

Advancing Sustainable Cold Chains with Natural Refrigerants

14 November, 14:15 – 15:15 (Belém local time)

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 **AUTODESK**



Moderator



Dr. Graeme Maidment
Cool Coalition Executive
Committee, International
Institute of Refrigeration (IIR)

Opening Address



Niklas Hagelberg
Senior Programme Coordinator,
Climate Action
UNEP

Keynote Address: Sustainable Transport Refrigeration



Helen Walter-Terrinoni
Director of Global Policy
Trane Technologies

As a global climate innovator, our businesses and brands directly impact carbon emissions





World leader in sustainable transport temperature control solutions for food and medicines

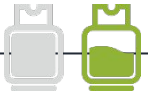
- We help our customers achieve their decarbonization goals for trailers, truck bodies, buses, air, shipboard containers and railway cars.
- Transport Refrigeration Units (TRUs) are densely packed, compact devices and must effectively operate on all road conditions, with extreme climate conditions and cargo differences
- Without a robust refrigeration system, there is a risk of load (food) loss
- 400k+ operating TRUs on HVDs in EU, 30k produced per year



Thermo King Refrigerant Milestones

2013

- 1/3 charge
and fewer
leaks



2015

45%
reduction of
GWP



2020

**GIGATON
Challenge**



2021

35% lower
GWP for
Marine



2022

Low GWP
HVAC unit
for bus

2024

EU F-Gas
Regulation



- Introduction of microchannel technology reducing refrigerant charge and fewer leaks

- Development of R-452A a low GWP solution, becoming industry standard well ahead of 2014 F-Gas Regulations

- Launch of **Gigaton Challenge** to reduce 1 gigaton of carbon emissions from its customers' footprint by 2030

- Launch High Efficiency Marine Reefer

- Launch Bus CO2 Heat Pump solution for moderate climates

- Continued investment in Low and Ultra Low GWP solutions

Transport Refrigeration represents <2% refrigerant direct GHG emissions

Refrigerant Selection

Trane Technologies is “refrigerant agnostic”

- We test and use nearly every refrigerant in our vast equipment types, balancing many factors.

Balancing Key Factors

- Safety (Flammability & Toxicity)
- Efficiency (Indirect emissions)
- Environment (Direct emissions)
- Equity (Cost & Complexity)



Enabling Flammable Refrigerants



We Move the Industry Forward with Engineering & Technology

Transport Temperature Control



Truck



Trailer



Marine



Rail



Air

Transport Comfort



Bus



Passenger Rail



APU

Digital & Services



Telematics



Services

Thermo King Trailer Products

Distribution and Regional Transport Refrigeration

- 150,000+ S-Series Precedent Units sold
- 250,000+ Total Precedent Units sold
- 12+ years of CARB Evergreen ULETRU Compliance
- Single & Multi-Temp Flexibility



Shore Power – “Smart Power”
Grid Powered Refrigeration



Flexible Capability – Precision Control



Fresh Produce



Dairy Products



Beverages



Frozen (Meats, Seafood,
Ice Cream, etc.)



Flowers



Chemicals



Pharmaceuticals



Refrigeration Shore Power Benefits

"Investing in transport refrigeration shore power not only reduces operational costs and environmental impact but also delivers a significant return on investment through enhanced efficiency and prolonged equipment lifespan."

