

Hall 8

**Chillventa Specialist Forums 2024**  
**Chillventa Fachforen 2024**

**CONNECTING  
EXPERTS.**





**ENGINEERED FOR EXCELLENCE**

# **THE IMPORTANCE OF REFRIGERANT SELECTION IN DATA CENTRE COOLING EQUIPMENT**

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# SAVING ENERGY IS CRUCIAL FOR DATA CENTERS

3%



Data centers consume about **3%** of global electricity.

40%



**40%** of the energy consumed by data centers goes into powering its cooling and ventilation systems.

2%



**2%** of global carbon emissions are produced by data centers. This will increase with AI development.

## MAJOR TRENDS FOR DATA CENTER COOLING

- **Invest in HVAC equipment with high performance**
  - The cooling equipment should be highly efficient at full and partial loads, in order to require as little energy as possible to manage different cooling loads.
- **Maintain safety and ensure operational excellence**
  - Lower flammability risk brings piece of mind to data center owners and operators who can benefit from a safer indoor environment, as well as lower maintenance costs and potential downtime.
  - Continual maintenance will help the cooling system to stay up and running as efficiently as possible.
- **Optimise Free Cooling**
  - Wherever possible, use free-cooling (outdoor air, seawater, evaporating water or similar) to cool the data center which in turn reduces the energy usage and operating cost.
- **Recover Heat**
  - All the electricity input to the IT equipment turns into heat and needs to be cooled-down in order for the equipment to function properly.
  - If there is a heating demand in the other areas of the building, or a district heating network, this heat can be used via a heat pump instead of getting wasted.

Source: <https://www2.deloitte.com/us/en/pages/consulting/articles/big-data-or-low-carbon-earth-day.html>

<https://dataspan.com/blog/data-center-cooling-costs/>

# REFRIGERANT IMPACT | DATA CENTRE

## 3 Offices / Housing



- **Sustainable Options for Heating**  
Recover low temperature waste heat from the Data Centre and reuse it **for the heating needs of other zones such as offices.**
- **Connect it to the heat network of a District Heating system** that can provide heating to residential homes.
- **Increase the amount of clean energy and reduce CO2 emissions.**

## 1 COOLING



- Honeywell Solstice<sup>®</sup> ze, or Solstice<sup>®</sup> N15 (R515B) **help chillers achieve energy efficiency more safely with reduced environmental impact up to 99%.**
- Refrigerants for new chillers and retrofit option available for 134a based chillers (R513A).
- Low-GWP Fluids for CRAC units, Rack Door and Direct Chip Cooling (R513A, R515B).

## 2 HEAT RECOVERY



- **Reuse the heat generated** in datacenter instead of rejecting heat to atmosphere to avoid direct contribution to global warming.
- **Value this low heat waste** into electrified heat resource (up to 120C) by HTHP with R1233zd.
- **Avoid using heat produced with other fuels having a higher rate of CO2 emissions.**

**Solstice refrigerants can help reducing CO<sub>2e</sub> impact of data centres**

# SOLSTICE REFRIGERANTS FOR DATA CENTRES

| Product                             | Compressor Type  | Legacy Refrigerant | Installation | HONEYWELL Interim Solution | HONEYWELL Long Term Solution | Product Image                                                                         |
|-------------------------------------|------------------|--------------------|--------------|----------------------------|------------------------------|---------------------------------------------------------------------------------------|
| Chiller / Heat Pump (low pressure)  | Centrifugal      | R-134a<br>GWP=1430 | Outdoor      | R-1233zd / A1<br>GWP = 3.9 |                              |    |
|                                     |                  |                    | Indoor       |                            |                              |                                                                                       |
| Chiller / Heat Pump (mid pressure)  | Turbo (Oil-free) | R-134a<br>GWP=1430 | Outdoor      | R-513A / A1<br>GWP = 630   | R-1234ze / A2L<br>GWP = 1.4  |    |
|                                     | Screw            |                    | Indoor       | R-513A / A1<br>GWP = 630   | R-515B / A1<br>GWP = 288     |                                                                                       |
| Chiller / Heat Pump (high pressure) | Scroll           | R-410A<br>GWP=2088 | Outdoor      | R-454B / A2L<br>GWP = 465  | R-1234ze / A2L<br>GWP = 1.4  |    |
|                                     |                  |                    | Indoor       | R-515B / A1<br>GWP = 288   |                              |                                                                                       |
| CRAC (high pressure)                | Scroll           | R-410A<br>GWP=2088 | Indoor       | R-513A / A1<br>GWP = 630   | R-515B / A1<br>GWP = 288     |  |

