Cool Up

Recommended ✓✓
sustainable cooling solutions for

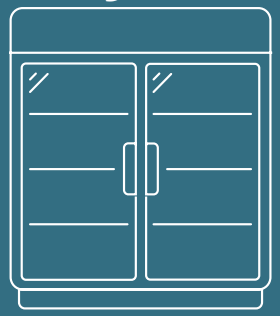
Commercial refrigeration

in **Egypt, Jordan, Lebanon and Türkiye**



Options for sustainable COMMERCIAL REFRIGERATION

Sustainable cooling options for **commercial refrigeration**



Cooling technology		Natural refrigerants			Benefits			Challenges		
		R744 Carbon dioxide	R290 Propane & other HCs	R717 Ammonia	Mature technology	Energy efficient	Simple & cost effective	Safety	Trained technicians required	High upfront costs
Central direct systems	Trans-critical CO_2 systems	R744			●				●	●
	Sub-critical hybrid CO_2 systems	R744			●	●		●	●	●
Central indirect systems	Sub-critical hybrid CO_2 systems	R744			●	●		●	●	●
	Propane systems		R290		●	●	●	●	●	
	Ammonia systems			R717	●	●	●	●	●	
Condensing units	CO_2 systems	R744				●				●
	Propane systems		R290		●	●	●	●	●	
Stand-alone refrigerators	CO_2 systems	R744				●				●
	Propane systems		R290		●	●	●			
Stand-alone freezers	Propane systems		R290		●	●	●			

— **Yellow** Opportunity for the future

— **Green** Ready for implementation

Icon — Technology is available

Solutions ready for implementation

Technology & applications	Energy & climate	Safety & implementation	Market considerations	Recommended for locations
SECTOR WIDE				
Hydrocarbon (R290 & R600a) based stand-alone units Energy efficient and utilising a low global warming potential natural refrigerant, hydrocarbon based stand-alone refrigerators and freezers are becoming increasingly common. The challenge of eliminating direct emissions from HFCs in older systems requires ensuring safety is not compromised with the use of a flammable hydrocarbon refrigerants.	— Large energy savings ✓ Energy efficient technology ✓ Low GWP refrigerant ✓ Renewable integration	— Technician friendly tech ✗ No safety risks or measures ✗ Non-flammable refrigerant ✓ Non-toxic refrigerant	✓ Market ready products ✓ Low-cost solution ✓ Wide consumer acceptance ✓ Large expansion possible	✓ Egypt ✓ Jordan ✓ Lebanon ✓ Türkiye
Development of hydrocarbon based service sector Especially in countries with an extensive informal service sector, the lack of sufficiently trained technicians that know how to handle flammable refrigerants such as R290 (propane) and R600a (isobutane) is a key barrier to uptake of this sustainable cooling technology. The cost of tools and training is high but significant long-term investment by governments is critical.	— Large energy savings ✓ Energy efficient technology ✓ Low GWP refrigerant NA Renewable integration	— Technician friendly tech ✗ No safety risks or measures ✗ Non-flammable refrigerant ✓ Non-toxic refrigerant	— Market ready products — Low-cost solution — Wide consumer acceptance ✓ Large expansion possible	✓ Egypt ✓ Jordan ✓ Lebanon ✓ Türkiye
Supporting low volume commercial refrigerator producers Production costs for hydrocarbon based stand-alone units are typically higher than for HFCs. This extra cost is manageable for larger, high-volume producers, but unmanageable for smaller producers, especially those that design custom units. Support in designing a safe, low-cost manufacturing setup that can be easily adopted, is key in speeding the transition.	✓ Large energy savings ✓ Energy efficient technology ✓ Low GWP refrigerant NA Renewable integration	— Technician friendly tech ✗ No safety risks or measures ✗ Non-flammable refrigerant ✓ Non-toxic refrigerant	— Market ready products — Low-cost solution — Wide consumer acceptance ✓ Large expansion possible	✓ Egypt ✓ Jordan ✓ Lebanon ✓ Türkiye
Monitoring solutions As in the AC segment, monitoring data collection and data storage of energy consumption, cooling performance, maintenance information, leakage, etc. can provide further insights into system efficiency and help identify optimisation potential. It also provides incentives for preventive maintenance and for building/sections complying with natural refrigerants.	✓ Large energy savings ✓ Energy efficient technology NA Low GWP refrigerant NA Renewable integration	— Technician friendly tech ✓ No safety risks or measures NA Non-flammable refrigerant NA Non-toxic refrigerant	✓ Market ready products ✓ Low-cost solution ✓ Wide consumer acceptance ✓ Large expansion possible	✓ Egypt ✓ Jordan ✓ Lebanon ✓ Türkiye
SUPERMARKETS				
Sub-critical CO_2 hybrid systems Offering excellent energy efficiency in cooler climates, sub-critical systems struggle to work in warmer climates. To overcome this, hybrid systems using hydrocarbon chillers (R290) for medium temperatures (fridges) with the return feeding smaller individual sub-critical CO_2 systems indoors for low temperatures (freezers). Costly option for existing supermarkets.	✗ Large energy savings ✓ Energy efficient technology ✓ Low GWP refrigerant ✓ Renewable integration	— Technician friendly tech ✗ No safety risks or measures ✗ Non-flammable refrigerant ✓ Non-toxic refrigerant	✓ Market ready products ✗ Low-cost solution ✓ Wide consumer acceptance ✓ Large expansion possible	✓ Egypt ✓ Jordan ✓ Lebanon ✓ Türkiye