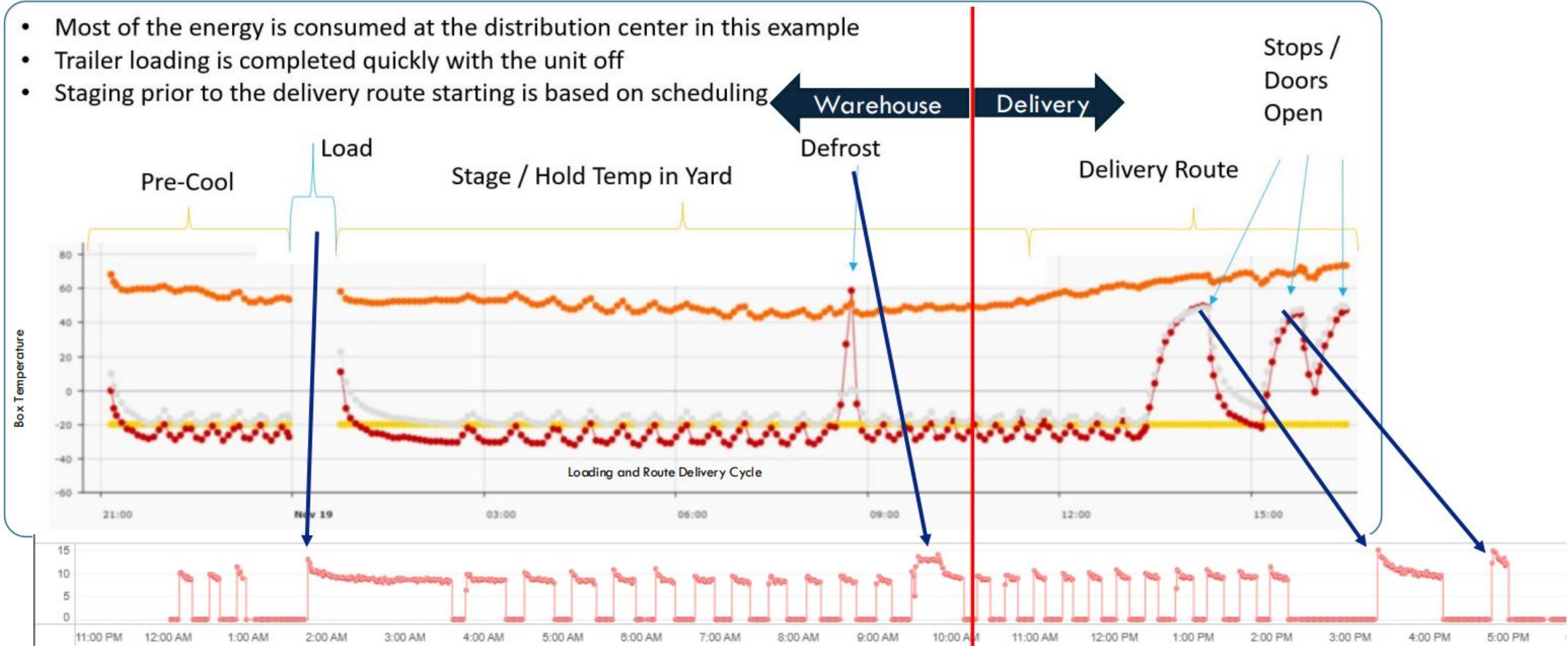
- Direct reduction of Diesel Engine hours for temp controlled cargo Significant Fuel Use Savings = \$\$ ROI with direct emissions reduction
 - \$4 / gallon diesel yields ~ \$1.50/hour savings based on \$.11/kWh
 - \$5/ gallon diesel yields ~ \$2.50/hour savings
- Lower engine run hours = extend maintenance durations
- Fleets can maximize benefits by plugging in every day
- Telematics data provides energy utilization intelligence



