Alternative refrigerants
Trends in Developing Countries

by

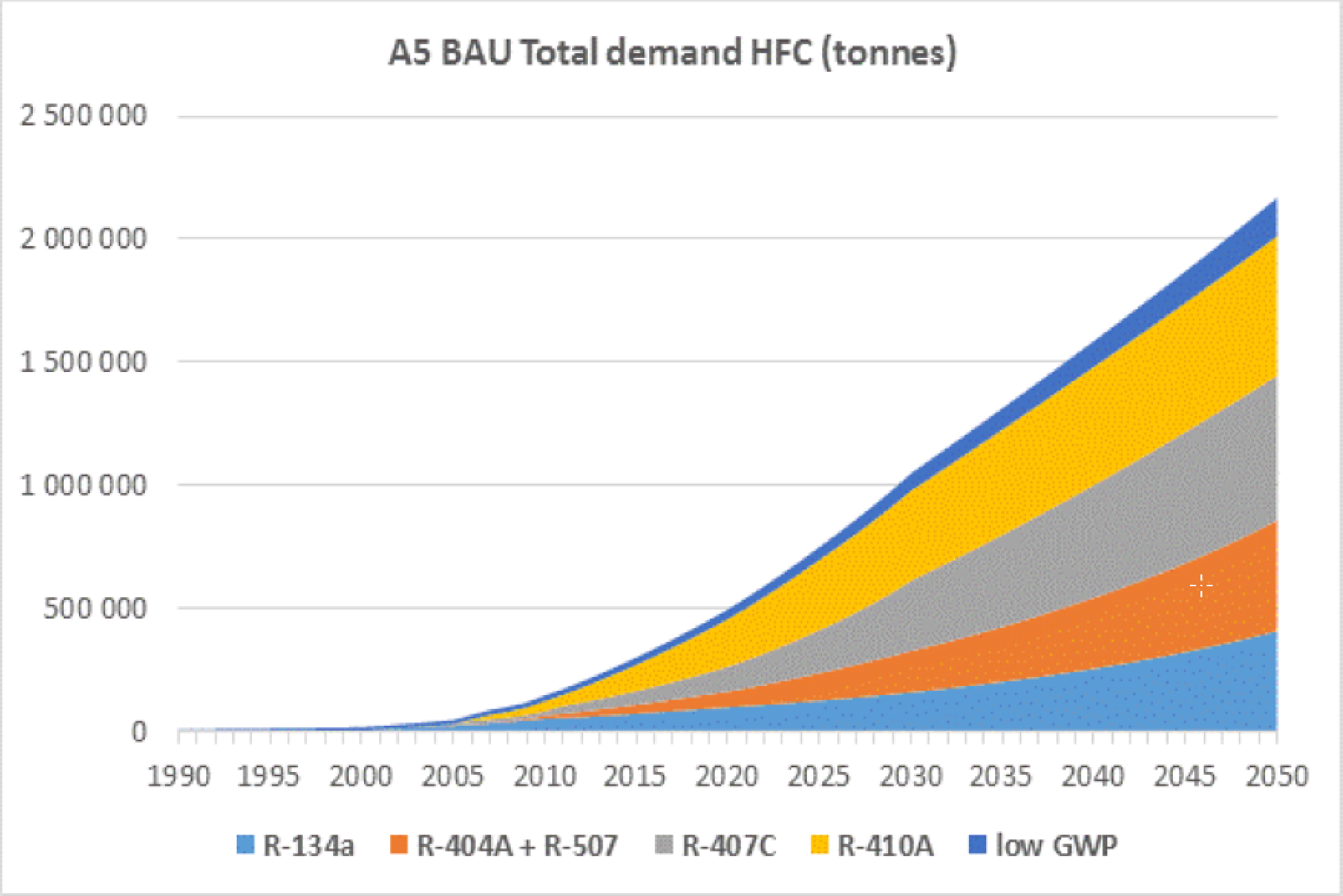
Stephan Sicars
United Nations Industrial Development Organization

