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natural refrigerants

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Hydrocarbons – A Viable Natural Refrigerant Solution For Medium Temperature Commercial Refrigeration Applications

Venugopal Kandi
Product Manager Refrigeration Marketing
Emerson Climate Technologies GmbH
Aachen, Germany
Venugopal.kandi@emerson.com

The Commercial Refrigeration Industry Is Going Through A Refrigerants Transition Phase

- **Factors Influencing The Choice of New / Alternative Refrigerants**

Regulations

Investment
Cost

Operational
Cost

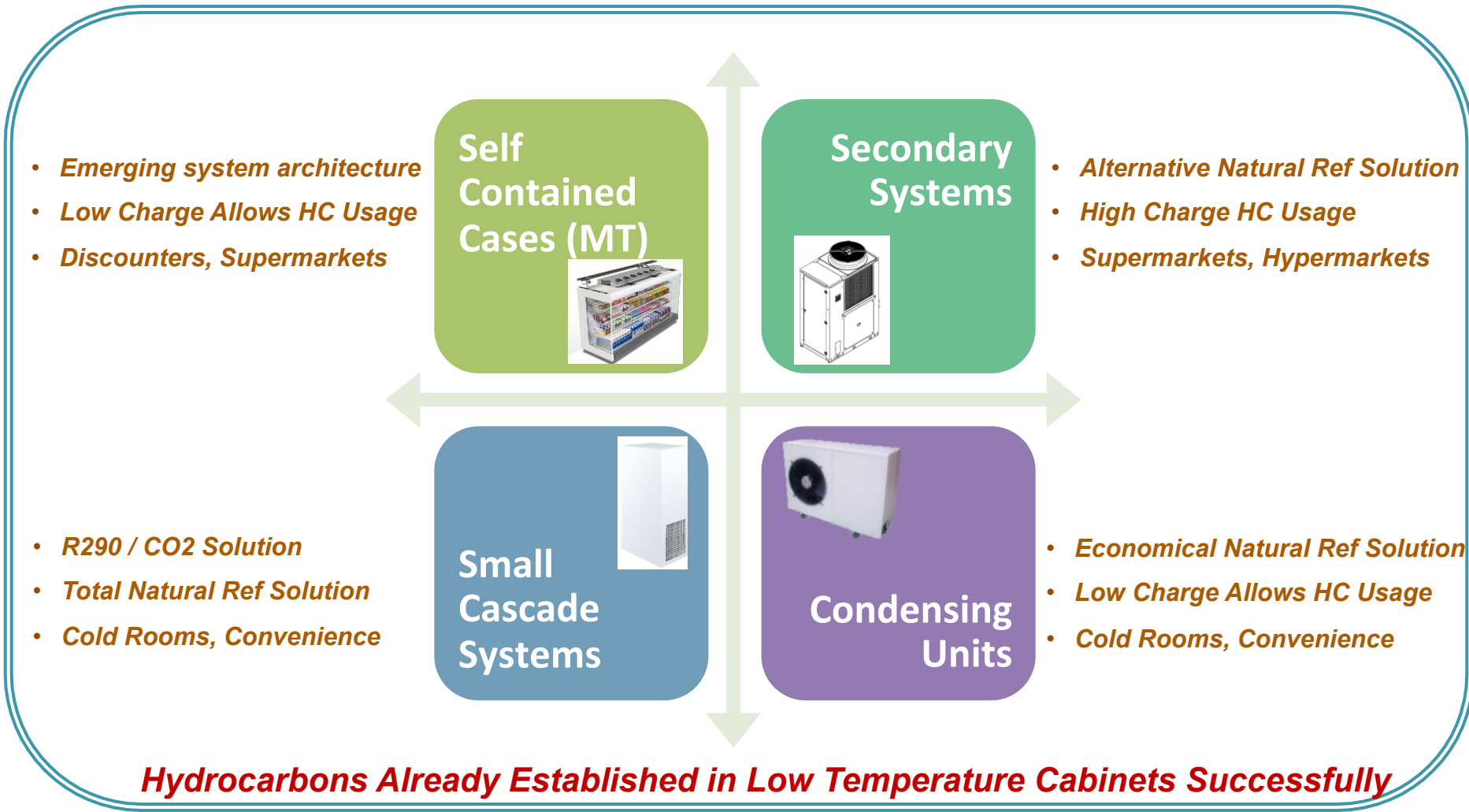
Safety

System
Architecture

Components
Availability

- **In Natural Refrigerants,**
 - **R744 (CO₂) – Has Been Gaining Good Market Acceptance & Proven To Be An Good Alternative**
 - **Hydrocarbons – With Excellent Thermodynamic Properties Can Be Another Attractive Candidate**