Opportunities for future implementation

Technology & applications	Energy & climate	Safety & implementation	Market considerations	Recommended for locations
SUPERMARKETS				
Trans-critical CO_2 systems Trans-critical CO_2 systems are energy efficient and widely used in larger supermarkets in developed countries, but due to the high pressures involved, it requires high quality components and specialised technicians, making it a relatively costly and technically complex solution to install and maintain.	✗ Large energy savings ✓ Energy efficient technology ✓ Low GWP refrigerant ✓ Renewable integration	✗ Technician friendly tech ✗ No safety risks or measures ✗ Non-flammable refrigerant ✓ Non-toxic refrigerant	✓ Market ready products ✗ Low-cost solution – Wide consumer acceptance ✓ Large expansion possible	✓ Egypt ✓ Jordan ✓ Lebanon ✓ Türkiye

Pros and cons of using natural refrigerants

Natural refrigerants

Are non-synthetic substances found in nature with negligible ozone depletion & global warming effects. The refrigerants below have good market development perspective while satisfying F-gas regulations.

Benefits

Mature tech & widely available | Energy efficient | Cost effective | Suitable for warmer climates | Non-flammable | Non-toxic

Challenges

New tech with limited availability | High pressure operation | Safety issues & measures | Trained personnel required | Large volume of space required | Limited temperature lift

Natural refrigerants	Benefits	Challenges
R744 **Carbon dioxide** Trans-critical operation under high pressure	CO_2 is a safe, cheap and environmentally friendly substance with good thermal conductivity and heat capacity. Trans-critical operation is widely used in cooler climates.	CO_2 changes from gas to liquid at around 32°C, operating above this requires very high pressures, quality components and specialized technicians. Less suitable in warmer climates.
R744 **Carbon dioxide** Sub-critical operation in a cascade system with a secondary refrigerant	Operating below the critical temperature and pressure point, CO_2 can follow the standard boiling and condensation process, making it simpler and cheaper to install and operate.	Warmer climates require a secondary system for sub-critical operation. Safety and trained technicians are required when using flammable refrigerants for 2nd system. Asphxiant gas.
R290, R1270, R600a **Hydrocarbons** Propane, propylene, isobutane	Hydrocarbon refrigerants are simple, environmentally friendly, efficient and cost-effective. They have been in use for decades and design standards exist for most products.	Flammability is the most significant challenge. Following standard IEC 60335-2-40, careful design is required, with installation & maintenance by trained technicians.
R717 **Ammonia**	Being employed in refrigeration for over a century, ammonia is widely available, cost-effective, ozone and climate friendly refrigerant with highly efficient thermodynamic properties.	Rated B2L, safety is a factor. Ammonia is toxic to humans, flammable under certain conditions and corrosive to some metals, requiring safety measures and trained personnel.
R718 **Water**	Abundant and essential to life, water avoids all safety, cost and environmental concerns. Water has a high heat capacity & is usually more energy efficient than standard refrigerants.	Early stage technology with few products commercially available so far. Requires more space due to gas expansion & has operational limitations. Can lead to corrosion & scaling.