Understanding the Transport Refrigeration Duty Cycle

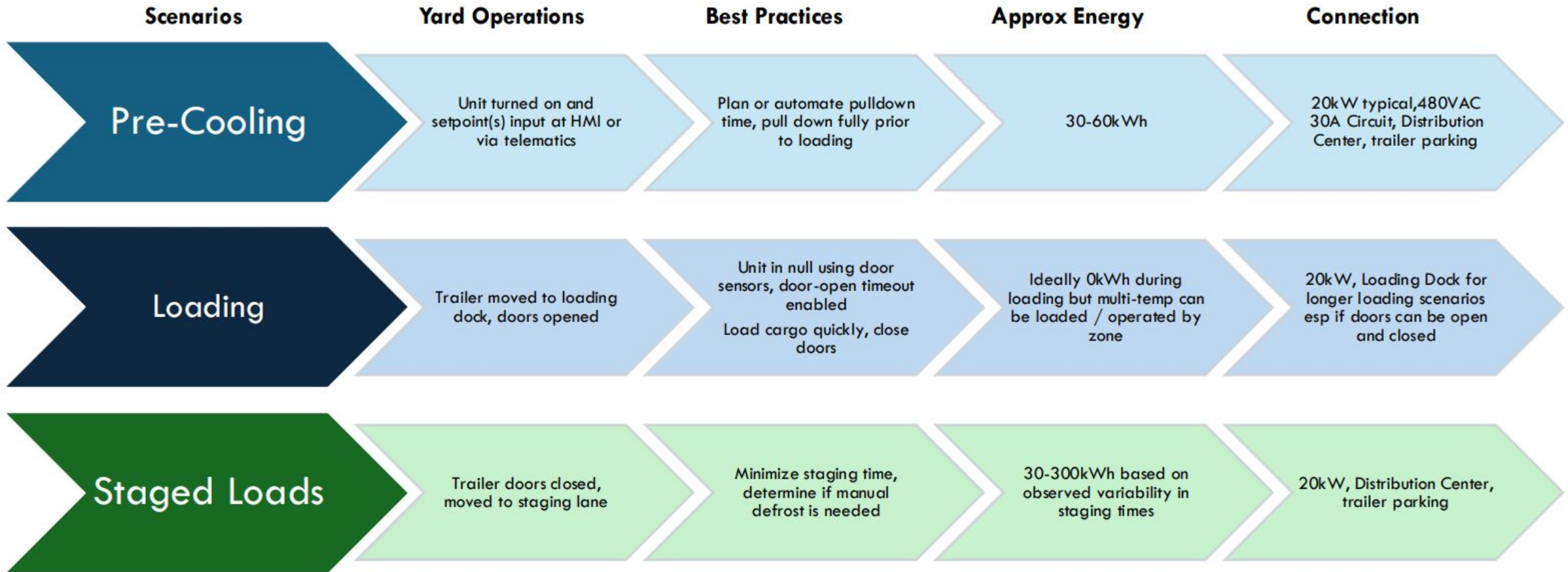
- Pre-Cooling is the highest kW load. Staging, holding the loads at temp prior to trip departure, **consumes the most kWh**.
- Temp setpoint recovery from door openings consumes the most kWh during delivery trips.

- Most of the energy is consumed at the distribution center in this example
- Trailer loading is completed quickly with the unit off
- Staging prior to the delivery route starting is based on scheduling