The Usage Of Hydrocarbons Can Be Extended To Wider Refrigeration Applications



State-Of-The-Art Scroll & Controls For R290

Fixed Speed Scroll

- 7 Displacements
- 3 to 11 kW at MT
- Fully Hermetic Design
- ATEX Zone 2 certified
- Single and Multiple



Scroll Variable Speed

Variable Speed Scroll

- 2 Displacements
- 2 to 9 kW at MT
- Optimized Inverter
- 2000 to 7000 RPM Speed
- High versatility



R290 Solution

Scroll Fixed Speed

Flow Controls

System Flow Controls

- Full range of controls
- Expansion Valve
- Pressure switches, Pressure transmitters and Filter driers etc...



Relevant EN Standards For Hydrocarbons Usage Commercial Refrigeration



- EN 60335-2-89 (Commercial Ref. Appliances): **max. 150g**
- EN 378 (Refrigeration Systems): **see below**

EN378: Max. Charge Limit for HC (Propane), kg

System Design & System Location	Occupancy		
	Public Access	Supervised Occupancy	Authorized Access Only
System in Occupied Space	1.5	2.5	10
Compressor & Receiver in unoccupied space	1.5	2.5	25
All refrigerant in unoccupied space	5	10	unlimited

Hydrocarbons Usage – Implications For OEMs And Operators

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Application	OEM	Operator
<p>A3 Refrigerant ≤ 150 g</p> <p><i>R290, R1270</i></p>	<ul style="list-style-type: none"> • Design & safety based on EN 60335-2-89: Part 2-89 	<ul style="list-style-type: none"> • No special requirements for installation and operation of the system
<p>A3 Refrigerant 150 g ... 1.5 kg</p> <p><i>R290, R1270</i></p>	<ul style="list-style-type: none"> • Conformity EN378 • ATEX 94/9/CE compliance • Charge limit for vicinity with public : max 1.5 kg or practical limit x volume* 	<ul style="list-style-type: none"> • Risk analysis, raised complexity for service, operation and personnel instructions 
<p>A3 Refrigerant > 1.5 kg</p> <p><i>R290, R1270</i></p>	<ul style="list-style-type: none"> • Practically, systems can be moved outside public area • Conformity EN378 • ATEX 94/9/CE compliance 	<ul style="list-style-type: none"> • Same as above • Outside area, e.g. roof top, restricted access 

*Example: Practical limit R290 = 0.008 kg/m³; Room 8 m x 8 m x 3 m => 1.54 kg

Project Reference I : A1 Engineering Secondary System With Emerson R290 Scroll

- Refrigeration System

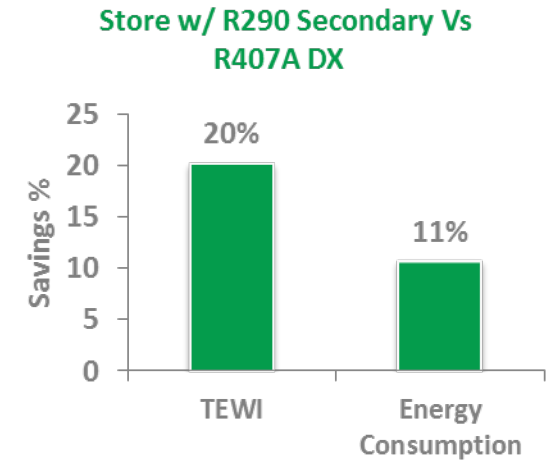
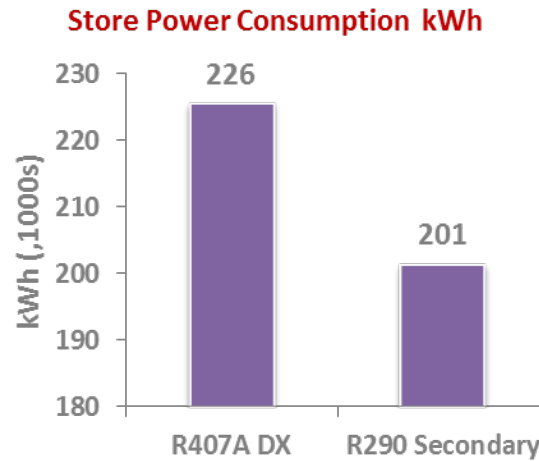
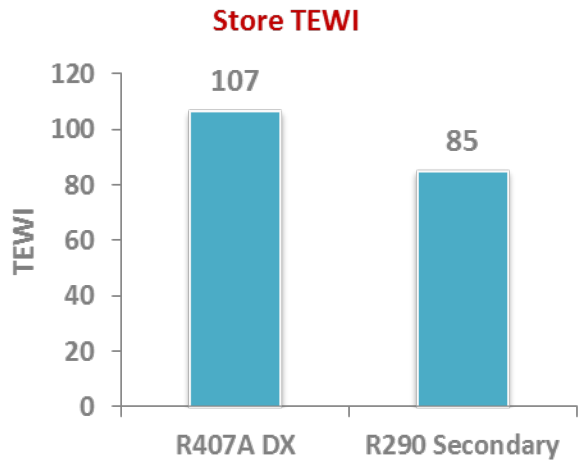
- Secondary system with R290 / Water-Glycol for MT
- Cooling 10 to 63 kW at -6C supply temperature
- Heating 12 to 42 kW at +50C supply temperature
- 3 to 6 compressors per system
- Refrigerant charge \approx 12 to 16kg

