this scenario exceeds the PrimeLINE unit’s energy requirements by nearly eight percent.

“And this is at a time when savings of as little as a percent or two is significant,” Taeckens said.

Testing the Field

Carrier evaluated the PrimeLINE unit and competitive models to measure energy usage and calculate energy costs over a 12-year life cycle. Criteria included bunker fuel costs at \$700 per tonne, the price as of July.

Calculations factored 140 days of operation per year, of which 110 days were shipboard and 30 were in terminals.

Power draw was measured in full-power mode and part-load mode, with long-term calculations based on working in full-power mode for 20 percent of the time, representing pull-down periods, and part-load mode for 80 percent of the time.

Tests were done for both standard operation and power-saving mode, if available.

Four sets of operating conditions were factored: 100 percent perishable, and perishable-to-frozen balances of 80/20, 50/50 and 20/80.

Power-Saving Mode

For even further energy savings, customers can tap the power of Carrier’s QUEST power-saving mode. QUEST mode is a breakthrough solution that enables the control software to modulate refrigeration

“The QUEST mode saves energy for PrimeLINE®, ThinLINE® and EliteLINE® units.”

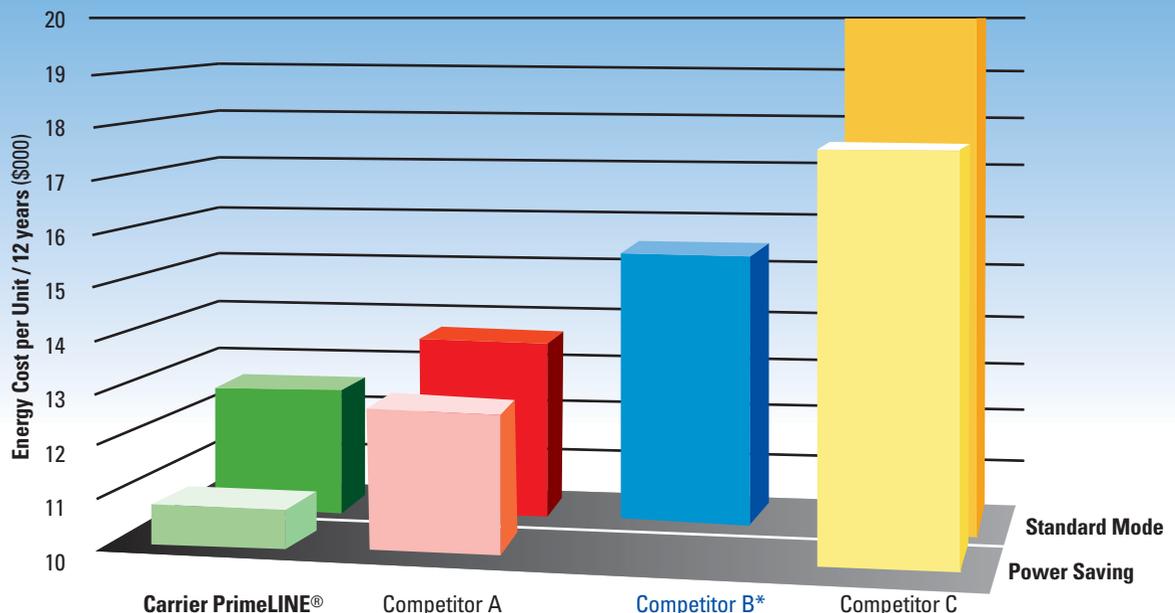
unit operation within defined parameters to save energy. It is compatible with Carrier PrimeLINE, ThinLINE® and EliteLINE® units. It intermittently cycles the refrigeration system on and off, eliminating the need to power the compressor and fans continuously.

With the PrimeLINE system, the QUEST mode is capable of reducing energy needs by at least 22 percent in an all-perishable operation.

“Some competitive units also offer power-saving modes, but none match the PrimeLINE unit in terms of performance”, noted Taeckens.

“In all of our test scenarios, the PrimeLINE unit with QUEST mode beat all competitors’ power-saving modes,” said Taeckens, adding, “The PrimeLINE unit is, in fact, so efficient that in an 80 percent frozen situation as well as the 50 percent perishable operation, its *standard mode* can outperform competitive units operating in their *power-saving modes*.”

Optimizing Energy Savings: PrimeLINE® Unit With QUEST Mode Outperforms the Pack



Based on 50% Perishable / 50% Frozen Usage. Fuel cost: U.S. \$700 / metric tonne.

*No power-saving mode available as of July 2008

Refrigerants Today and Tomorrow

Worldwide concerns about Earth's fragile biosphere loom large today, and refrigerants are once again a target in the environmental discussion.

Although ozone-depleting refrigerants were banned years ago by the United Nations Montreal Protocol, the current discussion has shifted to greenhouse gases – chemicals with high global-warming potential (GWP), including contemporary refrigerants such as hydrofluorocarbons (HFCs).