Nuremberg (Germany), 12th October 2016

Outline

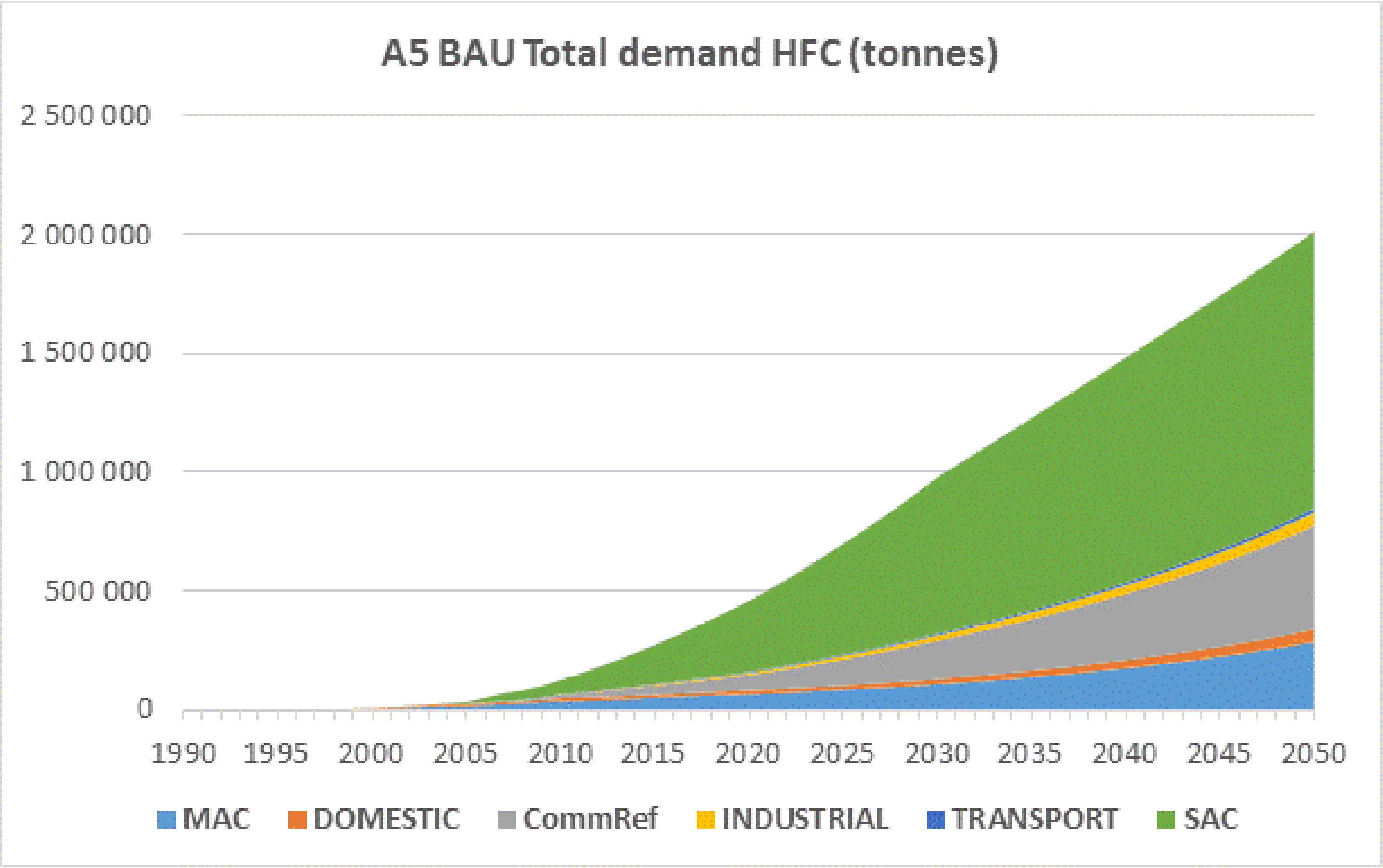
- Trends on alternative refrigerants in Developing Countries
- Policy environment
- Use of natural refrigerants in Developing Countries
- Drivers and Barriers
- Montreal Protocol
- UNIDO’s role on natural refrigerants
- Conclusions