\*According to the new EU regulation 573/2024 HFCs GWP is calculated as per AR4 standards and HFOs GWP is taken as per AR6 standards

A1: low toxicity, non-flammable  
A2L: low toxicity, mildly flammable  
GWP: Global Warming Potential

# EXAMPLE 1 | 7000 AMK - SINGAPORE

| Key Facts & Figures    |                                                                                                                                                                                                                                                              |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| End User               | 7000 AMK / Kaer                                                                                                                                                                                                                                              |
| Equipment Provider     | Trane - Carrier                                                                                                                                                                                                                                              |
| Plant Description      | Initially, the facility's cooling was supplied by 17-year old chillers charged with HCFC-123. Due to aging and low performance, the existing equipment has been replaced with the new cooling system to improve the capacity and sustainability of the plant |
| Commissioning Date     | 2015-2016                                                                                                                                                                                                                                                    |
| Equipment Used         | Trane 900TR & Carrier 800TR chillers                                                                                                                                                                                                                         |
| Refrigerant Used       | R-1234ze by Honeywell                                                                                                                                                                                                                                        |
| Total Cooling Capacity | 11.6 MW (2 x 3165 kW) & (2 x 2813 kW)                                                                                                                                                                                                                        |
| Results / Benefits     | The energy efficiency of the cooling system is 15% better than current Green Mark Platinum benchmarks<br>Facility now boasts fully automated operations, resulting in a 90% reduction in manpower to operate the plant                                       |

kaer



# EXAMPLE 2 | EUROCONTROL - BRUSSELS

| Key Facts & Figures    |                                                                                                                                                                                                                                                                                                                                                                 |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| End User               | EuroControl                                                                                                                                                                                                                                                                                                                                                     |
| Equipment Provider     | Engie Axima                                                                                                                                                                                                                                                                                                                                                     |
| Plant Description      | Eurocontrol's air-traffic flow management and data centres require constant cooling for optimal performance and stable operations. Thermal issues account for more than one-third of unplanned data centre outages. The new dual-chiller system has been installed to prevent overheating and reduce operating costs at Eurocontrol's headquarters in Brussels. |
| Equipment Used         | Quantum chiller                                                                                                                                                                                                                                                                                                                                                 |
| Refrigerant Used       | R-1234ze by Honeywell                                                                                                                                                                                                                                                                                                                                           |
| Total Cooling Capacity | 5 MW (2 x 2500 kW)                                                                                                                                                                                                                                                                                                                                              |
| Results / Benefits     | 12+% reduction in annual energy consumption<br>1,500MWh in energy savings (payback in less than 10 years)<br>€ 150,000 saved per year in energy costs<br>Reduced carbon footprint without sacrificing performance                                                                                                                                               |





# EXAMPLE 3 | DANFOSS – NORDBORG (DN)



Source: <https://www.danfoss.com/en/service-and-support/case-stories/cf/green-data-centers-at-danfoss-headquarters/>

## CLIMATE FRIENDLY DATA CENTER – DANFOSS HEADQUARTERS IN NORDBORG, DENMARK

- “Net Zero” CO<sub>2</sub> emissions goal
- 25% of their heat requirement to be provided by excess heat from their own data centers
- Supplementing the existing air-cooled chiller by two water to water heat pumps using Solstice ze
- Cooling capacity – 500KW/ Heating capacity – 700 kW
- Solstice ze Turbocor technology
- Extracting heat from return water & feeding it back to the city’s District heating grid – they’ll transform from becoming a "Consumer of Energy" to a "Sustainable Source of Energy"