- Safety Aspects

- Completely closed and isolated electrical panel
- Up to 6 leak detection sensors at critical locations
- Full system shut down in case of leakage
- ATEX rated Compressors, pressure switches
- ATEX rated axial extraction fan (for high static pressure)
- Brazed receiver connections & Brazed valves on compressors



Project Reference I : Annual Savings TEWI & Energy Consumption w/ R290 Secondary



• Existing Store

- Supermarket
- R407A DX system for MT & LT
- R410A condensing unit for heating & air conditioning

• New Store

- Supermarket of same size
- R290 secondary system for MT<
- Heat recovery from R290 system

Store Ref System Configuration		TEWI	Energy Consumption (kwh)	Energy Costs
R407A Centralized DX	MT	70.7	144,640	£10,125
	LT	15.5	34,850	£2,440
	AC/Heating	12.0	26,349	£1,844
	Water Heating	8.3	19,710	£1,380
	Total	106.5	225,550	£15,789
R290 Secondary	MT	57.0	135,557	£9,449
	LT	25.4	60,268	£4,219
	AC/Heating	2.6	6,075	£425
	Water Heating	0	0	0
	Total	85.0	201,329	£14,093

Project Reference II: AHT Self Contained Cases With Emerson R290 Scrolls

- Self-Contained Cases For Medium Temp
 - Fully hermetically sealed refrigeration system
 - 2.5 and 3.75m self-contained cabinets
 - 4.8 to 7 kW cooling capacity
 - Refrigerant charge 500 to 700g per cabinet
 - ATEX components & safety sensors
- Benefits Associated With Self-Contained



Feature	Centralized DX Remote System	Self-Contained Display Case
Flexibility	Low	High – Plug And Chill
Service Complexity	High	Low
Refrigerant Charge	High	Low (- 85% ∩)
System Lead Time	Long	Fast
Onsite Installation	Complex, Long Pipe Length	Simple, Factory Built
Refrigerant Leak Rate	High	Minimal

Summary & Conclusions

- Hydrocarbons are an attractive natural refrigerant solution for commercial refrigeration applications
- State-of-the-art components are available for Hydrocarbons
- ATEX certified fully hermetic R290 Scroll compressor is a safe choice for flammable refrigerants
- Hydrocarbons can be used in multiple applications such as secondary systems, self contained cases and condensing units
- Safety and related legislations / regulations are the key areas to address for Hydrocarbons



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Thank you very much!

R290 Scroll Product Range

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Platform	Model	Displacement (m3/h)	Cooling Capacity (kW)	Power Input (kW)	COP
Quantum	ZB12KCU	5,8	2,8	1,2	2,3
	ZB17KCU	8,0	3,8	1,7	2,3
	ZB20KCU	10,0	4,8	2,1	2,3
Quest	ZB25KCU	11,7	5,7	2,4	2,3
	ZB31KCU	14,4	7,0	3,0	2,3
	ZB37KCU	17,1	8,3	3,4	2,4
	ZB49KCU	21,4	10,4	4,3	2,4