Trends on alternative refrigerants in developing countries



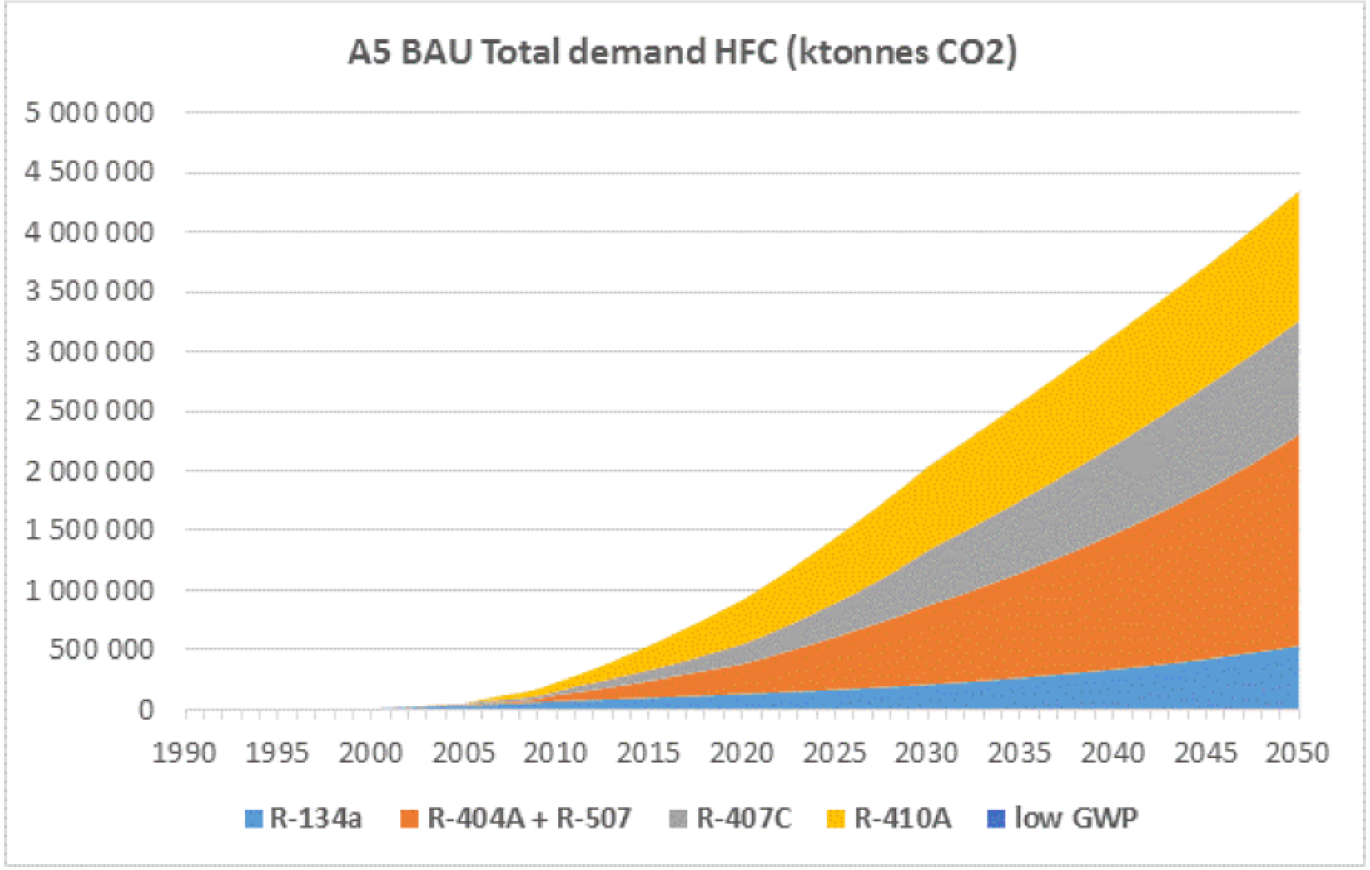
Source: TEAP, 2016.

