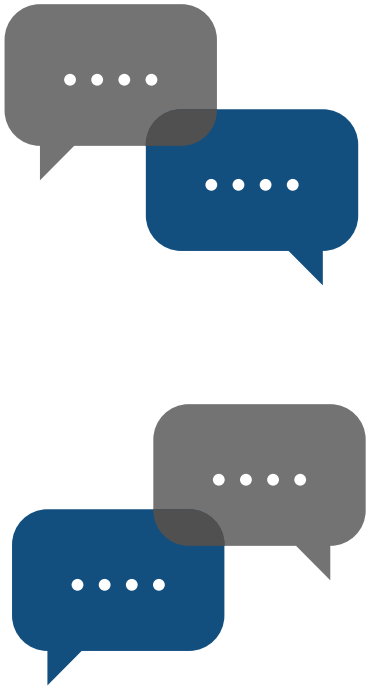
COPA Session for Pilot Methodology Report: Refrigerant Recycling in China's Automotive Maintenance Industry

7th Nov. 2024, Moderator: Theresa Bruns (GIZ)

MEETING ETIQUETTE

- The session will be recorded and later published on the COPAs website.
- Participation in this session mean you agree to being recorded.
- Write your comments or questions in the chat.
- Mute yourself.
- Have fun!



REVIEW: PILOT PROJECT IN GUANGZHOU, CHINA

22 October

Subject:
Car industry, a key area for the use and recycling of refrigerants, expected to increase due to electrical vehicles

Goal of COPA Pilot
Estimate the **potential HFC emission reduction** from car cooling systems if **standardized recycling processes** are established.

Implemented by
COPA, in collaboration with the China Automotive Technology Research Center (CATARC), HEAT and the Harson Group

AGENDA

0	**Agenda & Introduction**	Theresa Bruns (GIZ Proklima)
1	Methodology approach & Data collection	Mr. Manuel Prieto Garcia, Heat GmbH
2	Baseline calculation & Mitigation scenarios	
3	Discussion & Questions	All
4	Wrap-up	Malin Emmerich (GIZ Proklima)
5	Session closing	

COPA
Cutting refrigerant emissions

Demonstration Project on Refrigerant Recycling in China's Automotive Maintenance Industry – Methodology and Results

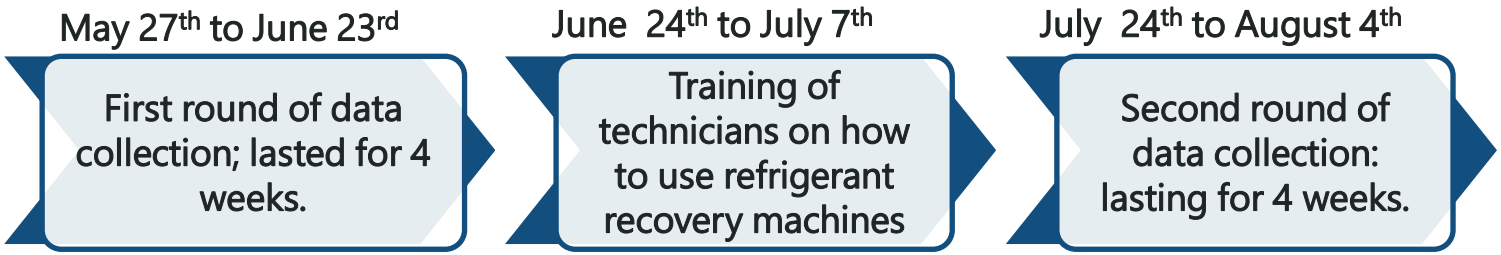
Manuel Prieto Garcia – Environmental Consultant HEAT

METHODOLOGY APPROACH & DATA COLLECTION

1. Selection of demonstration enterprise and pilot workshop
2. Develop, test and finalize Template for data collection
3. Data collection
4. Baseline calculations & Mitigation Scenarios

TIMELINE – DATA COLLECTION CAMPAIGNS

1. Selection of demonstration enterprise and pilot workshop in March 2024.
2. Develop, test and finalize Template for data collection during March-May 2024.