Work Practices & Energy Use Ranges

Place connections where the trailers spend the most time operating

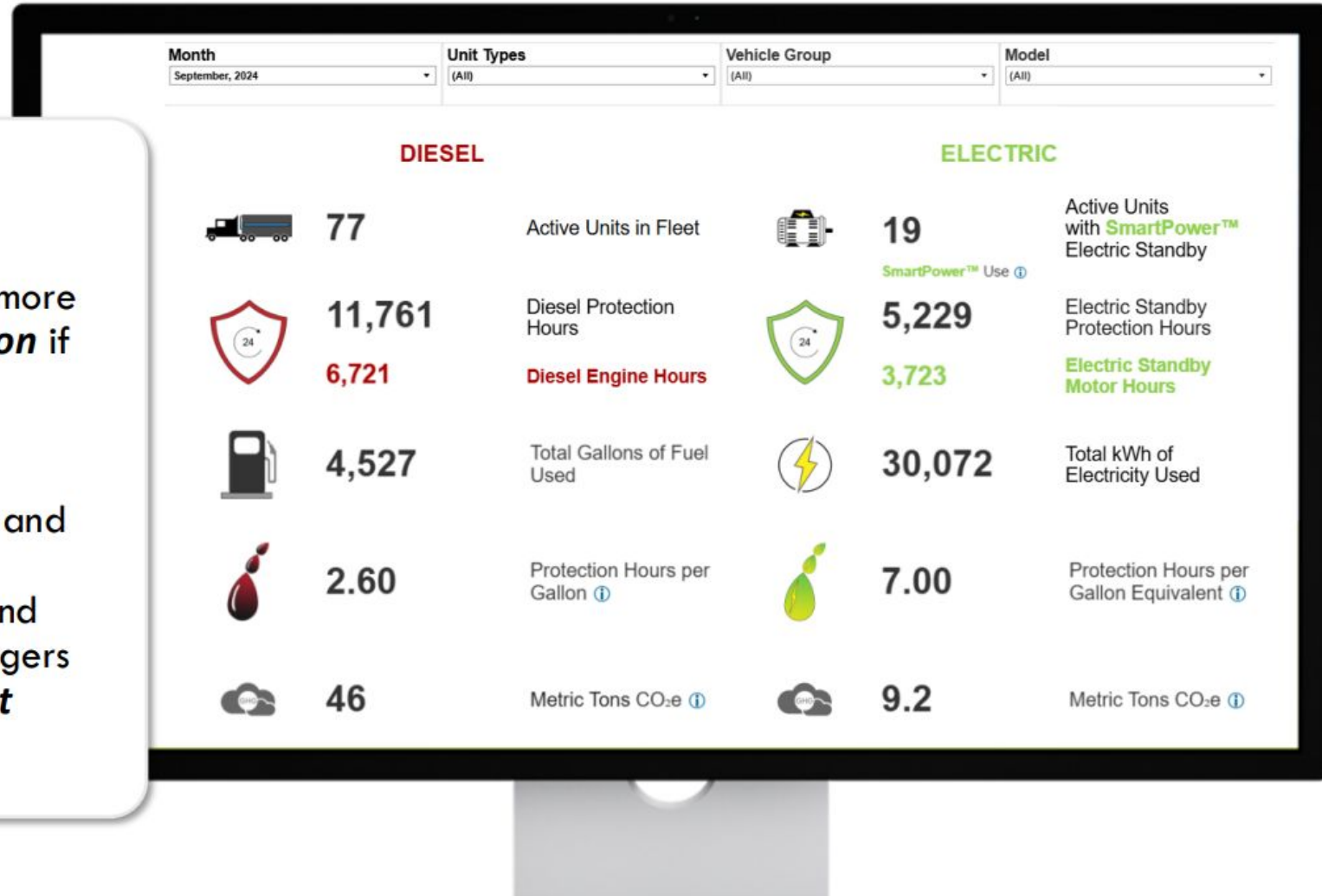


Site Energy assessments should allow for concurrent loads at 15-20kW per trailer. That is ~ 1 MW for every 50 trailers. Intelligent scheduling of pre-cooling with batch schedule features or via an API connection can help manage peak demand. Yard logistics and current SOP's may need to change to adapt to shore power use optimization. Future charging can 2X this.