Trends on alternative refrigerants in developing countries



Source: TEAP, 2016.

Trends on alternative refrigerants in developing countries



Source: TEAP, 2016.

Policy Environment

- The BAU scenario in developing countries: large growth in demand for high-GWP refrigerants R-404A, R-407C and R-410A (HFCs)
- Phase down HFCs: Critical to meet Paris climate goal
- HFCs considered to put under the Montreal Protocol
- Regulatory certainty
  - signal to industry
  - driver for technological development

Use of non-halogenated ("natural") refrigerants in developing countries

- Natural refrigerants widely used in domestic and industrial refrigeration as well as cold chain
- Growth is expected in
  - Commercial refrigeration
    - Supermarkets
    - Vending machines, display coolers, …
  - Possibly larger scale AC (district cooling, extended chiller applications to replace PAC)
  - Market shares still small
- Growth further expected in a number of sectors

Use of natural refrigerants in developing countries - China

- Light-commercial
  - 400,000 HC stand alone cabinets
  - 322,000 HC ice cream freezers
  - 25,000 CO_2 bottle coolers and vending machines
- Food stores
  - 8 CO_2 stores
  - More than 15 CO_2 hybrid stores planned
- Industrial Refrigeration
  - 30,000 end-users of NH_3 systems
  - 34 CO_2 cascade/secondary projects

Drivers and Barriers for use of natural refrigerants

- Main drivers
  - Regulatory requirements and disincentives
  - Environmental impact
  - Efficiency & reliability
  - Long term cost benefits

Drivers and Barriers for use of natural refrigerants

- Main barriers
  - Safety: Flammability, toxicity lead to cost and application disadvantages
  - Restrictive Standards (no or unfavorable safety & trade standards)
  - Higher investment costs for some HFC-free equipment
  - Need for a significant knowledge increment in installation/after-sales service
    - Risk awareness, risk mitigation and application limitations
    - Quality of workmanship and reliability
    - Effective restrictions to deny market access to insufficiently educated technicians
  - Sources of technical information differ from status quo (distribution, perceived reliability)
  - Limited promotion of advantages

Montreal Protocol

- Funding mechanism Multilateral Fund / so far ~150 million $/a
- 4 implementing agencies plus bilateral agencies
- UNIDO
  - Almost 40% of total MLF funding for HCFC phase-out
  - National plans; refrigeration; foam; policy & capacity; others
  - More than 1,300 projects completed
  - Reduction of 340 million tCO_2e use p.a.
  - 1.4 USD/tCO_2e use p.a.
  - OECD average effective carbon rate amounts to EUR 14.4 per tonne of CO_2

UNIDO's role on natural refrigerants

- Main objective
  - Innovation
  - Safety
- Projects
  - Demonstration activities
  - Conversions of production lines
  - Service sector interventions

Innovation and demonstration activities

- PRAHA I project (Bahrein, Kuwait, KSA, UAE)
  - Manufacture & test of purpose built prototypes in A/C industry to understand behavior of alternatives in high ambient temperature conditions (low GWP) a tool to assist in the decision making
  - Main finding: some low-GWP alternatives have similar or even better cooling capacity and energy efficiency performance than baseline refrigerants Engineering is crucial to reach optimum design and performance
  - Upcoming PRAHA II: Building local design capacities + Developing comprehensive Risk Assessment

Innovation and demonstration activities

- Funds mobilization initiative in Viet Nam and The Gambia
  - Funding sources: GEF + co-financing from governments, beneficiaries, technology providers, local development banks and UNIDO
  - The projects consist of Policy and regulatory support; Technology transfer (Low GWP and energy efficiency); and Awareness raising

UNIDO demonstration and conversion projects

- **Algeria** (split and window AC):
  Conversion of one line to two refrigerants depending on application/size (likely R-290 and R-32)
- **Bahrain** (split AC):
  Conversion of one line to two refrigerants depending on application/size (likely R-290 and R-32)
- **Brazil:**
  conversion of 3 enterprises likely to R-290