**“Net Zero” CO<sub>2</sub> emissions, Solstice enables a sustainable source of energy**



# EXAMPLE 4 | ERICSSON - KIRKKONUMMI

| Key Facts & Figures    |                                                                                                                                                                                                                                                                                        |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| End User               | Leading Turkish telecoms company and network operator                                                                                                                                                                                                                                  |
| Equipment Provider     | Climaveneta                                                                                                                                                                                                                                                                            |
| Plant Description      | A leading Turkish telecoms company and network operator was looking for a chiller solution at its large data centre in Istanbul that would be extremely efficient, even at part load, and could offer robust, powerful and reliable performance with an integrated free cooling system |
| Equipment Used         | RTAF 280 HSE                                                                                                                                                                                                                                                                           |
| Refrigerant Used       | R-1234ze by Honeywell                                                                                                                                                                                                                                                                  |
| Total Cooling Capacity | 2.4 MW (2 x 1200 kW)                                                                                                                                                                                                                                                                   |
| Results / Benefits     | Achieved lower than 1.3 pPUE (partial Power Usage Efficiency)<br>Savings over 10% on energy consumption<br>Exceptional efficiency means less energy consumed leading to lower electricity bills and lower carbon emissions.                                                            |



Source: <https://www.coolingpost.com/features/r1234ze-provides-cool-answer-to-heat-recovery/>

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# HONEYWELL SOLSTICE® | SUSTAINABLE SOLUTIONS FOR DATA CENTERS

1

## LOW TCO / HIGH EFFICIENCY

- **Low energy costs** with Solstice ze, N15, zd due to high system efficiency and **low maintenance costs** (OPEX).
- **Low CAPEX (investment costs)** with Solstice 454B and R513A due to simple equipment design.

2

## LOW EMISSIONS

- With ultra-low GWP, Solstice HFO solutions can:
  - a. Lead up to 99% reduction in CO<sub>2</sub> emissions.
  - b. Contribute to **minimization of energy consumption** of HVAC equipment.
  - c. Enable **Net Zero data centers** with heat recovery.

3

## SAFETY

- A1 and A2L class **components** are **easy** to transport, handle, install and maintain.
- **Lower flammability risks** vs. Hydrocarbons brings piece of mind to data center owners and operators who benefit from a safer indoor environment, as well as lower maintenance costs and down time.

4

## COMPLIANCE

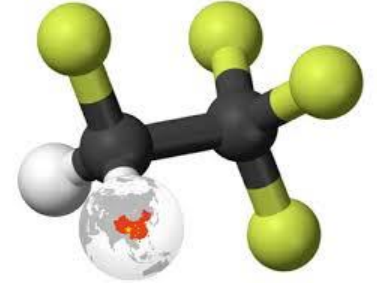
- **New systems:** with GWP<150, Solstice solutions are **compliant with long-term regulatory requirements** at European & International levels.
- Solstice molecules have zero ODP and a short atmospheric life-time, reducing environmental impact and facilitating regulatory compliance.

# PERSPECTIVES | A DESIRABLE FUTURE

1

## **A1 with GWP <150**

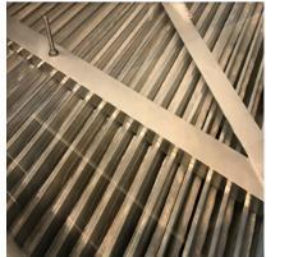
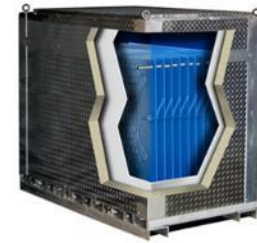
- To operate in DX,
- To save additional 10 to 15% of energy (OPEX / SCOPE 2),
- To reduce SCOPE1 of CO2 emissions by 50% vs. NBA.



2

## **Thermal Energy Storage (TES)**

- To increase the energy efficiency of the Cooling/Heating systems,
- To reduce drastically CO2 emissions (SCOPE 2),
- To reduce energy bills (storing low-cost electricity at off-peak times for later use).



3

## **Transform the Data Center to “numerical boiler”**

- Transform low temperature heat waste into useful high temperature up to 120°C by HTHP with R1233zd,
- Electrification and decarbonization of heating,
- TCO optimization.



