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SHAKTI SUSTAINABLE ENERGY FOUNDATION

COP28 UAE SIDE EVENT

Promoting Green Cooling in India and the Global South

Saturday, 9th December 2023
5:00 PM to 6:30 PM (GST)

Promoting Green Cooling in India and the Global South

COP28 Side Event

GIZ Proklima | 09.12.2023 | Philipp Denzinger, Project Manager, Proklima International

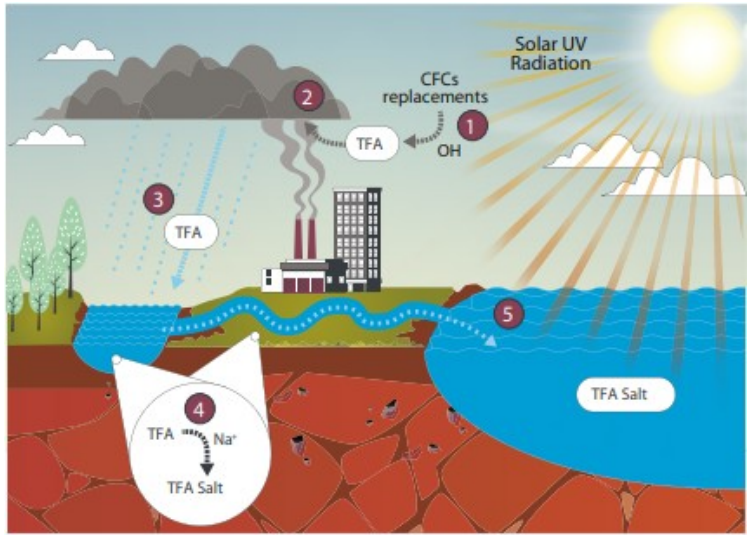
PROKLIMA
NATURALLY COOL

german cooperation
DEUTSCHE ZUSAMMENARBEIT

Implemented by
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Present and future refrigerant options

Refrigerant	Type	GWP 20	GWP 100	PFAS	TFA
R22	HCFC	5690	1960	No	No
R404A	HFC blend	7208	4728	Yes	**Up to 20% R134a (4%)**, up to 10% R143a (52%)
R407A	HFC blend	4944	2262	Yes	Up to 20% R134a (20%)
R410A	HFC blend	4850	2256	Yes (R125)	No
R134a	HFC	4140	1530	Yes	Up to 20%
R32	HFC	2690	771	No	No
R513A	HFC/HFO blend	1823	673	Yes	Up to 20% R134a (44%), up to 100% R1234yf (56%)
R1234ze(E)	HFO	4.94	1.37	Yes	Up to 10%
R1234yf	HFO	1.81	0.501	Yes	Up to 100%
R744	Natural (CO_2)	1	1	No	No
R717	**Natural (Ammonia)**	<1	<<1	No	No
R600a	**Natural (Isobutane)**	<<1	<<1	No	No



PFAS (forever chemicals) are not manageable, and all efforts should be undertaken to avoid them as completely as possible.

Per- and polyfluoroalkyl substances (PFAS) are a large class of synthetic chemicals that increasingly detected as environmental pollutants and linked to negative effects on human health. **Trifluoroacetic acid (TFA)** is an ultra short chain type of PFAS, commonly found in the breakdown of f-gases.

UNEP, "Refrigeration, Air conditioning and Heat Pumps Technical Options Committee, 2022 Assessment Report", 2022.
Climate-friendly alternatives to HFCs (europa.eu)

Climate-friendly solutions exist for (almost) all applications

AC/HP

HC
CO_2

Refrigerators

HC

Commercial refrigeration

CO_2
HC
NH_3

Chiller

CO_2
NH_3
HC

Industrial refrigeration

NH_3
HC

Transport refrigeration

CO_2
HC

HC: Hydrocarbons (e.g Isobutane, Propane) CO2: Carbondioxide NH3: Ammonia

Best practice examples from India and the Global South

Avoiding emissions by "leapfrogging" to Green Cooling

Instant switch to highly **energy-efficient** technologies with **natural refrigerants** without relying on environment- and climate-damaging interim technologies.
Use of **natural blowing** agents for insulation materials.
Use of **solar powered technologies** combined with **ice storage**.