UNIDO demonstration and conversion projects

- **Pakistan:**
  Conversion of one line to R-290
- **Tunisia/Argentina** (retail sector):
  Conversion of two supermarkets to transcritical CO2 with R-290 subcooling
- **Jordan** (retail sector):
  Conversion of one supermarket to CO2 transcritical

China

- UNIDO conversion projects in China – HCFC-22 to R-290
  - Demonstration: Midea (split) and GMCC (compressor)
  - HPMP stage I (2011 – 2016): 18 AC mini split lines; 3 compressor lines; capacity 6 million
  - HPMP stage II (2016 – 2021): AC mini split & some HPWP (CO2), expected approval 12/2016: 25 assembly lines; 4 compressor lines
  - Market access remains challenging
- Also interesting
  - Demonstration on NH3/CO2: Yantai Moon Group (UNDP)
  - Large-scale cold storage / low temperature industrial applications

Conclusions

- Currently HCFC-22 replacement activities
- Already strong tendency towards natural refrigerants
- HFC replacement (conversion/demonstration) projects likely to commence soon (HFC amendment)
- Development and introduction of natural refrigerants face important challenges
- Still work on innovation, safety, service issues (flammability & toxicity) – difficult but manageable
- Climate benefits extremely cost efficient

Thank you for your attention!

Trends on alternative refrigerants in developing countries

Table 6-7: Current and future refrigerant demand for (refrigerant) ODS alternatives (BAU scenario) for the period 2010-2050 in Article 5 Parties (tonnes)

		2010	2015	2020	2025	2030
A5 BAU	HFC-134a	54,393	74,524	100,162	127,267	161,107
	R-404A + R-507	13,085	36,404	63,963	111,927	167,690
	R-407C	16,543	55,278	101,216	174,433	285,500
	R-410A	40,975	106,661	192,770	284,682	364,845
	Low GWP	22,430	29,318	39,132	51,975	69,915
	Total	**147,426**	**302,185**	**497,243**	**750,284**	**1,049,057**
		2030	**2035**	**2040**	**2045**	**2050**
A5 BAU	R134a	161,107	204,027	257,413	324,537	409,494
	R404A + R507	167,690	223,579	287,745	361,077	449,614
	R407C	285,500	372,998	457,406	532,391	587,361
	R410A	364,845	427,266	479,588	524,488	566,180
	Low GWP	69,915	85,957	104,807	127,577	155,209
	Total	**1,049,057**	**1,313,827**	**1,586,959**	**1,870,070**	**2,167,858**

Source: TEAP, 2016.

Trends on alternative refrigerants in developing countries

Table 6-8: Current and future refrigerant demand for (refrigerant) ODS alternatives (BAU scenario) for the period 2010-2050 in Article 5 Parties (ktonnes CO_2-eq.)

		2010	2015	2020	2025	2030
A5 BAU	HFC-134a	70,712	96,880	130,210	165,447	209,440
	R-404A + R-507	51,584	143,511	252,168	441,229	661,025
	R-407C	26,799	89,550	163,971	282,581	462,511
	R-410A	78,671	204,789	370,118	546,589	700,502
	Low GWP	62	115	203	314	469
	Total	**227,828**	**534,845**	**916,670**	**1,436,160**	**2,033,947**
		2030	**2035**	**2040**	**2045**	**2050**
A5 BAU	HFC-134a	209,440	265,234	334,637	421,897	532,343
	R-404A + R-507	661,025	881,313	1,134,195	1,423,289	1,772,283
	R-407C	462,511	604,256	740,997	862,474	951,525
	R-410A	700,502	820,350	920,809	1,007,017	1,087,066
	Low GWP	478	601	752	940	1,171
	Total	**2,033,956**	**2,571,754**	**3,131,390**	**3,715,617**	**4,344,388**

Source: TEAP, 2016.

eurammon is available as your sparring partner at any time when it comes to questions about refrigeration with natural refrigerants.

Contact:
Dr. Karin Jahn
Lyoner Straße 18
60528 Frankfurt/Main
Germany
Phone: +49 (0)69 6603-1277
Fax: +49 (0)69 6603-2276
E-Mail: karin.jahn@eurammon.com