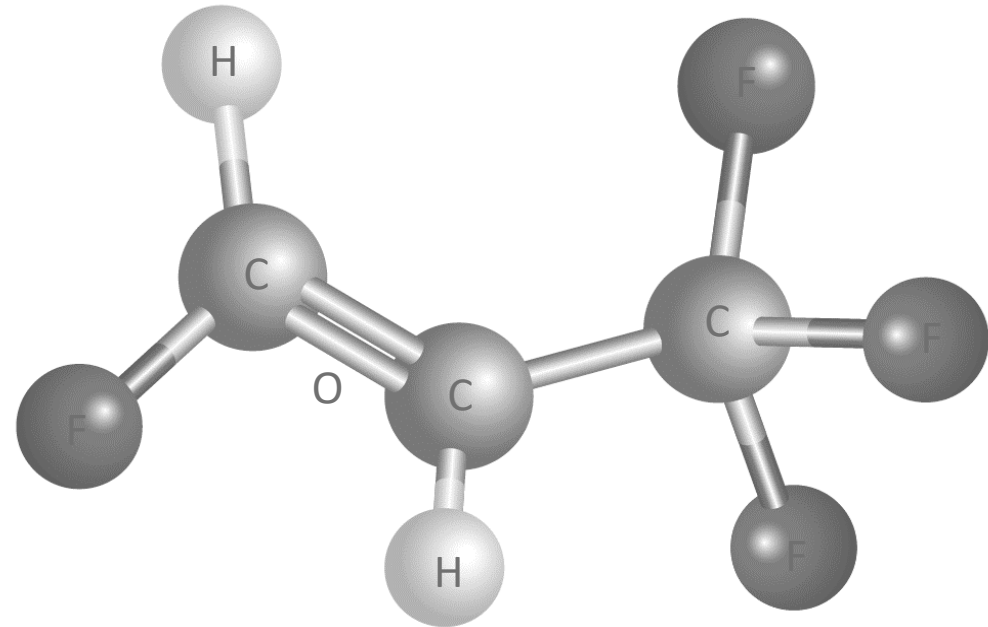




# THANK YOU

# SOLSTICE® ze (R-1234ze)

**Hydrofluoroolefin** is the 4<sup>th</sup> generation of **fluorine-based refrigerants**. The carbon double bonds results in **GWP <1**, which means a **long-term solution** with no phase down or restrictions.



# SOLSTICE® ze (R-1234ze)

Solstice® ze is **100% HFO**, a pure substance with **no glide**. It's approved and commercially available in high performance heat pumps and chillers of **global OEMs**, from appliances and HVAC, to commercial and industrial refrigeration.