Europe's recent F-Gas regulation phases out all automotive air conditioning system refrigerants with GWP ratings greater than 150 by 2017. Bans on certain HFCs are also being enacted in some European countries and are proposed in California in the United States.

These developments have raised concerns within the shipping industry about the long-term prospects of refrigeration technology investments.

"Carrier is closely watching these trends and looking ahead to the future," said David Smith, senior product manager. "In the meantime, R-134a, which is used throughout the Carrier container product line, remains the most environmentally sound refrigerant presently used in container applications."

A high-performing, cost-effective, non-flammable and non-toxic refrigerant, R-134a has the lowest GWP of any non-ozone depleting refrigerant used today. At the other end of the spectrum, R-404A, an HFC blend used in some competitive container applications, has the highest GWP, 2.5 times greater than R-134a. With a GWP rating of 3,260, R-404A is capable of trapping 3,260 times as much heat as carbon dioxide on a pound-for-pound basis.

One expects that with a well-made system, the chance of refrigerant ever escaping into the atmosphere is slight or not at all; however, R-404A has a relative leak rate 3.6 times that of R-134a, and once released into the atmosphere, R-404A has a lifespan of 48 years, versus only 15 for R-134a.

"Some manufacturers claim that R-404A is superior because it offers greater deep frozen capacities than R-134a," said

Smith. "The fact is that less than five percent of refrigerated cargo is in the deep frozen range, and most of that is kept at -24°C to -25°C (-11.2°F to -13°F), which R-134a units have handily accommodated for many years.

"With the new PrimeLINE® unit, Carrier's world-class engineering has resulted in even higher deep frozen capacity than any R-134a unit, and it provides about 10 percent more pull-down capacity than the nearest rival."

R-134a delivers environmentally sound performance for container refrigeration, and its use in container fleets is currently not affected by any bans. The F-Gas regulation in Europe is specific to the use of R-134a in automotive applications only.

"Further, if bans are at some point imposed on HFC refrigerants used in container units, we certainly would expect

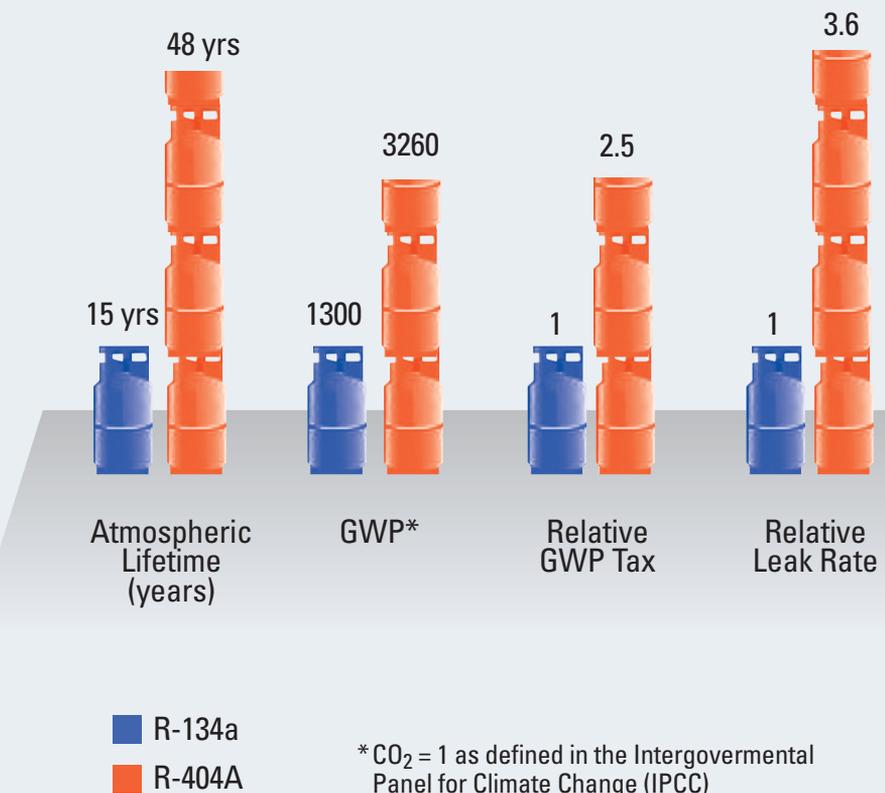
them to affect *all* HFCs, not just R-404A or R-134a," said Smith.

"As the saying goes, 'the only thing constant is change.' It's likely that changes affecting the use of HFCs in container refrigeration will eventually come."

Carrier's engineering teams are pressing ahead with research and development into systems that will tap those next-generation refrigerant alternatives that make the most sense for customers worldwide, always focused on developing solutions that deliver the same or better attributes of performance, compatibility, cost, safety and environmental soundness, as found in today's R-134a.