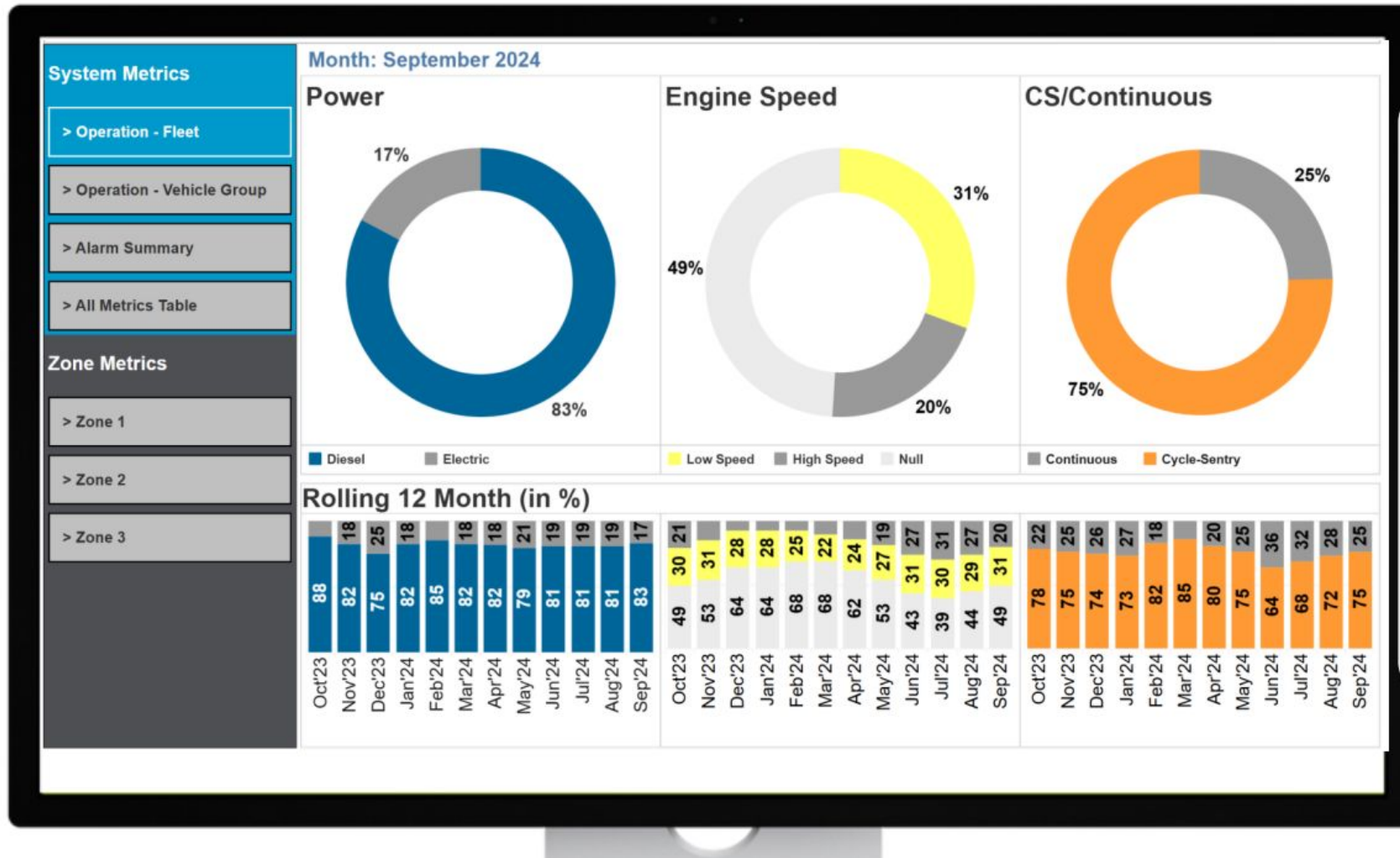
Connectivity and Analytics

TrackKing

- Fleets using shore power are more likely to have **higher utilization** if they manage their fleet via connected solutions
- Value-based metrics like Fuel and kWh use, utilization rates and real-time alerts for location and operational mode, help managers focus on areas of **high impact**



Connectivity and Analytics



- Use of Electric Shore Power vs Diesel can be tracked using a configurable dashboard view
- Fleets can view their use cases, operation modes and settings as a summary

Thermo King Working Today for a Sustainable Tomorrow

Our intent has always been to offer our customers the most sustainable solutions without compromising the product performance and reliability they expect from Thermo King

We are working on solutions that combine significantly reduced refrigerant impact with high efficiency across all temperature ranges required for our global refrigerated road and marine transport applications



New Generation of Refrigerants



Thank you!