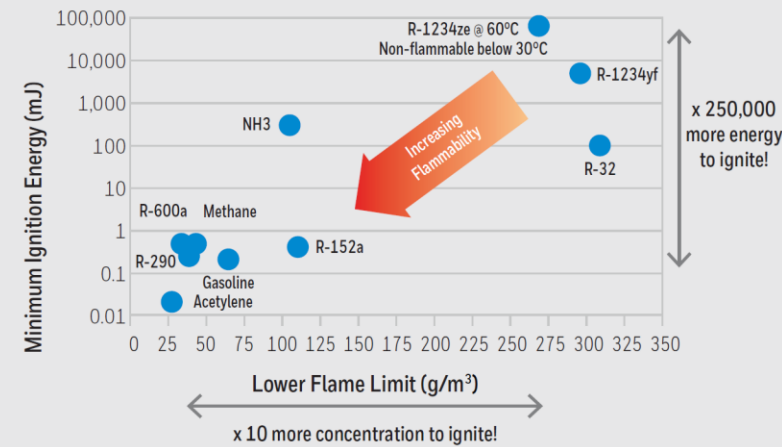




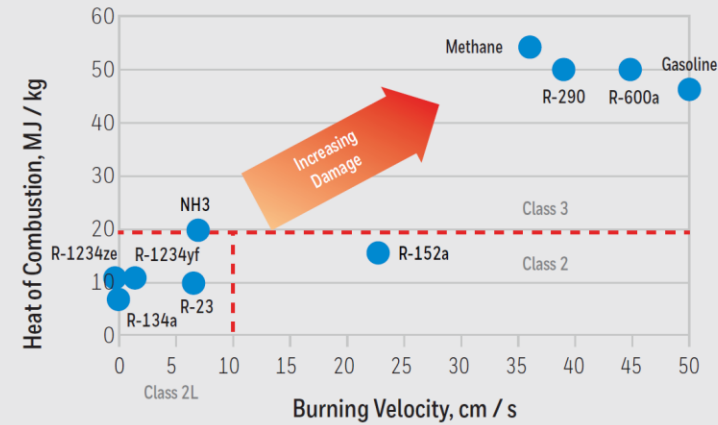
# SOLSTICE<sup>®</sup> ze (R-1234ze)

ASHRAE classifies it as **A2L**, meaning non-toxic and low flammability.

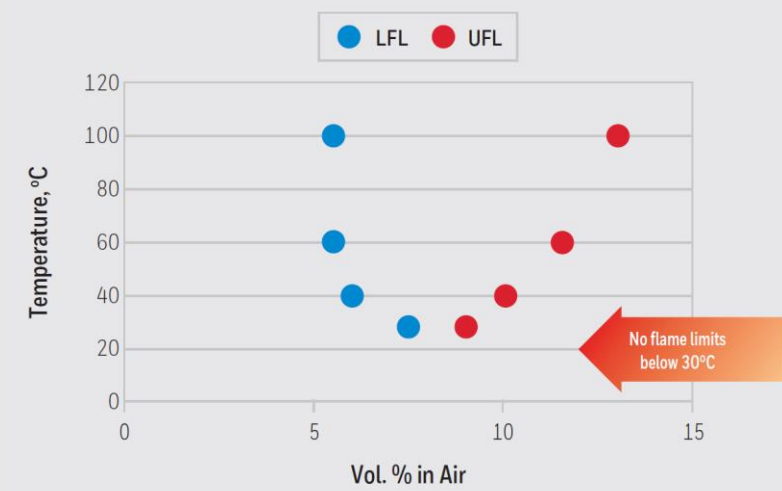
A **Group 2**, non-hazardous substance according to the PED, it **reduces costs and system complexity**.