Indian success story on R290 split ACs

- German (BMU IKI) funded GIZ R290 AC conversion project in 2011 jointly with Godrej
- Up to 1 million R290 split ACs have been produced and installed
- Fixed speed and inverter units (12, 18 & 24k) with high energy efficiency
- Godrej successfully demonstrated that R290 split ACs are a climate, environmentally friendly and highly energy efficient technology
- R290 compressor optimisation regarding energy e

Sources: IPCC 6th Assessment Report (GWP 100 or 20 years data)

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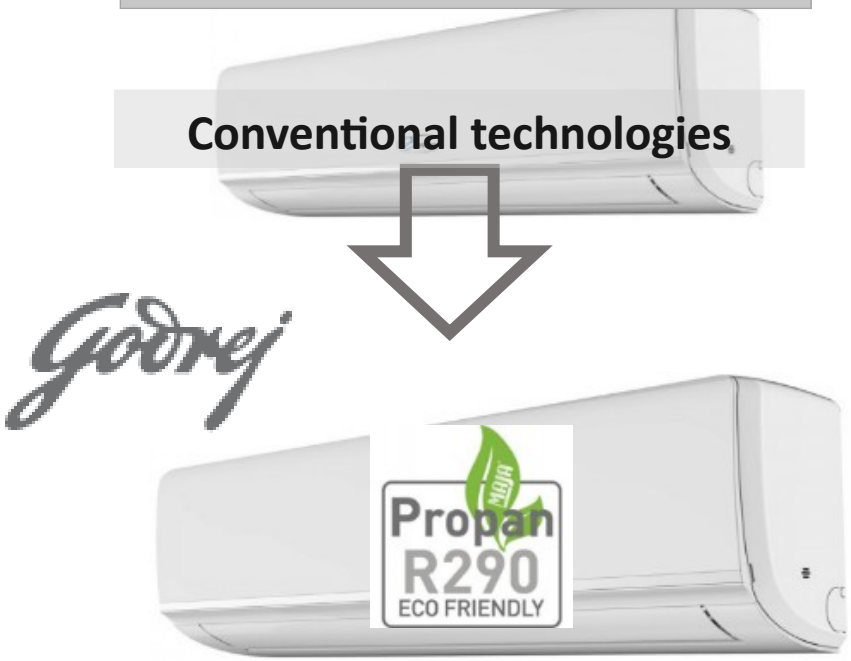
Conventional split ACs compared to Green ACs (high energy efficiency and natural refrigerant (R290)

- **Over lifetime (10 years) per AC:**
  - Reduced energy consumption, on average by **5,000 kWh***
  - Significant cost reduction for consumers and government
  - Reduced emissions on average of **5-10 t CO_2eq***

- **Equivalent to emissions of:**
  - Approx. up to 3 return travels **India - Frankfurt**
  - Approx. **15 - 30,000 km**

R22 (**GWP 1960/5690**)
1 kg = 1.9 / 5.6 tonnes CO_2eq

R410A (**GWP 2256/4850**)
1 kg = 2.3 / 4.9 tonnes CO_2eq



GWP 0.02/0.072
(1 kg = 0.02 / 0.072 kg CO_2eq)

Sources: IPCC 6th Assessment Report (GWP 100 or 20 years data) *depending on grid emission factor, running hours, etc.