“Natural” Refrigerant Landscape for Transport Cold Chain

Hydrocarbons (Propane)

- **Safety** – High flammability (A3's)
- **Efficiency** – Good in DX application
- **Efficiency** – Very poor if applied in chiller format at refrigeration conditions (↓>35%)
- **Equity** – Cost, efficiency and complexity of chiller application
- **Issues:** Charge limits (150 to 500 grams) limits refrigeration capacity application range (<1 Kw). Public safety concerns since products deployed in confined public spaces

Ammonia (R-717)

- **Safety** – Highly toxic (B)
- **Safety** - 2L Flammable (2L)
- **Efficiency** – Poor in DX Applications, No copper – materials compatibility
- **Efficiency** – Poor if applied in chiller format at refrigeration conditions (↓>35%)
- **Equity** – Cost, efficiency and complexity of chiller application
- **Issues:** Managing toxicity and efficiency issues with no copper allowed for heat transfer surfaces. Public safety concerns since products deployed in confined public spaces

Carbon Dioxide (R-744)

- **Safety** – A1 (nonflammable)
- **Safety** – High pressure
- **Efficiency** – Low critical temperature which results in poor efficiency at above room temperature heat rejection uses. High efficiency required for fully electric products.
- **Equity** – Efficiency, Cost, Weight
- **Issues** – Poor properties reduces operating map as well as efficiency in high ambients.

Limited Natural Refrigerants Options for Transport Cold Chain

Panel Discussion



Petter Neksa
SINTEF Energy
and IIR



Mark Major
Kuehne Climate
Center, Germany



Satish Kumar
AEEE



Edilaine Camillo
CLASP



Jakub Vrba
Energy Saving
Trust



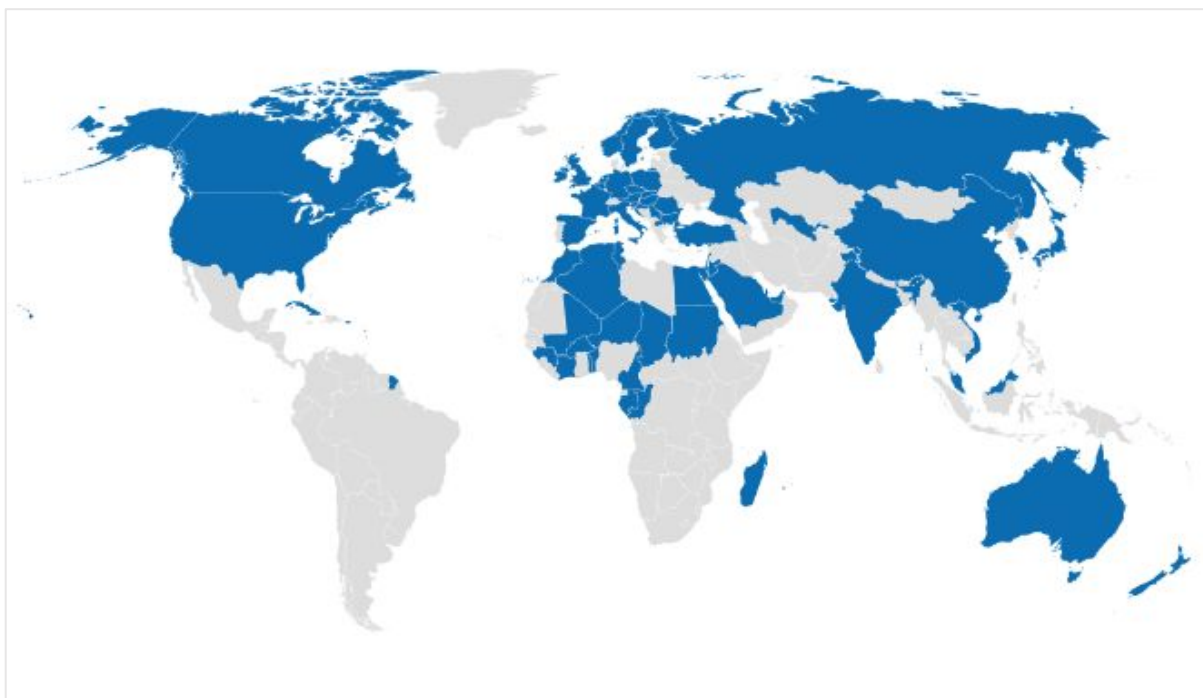
Nidhi Nagabhatla
United Nations
University - CRIS



Petter Neksa
Chief Research Scientist,
SINTEF Energy Research and IIR

Who is the IIR?