"Just as we helped to guide the container shipping industry through the major transition from the ozone-depleting refrigerants of the past into today's standard," Smith said, "Carrier will lead our customers into the next phase of refrigerant technology."

R-134a: The Proven Environmentally Sound Refrigerant



Where the Carbon Footprint Leads

Global warming, carbon footprint and “cap and trade” currently are among the leading news topics around the world. Already this year more than 40,000 English-language stories have been published on these very subjects.

Carrier’s Vice President of Government and International Relations, John Mandyck, has a wealth of experience as principal liaison to governments and international associations.



John Mandyck

ContainerLINE met with Mr. Mandyck to get some answers designed to help you make sense of the global discussion on carbon emissions:

ContainerLINE: What is happening globally with respect to CO₂ regulations?

John Mandyck: The United Nations and many countries around the world are looking to slow greenhouse gas (GHG) emissions, like carbon dioxide (CO₂), to reduce the negative impacts of climate change. World scientists have concluded that GHG emissions must

be reduced 60 to 80 percent by 2050 to reverse the human impact on climate change. CO₂ represents about 90 percent of all GHG emissions. Hydrofluorocarbons (HFCs), which are used as refrigerants, represent less than 2 percent.

The Kyoto Protocol was a first attempt for developed countries to reduce GHG emissions by 5.2 percent from 1990 levels between 2008-2012. It’s likely that this treaty will fall short of its goals. Last year, the world community met in Bali, Indonesia to discuss the path forward after 2012, when Kyoto expires. The “Bali Roadmap” calls for a new international framework by the end of 2009 to address climate change by both developed and developing countries. Just recently, the G8 countries pledged to cut emissions by 50 percent by 2050 and called on developing nations such as China and India to follow suit.

CL: Why is this of interest to the container industry?

JM: Climate change regulations will constrain carbon emissions. For containers, the impact could come in two principal forms: (1) the energy used to operate the refrigeration system, and (2) the refrigerant used as the cooling gas.

CL: What experience does Carrier have in dealing with global environmental regulations on the scale of GHG emissions reduction?

JM: For decades, Carrier has been an industry leader in environmental stewardship. In 1994, we were the first company to phase-out chlorofluorocarbons (CFCs) in air-conditioning systems on a global basis – two years ahead of requirements in the U.S. and 16 years ahead of mandates in developing countries. We are committed to offering systems that minimize

environmental impact, such as our investments in products that do not deplete the ozone layer. We work proactively with governments to provide the status of environmental technologies. And we strive to offer our customers a choice of environmentally sound solutions.

CL: Explain what is meant by the term “cap and trade?”

JM: The centerpiece of most climate regulatory proposals is a market-based approach called “cap and trade.” The “cap” is where a government would establish a discreet limit of carbon emissions that decreases over time. While systems can be designed in a number of ways, it is envisioned that caps would be assigned to different sectors of the economy that emit large quantities of GHG. Those sectors that reduce emissions below the capped levels would be able to sell credits to those sectors that exceed the limits. This is the “trade.” Currently, the EU is operating a cap and trade system that covers about 12,000 large emitters of CO₂ primarily in the electrical generation, cement and steel production industries. The EU is looking to add other sectors to its emission trading program, including shipping.

CL: In June, the U.S. Senate voted against the Climate Security Act, which would have set up a market-based cap-and-trade system for sharply cutting emissions by 2050. Similar legislation has been proposed in the U.S. House of Representatives. What effect will these actions have going forward?

JM: While the Senate bill did not pass this year, it was the first to pass out of committee with mandatory targets and timetables. In this instance, the Senate bill would have reduced greenhouse gas emissions 70 percent by 2050. In the House, legislation has been introduced to cut emissions 80 percent by 2050. Both would rely on a cap and trade approach. It appears that climate legislation will continue to be debated in Congress, with some hopeful for final passage in the next two years. In the meantime, states such as California have passed their own laws. Whatever the outcome and timeframe, reductions of GHG emissions will remain a public policy priority.

CL: According to an April 26 article in The New York Times, the European Union increased food imports 20 percent in the last five years. The value of fresh produce imported by the United States nearly doubled from 2000 to 2006. In real terms, what impact does refrigerated shipping have on GHG?

JM: Although refrigerated containers represent no more than 10 percent of all boxes on a ship, Carrier is focused on how we can help our container customers move product from point A to point B with the fewest carbon emissions. For example, our new PrimeLINE® unit is the most energy-efficient unit on the planet, and with QUEST power-saving mode conserves even more power. It follows that when you reduce energy requirements, you can reduce power generation and, hence, related emissions of GHG such as CO₂ and particulates. So we are making a very real difference.

ContainerLINE

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