CO2, NH3 and HC demonstration units in India

Area of Application	System and purpose	Leading Institutes	Vendor	End User
Hotels	CO_2 HP: 120 kW cooling capacity (Hot water and air conditioning)	NTNU	Medors Renewable Energy	
	CO_2 HP: 290 kW heating capacity. Hot water and air conditioning*	IIT Madras, NTNU	Koshyma Engineering Pvt Ltd	The Leela Ambience Delhi Convention Hotel
School kitchen	CO_2 HP: Hot water and air conditioning	IIT Madras, NTNU	Equipment Fabricators, aspiration energy	Akshaya Pātra
Pharmaceutical industry	CO_2 HP: 200 kW heating capacity. Hot water and air conditioning*	SINTEF, NTNU	Triveni Turbine Limited (TTL)	Triveni Turbines
Seafood processing plants	150 kW NH_3/CO_2 cascade system. Low temperature tunnel/blast freezer	SINTEF, NTNU	Cochin Food Tech Private Limited (CF Tech)	Bell Foods Group
	350 kW NH_3/CO_2 cascade system. Low temperature tunnel/blast freezer	SINTEF, NTNU	CF Tech	NAS Fisheries Private Limited
Fishing vessel	13 kW propane-based flake Ice maker for boats	SINTEF, NTNU	Mech Air Industries	

* To be agreed soon

NTNU SINTEF IIF IIR

Example: Switching Supermarkets to Natural Refrigerants & Energy Efficiency

- ✓ Two Pick n Pay supermarkets switched to combined CO2 cooling systems in South Africa
- ✓ Reduction of direct emissions of ozone and climate damaging refrigerants of more than 500.000 kg of CO2 equivalent
- ✓ Approximately 350 supermarkets switched up to date to CO2 in South Africa
- ✓ Centralized hydrocarbon supermarkets systems are also being installed in Thailand (water loop), South Africa and in Kenya (semi plug-in) in near future and offer another excellent technology solution

Read more: IKI Website

Example: Installation of R-290 Chillers for Industry and Businesses in Indonesia

	HFC Chiller (R-22)	Green Chiller (R-290)	Difference (%)
Unit Price (USD)	37.822 USD	55.886 USD	32%
Energy Efficiency Ratio (EER)	2,7	3,6	+ 25%
Energy Consumption (kWh/year)	783,442	572,238	- 37%
Annual Energy Cost (USD)	61,584	44,982	- 37%
Lifecycle Cost, LCC (USD)	434,686	348,372	- 25%
Direct Emissions (tCO2eq)	451	0,34	
Indirect Emissions (tCO2eq)	12,367	9,033	
Total Emissions (tCO2eq)	12,819	9,034	- 42%
Global Warming Potential (GWP)	1810	3	
Ozone Depletion Potential (ODP)	0.055	0	
Internal Rate of Return (IRR) %	21 %		
Payback Period (years)	1,04 %		

Source: CCAC, 2019

Photo: MEMR 2022

Example: Solar Powered Walk-in Cold Room: Cold Hubs – Nigeria

- 24/7 off-grid storage and preservation of perishable foods
- “plug and play” modular
- Using natural refrigerant R290 (monobloc)
- 120mm insulating cold room panels retain the cold
- Batteries + inverter (newer generation with ice storage)
- Pay-as-you-store subscription model
- Around 100 units installed in Nigeria
- Newer installations also come with ice storage instead of batteries