The World Organisation for the Development of Refrigeration



IIR
Database

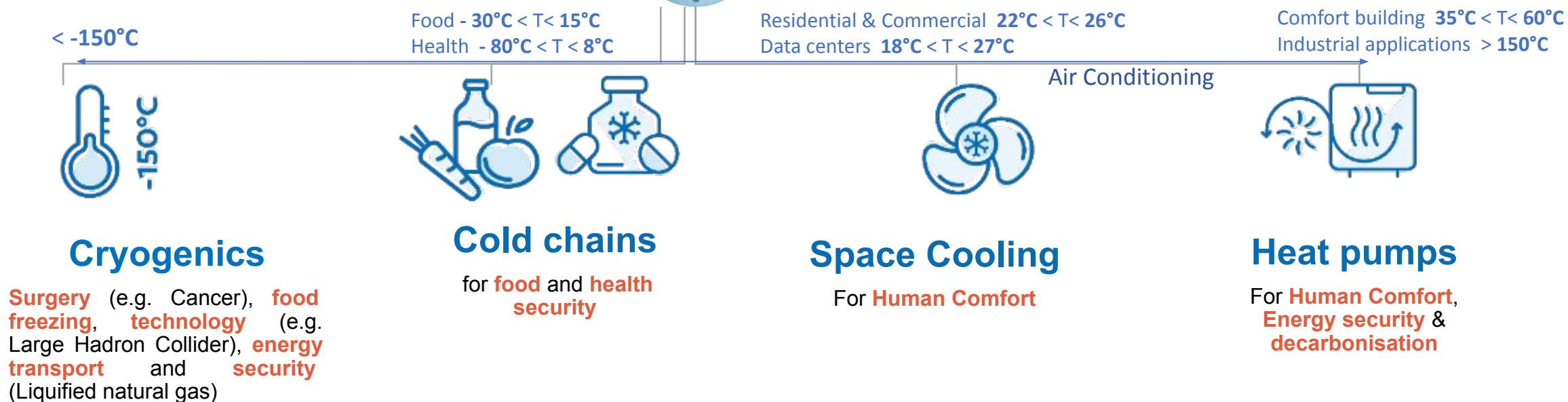


IIR International
Conferences



Refrigeration

Refrigeration: Why it matters?



It is a **cross-cutting** sector that influences **vital** aspects of economic and social growth.
Integral to economic development, **food safety**, **healthcare** and **energy systems**.

Key messages

Refrigeration, heat pumps and cold chains have a critical role in building a resilient, sustainable, and healthy society while protecting our climate.