Overcoming barriers to action

Key barriers blocking implementation

Market resistance

There is a reluctance and a degree of push back from leading manufacturers on shifting to sustainable AC technologies. Some have an economic interest in promoting synthetic refrigerants, while others are hesitant to shift as the demand is currently comparably low.

Lack of familiarity

Amongst the wider market there is a lack of experience and understanding of sustainable AC products. This dynamic is especially important with installers, who play a key role in what technologies are promoted and selected by customers.

Skills deficit

The increased safety risks for some natural refrigerants, especially flammable hydrocarbons such as R290, requires a higher level of skill and know-how when performing installation, maintenance, repair and servicing of sustainable AC units.

Higher upfront costs

Costs for installing sustainable cooling technologies are typically higher. This is largely due to the technologies being less mature, being lower down the technology learning curve, with lower mass-production capacities and low market competition.

Stand out projects - leading the way to sustainable cooling

EGYPT

1	EGYPRA Project
2	Bahareya Village
3	Smart Village District Cooling*
4	AUC New Cairo Campus*
5	Western desert gas complex (Gasco)*
6	Katameya Sporting Club (Petrosport)*
7	District cooling by Shaker group*
8	District cooling by Gas Chill company*
9	Eastern Company West Building*
10	AL Galala Resort DC plant*

JORDAN

1	Industry & commerce solar cooling
2	Abdali AURD district cooling
3	Al Salam Supermarket
4	Hashemite University Solar PV
5	Mutah University CSP trigeneration
6	HCST geothermal heating & cooling
7	Dead Sea Spa REACT solar thermal
8	Aqaba Residence Energy Efficiency
9	MAIA-TAQA solar thermal
10	SEED school & health centres

LEBANON

1	LEED residential VRF HVAC**
2	Ice bank cold storage**
3	Baabda high efficiency HVAC**
4	Halat RE & biomass absorption
5	Zouk Mosbeh waste heat chiller**
6	Geothermal cooling (Beriut)
7	Lemantec R600a & R290 products

TÜRKIYE

1	First transcritical CO_2 test unit 2006
2	Sub-critical CO_2 cascade
3	Carrefour CO_2 trans-critical system
4	Small trans-critical CO_2 systems
5	Supermarket refurbishment demo
6	CO_2/NH_3 cold room cascade
7	R290 monoblock cooling units (Iskid)

In summary, various activities can already be observed regarding sustainable cooling. While the above lists are far from complete with new project coming online, there are still limited sustainable cooling activities utilizing natural refrigerants.

* These projects are partly sustainable as while they utilise natural refrigerants, the energy source is supplied by fossil gas.

** These projects are partly sustainable as while they increase efficiency and/or are ready for the implementation of renewable energy, they currently do not use natural refrigerants.



More information

Full reports

This snapshot is based on the 2022 series of reports entitled:

Catalogue of Technical Solutions for Sustainable Cooling in:

- **Egypt**
- **Jordan**
- **Lebanon**
- **Türkiye**

AC technologies

- **Domestic air conditioning:** cooltechnologies.org/sector/domestic-air-conditioning
- **Commercial / industrial air conditioning:** cooltechnologies.org/sector/commercial-industrial-air-conditioning
- **Hydrocarbon technologies database:** hydrocarbons21.com

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