© coldhubs

Examples: Solar Powered Solutions with R290

R290 ice production in Indonesia

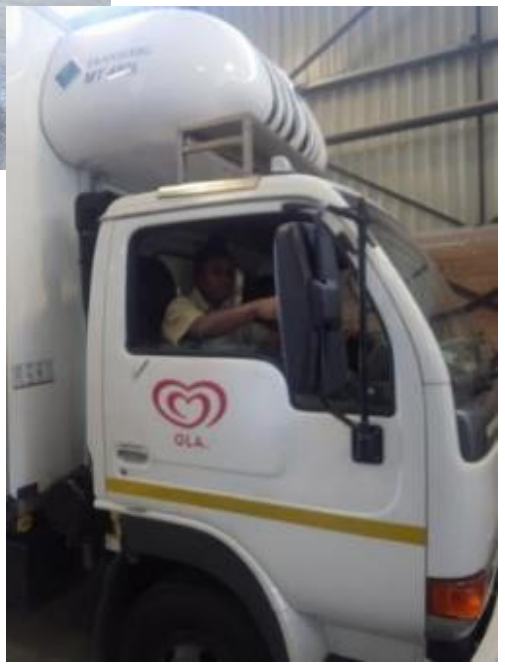
R290 walk-in fish cold room Kenya

Examples: Transport Refrigeration using Natural Refrigerants

- Demonstration and market induction in South Africa (IKI/BMU/GIZ Transport refrigeration)
- Demonstration in Burkina Faso (EU/BMZ/GIZ ROCA)
- Demonstration in the Philippines (UNIDO/ATMOsphere)

- Natural refrigerant R290 or R600a (or CO2)
- Outstanding efficiency
- Zero planned maintenance
- Reduces carbon footprint of the fleet

- Use of natural blowing (ultra low GWP) agents for foam / insulation materials and improved body design



Pictures: GIZ Proklkma

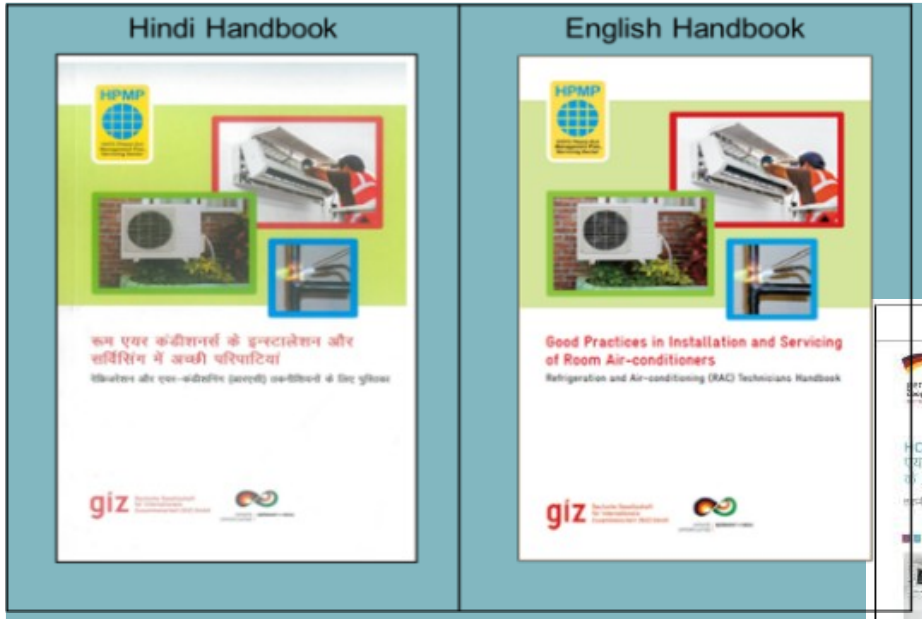
QCR System is essential – only certified technicians are permitted to work on flammable refrigerants!

- **(1) Qualification**
  - We provide 14 modules - freely accessible and free of charge for partner countries
  - We check refrigeration curricula according to international standards
  - We support training institutes in revising their curricula and, if necessary, integrating modules into their curricula
  - We conduct trainings for teachers (Trainings of Trainers)

- **(2) Certification**
  - We develop certification systems together with the national authorities
  - We provide exemplary examination questions and "Competencies to assess“
  - We cooperate with certification bodies and expand their capacities
  - We develop systems to recognize prior learning experiences

- **(3) Registration**
  - We advise on national registration systems and identify needs
  - We advise on licenses for technicians

Publications



Latest revised Syllabus of GIZ Proklima Good Service Practices Technicians and Trainers handbooks in 2018/2019

Regular publications regarding GIZ Proklima activities and cooling sector along with TERI, India in their newsletter “NewsTrack”

…and many more publications under www.green-cooling-initiative.org

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