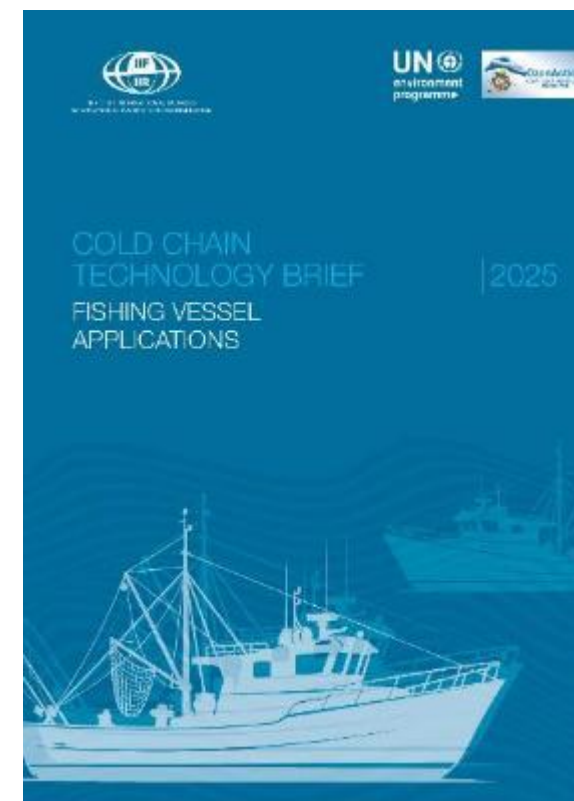
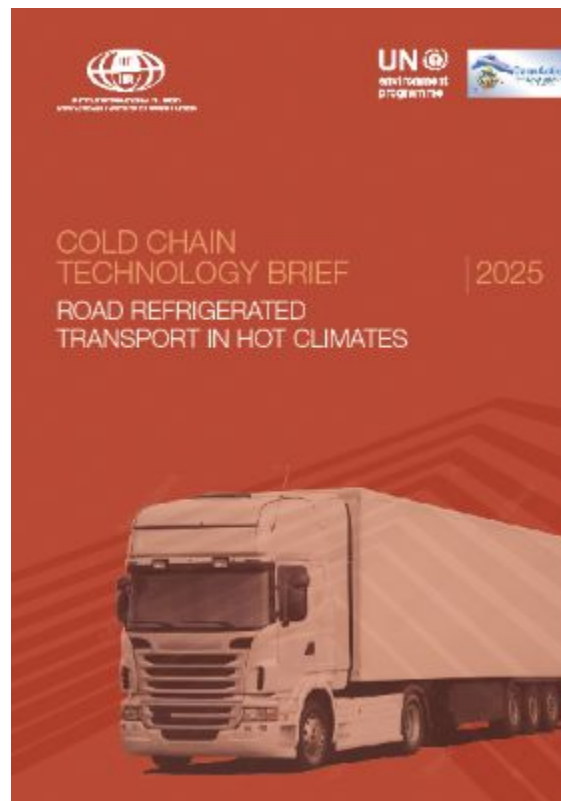
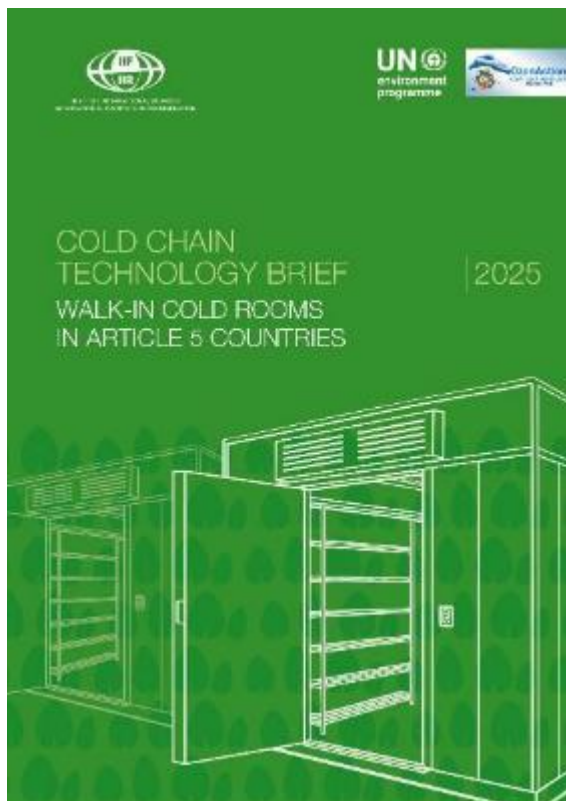
Refrigeration is not a mere convenience, it is a **vital infrastructure**, essential to preserve food, ensure healthcare, and critical economic stability, it enable to build resilience to rising temperatures.

The IIR therefore encourages all governments to **establish national inter-institutional coordination efforts** to coordinate sustainable refrigeration policies, decisions and programmes.

The IIR is eager to work with all governments and organisations to strengthen cooperation on **sustainable refrigeration and cooling to mitigate its associated emissions** and leverage its **potential to adapt to the rising temperatures**.

Use of **natural refrigerants in the cold chain is an available option** for many applications, others need further development of technology and standards, cooperation needed

2025 Cold chain Technology Briefs–UNEP OzonAction & IIR (Free download)



Stay tuned, Coming
soon





Thank you!