EMISSION SCENARIOS

Business as Usual (BAU)

- No refrigerant recycling machines in the workshops
- All gas in MAC unit vented during servicing (assumed)
- Unit refilled with virgin refrigerant until a full charged is reached

Workshop Scenario 1 (WS1)

- Based on actual workshop conditions during the data collection Phase 1
- Workshops equipped with refrigerant recycling machines (no training)

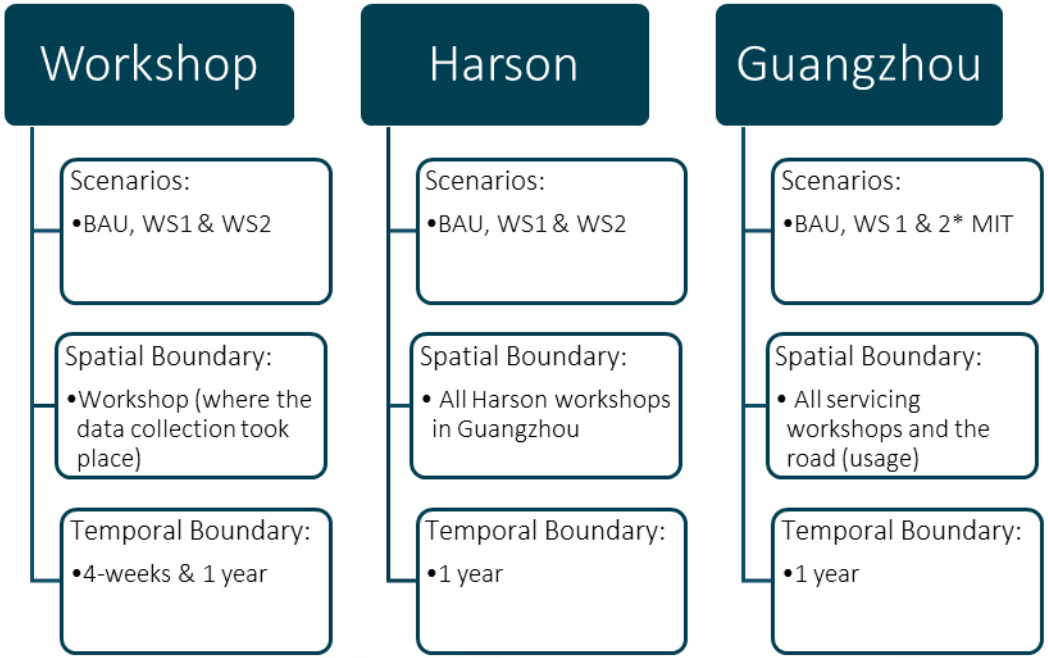
Workshop Scenario 2 (WS2)

- Based on actual workshop conditions during data collection Phase 2
- Workshops equipped with refrigerant recycling machines and trained technicians

Mitigation Scenario (MIT)

- Workshops follow international best practices for refrigerant management

TEMPORAL AND SPATIAL BOUNDARIES OF THE BASELINE AND EMISSIONS



* For the region of Guangzhou an average of the results of the WS1 and WS2 was used for the calculations

VARIABLES CALCULATED FOR THE BASELINE AND EMISSIONS OF THE WORKSHOP

N°	Variables	Name	Units	Special Boundaries	Temporal Boundaries	Sources
1	R_{rcyl}	Refrigerant recycled	kg	Workshop	4 weeks	Data collection campaigns
2	R_{vent}	Refrigerant vented	kg	Workshop	4 weeks	Data collection campaigns
3	VR	Virgin refrigerant needed for servicing	kg	Workshop	4 weeks	Data collection campaigns
4	Em	Refrigerant emissions	CO_2eq	Workshop	4 weeks	Data collection campaigns
5	BL_{BAU}	Baseline emissions	CO_2eq	Workshop	4 weeks	Estimation based on data
6	AvEm	Total avoided emissions	CO_2eq	Workshop	4 weeks	Estimation based on data
7	PR_{rcov}	Potential refrigerant for recovery	Kg	Workshop	4 weeks	Theoretical variable for MIT scenario