**PROBABILITY OF IGNITION**  
Chance of Flame occurring: Lower Flame Limit vs Minimum Ignition Energy



**DAMAGE POTENTIAL**  
Effect of Flame occurring: Burning Velocity vs Heat of Combustion

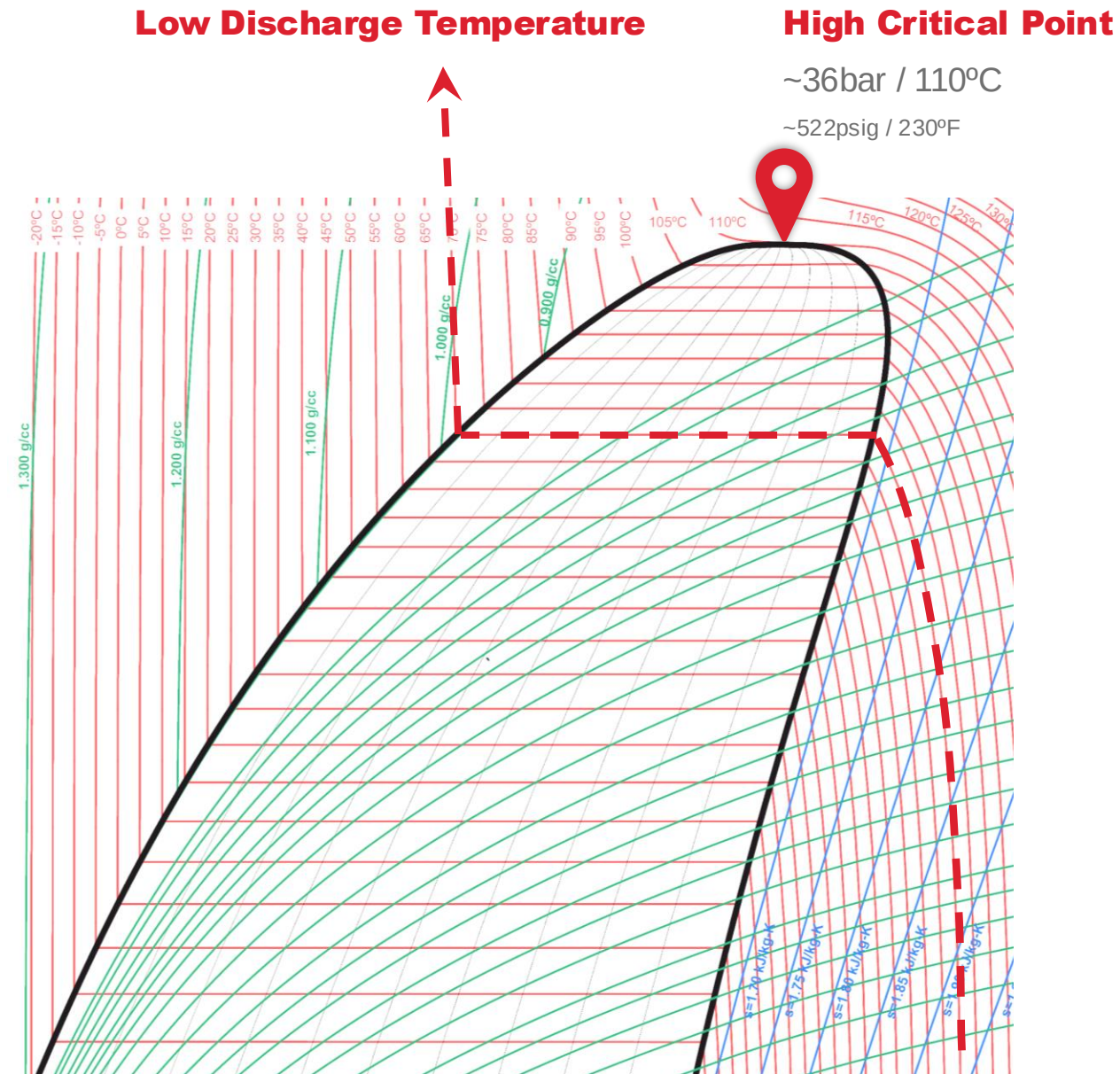


**R-1234ZE FLAME LIMIT: US DOT & ASHRAE**

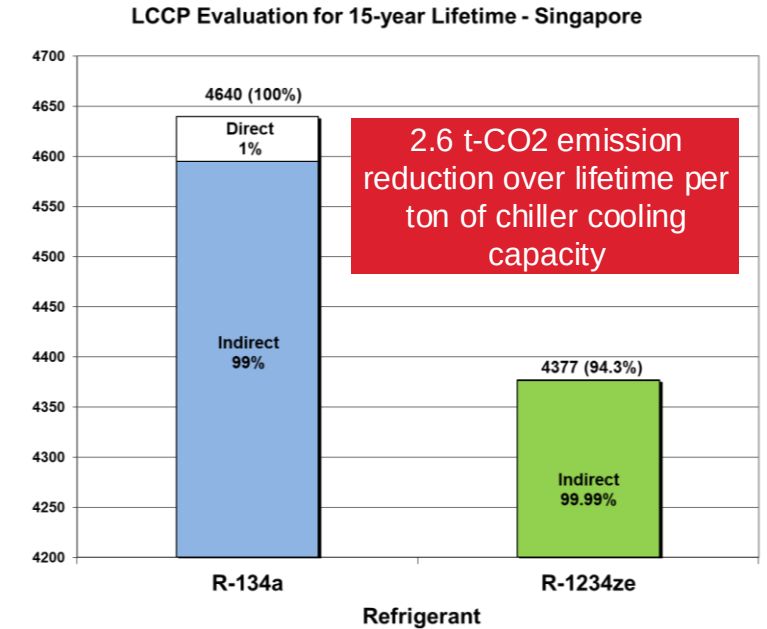
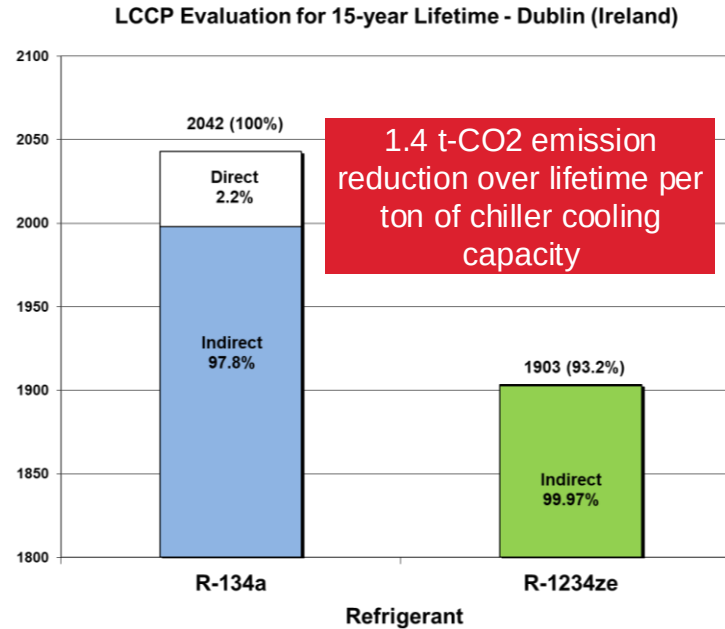
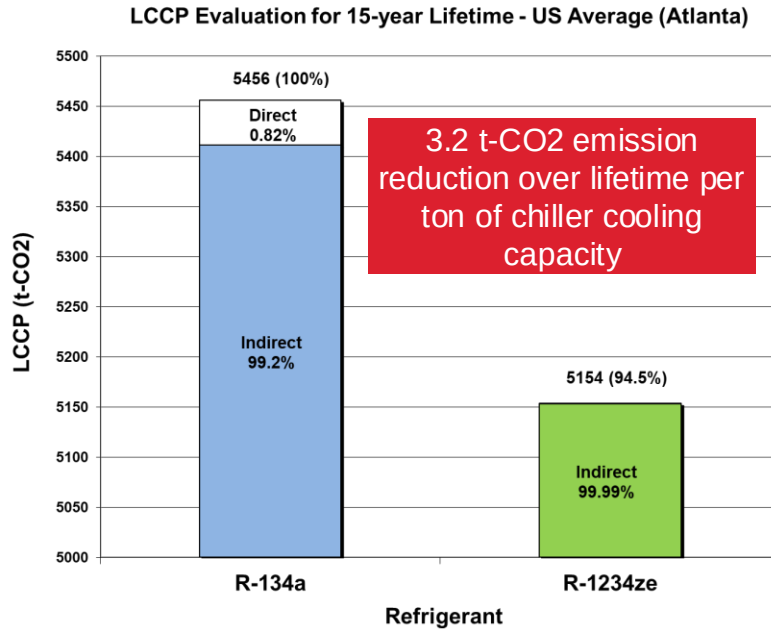


# SOLSTICE® ze (R-1234ze)

Shows a **High Critical Point** and **minimal discharge temperatures**, which allows extended temperature range to your working fluid, from -15°C to **close to 100°C** based on latent heat.



# EMISSION REDUCTION | COOLING



100 TR air-cooled chiller at 95 °F ambient and 55 °F chilled water supply temperature,  $COP_{R1234ze} = 105\%$  of  $COP_{R134a}$  (Honeywell's Internal evaluation)

Chilled water supply temperature: 55 °F, Free cooling when ambient < 46 °F, Constant cooling load year round

Electricity Grid Emission factors – USA 0.709 t-CO2/MWh, Ireland 0.324 t-CO2/MWh, Singapore 0.4085 t-CO2/MWh

A typical hyperscale data center in Singapore with 10,000 TR chiller capacity can reduce 26,000 t-CO2 over its lifetime by adopting R-1234ze instead of R-134a

**R-1234ze can reduce CO2 emissions by 5% as compared to R-134a**

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