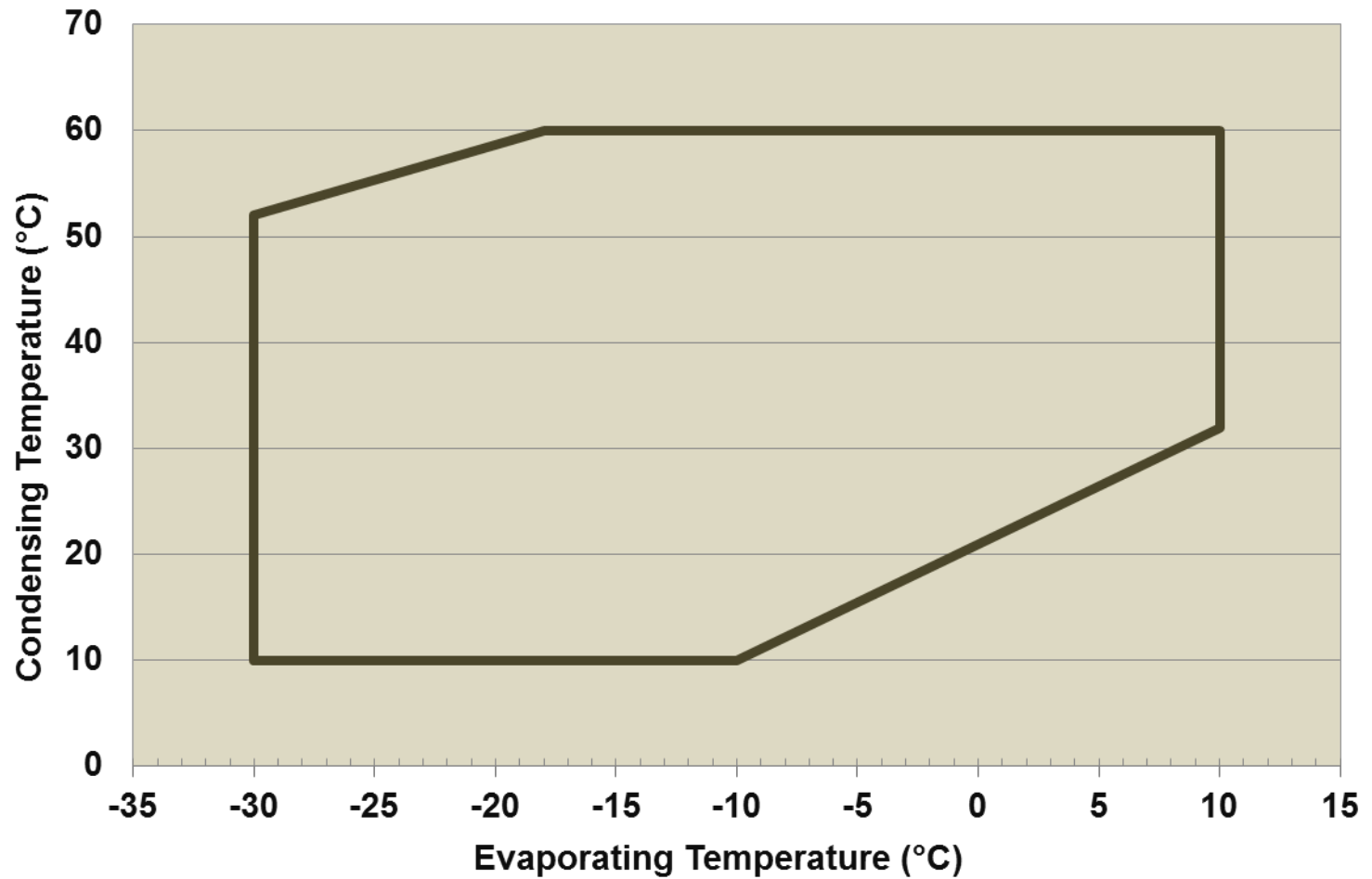


(-10C Evaporating, +45C Condensing, 10K Superheat, 0K Subcooling)

- Available for both single and multiple compressor applications

R290 Scroll Operating Envelope

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R290 Scroll Key Benefits

Compact And Less Weight
(Ideal For Self-Contained Cases And Refrigeration Chillers)

Full Hermetic Design –
(Best Choice For Flammable Refrigerants)

Mounting Hook

IP65 Terminal Box
(Dedicated Design For R290)

Option For Tandem Configuration
(Cascade & Ref Chillers)

Quiet Compressor
("Worry Free" Applications)

Nameplate Location
(Ease Of Application)

Possibility To Mount OM3
Active Oil Management
(Ref Chiller Applications)

Same Footprint
(Replacement Ease)

Dedicated Oil For Propane

High Efficiency
(Low Running Costs)

Regulatory Compliance - ATEX Class II Certified
(Safe Compressor)

Made Possible by EMERSON's Technologies