BASELINE AND EMISSIONS EQUATIONS FOR THE WORKSHOP CALCULATIONS

Equation 4 $$Em = R_{vent} \times GWP$$

Equation 5 $$\mathbf{BL_{BAU}} = Q_{ref} \times GWP$$

VARIABLES CALCULATED FOR THE BASELINE AND EMISSIONS OF GUANGZHOU

N°	Variables	Name	Units	Special Boundaries	Temporal Boundaries	Sources
8	BL_{mac}	Baseline emissions	kg, CO_2eq	Guangzhou*	1 year	Extrapolation using data from Harson
9	Em_{mac}	Refrigerant emissions	kg, CO_2eq	Guangzhou*	1 year	Extrapolation using data from Harson
10	Em_{w}	Workshops refrigerant emissions	kg	Guangzhou*	1 year	Extrapolation using data from Harson
11	Em_{road}	Refrigerant emission on the road	kg	Guangzhou*	1 year	Extrapolation using data from Harson
12	PRR_{mac}	Potential refrigerant for recycling	kg	Guangzhou*	1 year	Extrapolation using data from Harson
13	VR_{mac}	Virgin gas needed for servicing	kg	Guangzhou*	1 year	Extrapolation using data from Harson
14	$AvEm_{mac}$	Total avoided emissions	kg	Guangzhou*	1 year	Extrapolation using data from Harson

EQUATIONS FOR BASELINE AND EMISSION CALCULATIONS IN GUANGZHOU (1/2)

Equation 8 $$BL_{mac} = n_c \times \frac{IC_{avg}}{S_y}$$

Equation 9 $$Em_{mac} = Em_{road} + Em_w$$

Equation 10 $$Em_{road} = n_c \times IC_{avg} \times LR$$

EQUATIONS FOR BASELINE AND EMISSION CALCULATIONS IN GUANGZHOU (2/2)

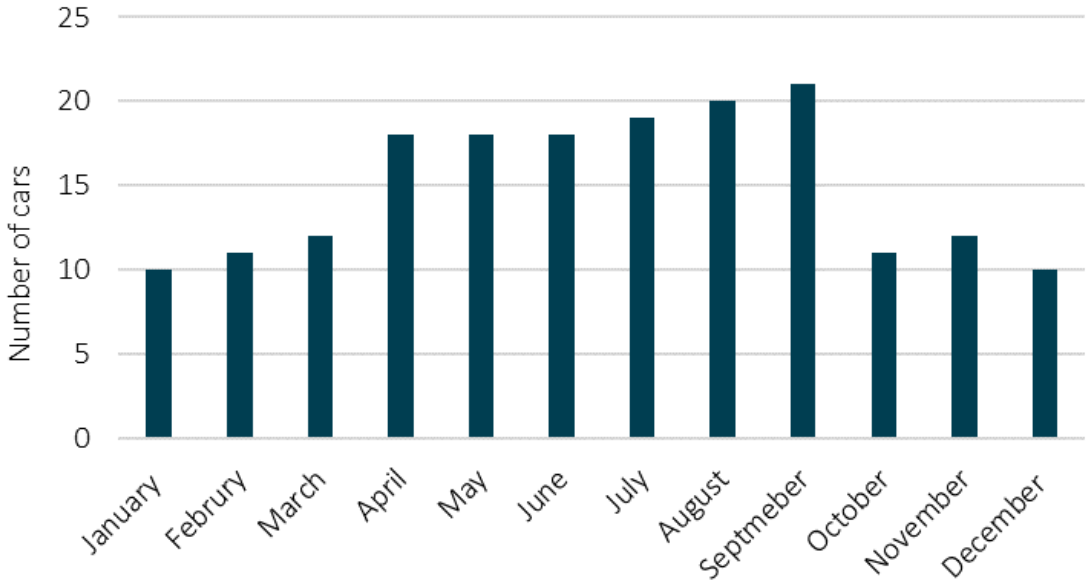
Equation 11 $$Em_w = PRR_{mac} \times \left(\frac{R_{vent}}{R_{rcyl}+R_{vent}}\right)$$

Equation 12 $$PRR_{mac} = \frac{n_c}{S_y} \times \left(IC_{avg} - IC_{avg} \times E_r\right)$$

RESULTS FOR THE WORKSHOP

Variable	BAU Scenario (Baseline)	Workshop Scenario 1	Workshop Scenario 2
Number of days	88	28	28
Number of weeks	12,57	4,00	4,00
Number cars surveyed	59	13	24
Cars surveyed per day	0,67	0,46	0,86
Standardized results			
Refrigerant recycled (R_{rcyl})	0 kg	9,3 kg	8,5 kg
Virgin refrigerant (VR)	13,1 kg	3,8 kg	4,6 kg
Refrigerant emissions (Em) or Potential refrigerant for recovery (PR_{rcov})*	9,5 kg	0,5 kg	0,7 kg
Refrigerant emissions (Em)	**14.481 kgCO_2eq (BL)**	**776,3 kgCO_2eq**	**1051,2 kgCO_2eq**
Total avoided emissions (AvEm)	-	**13.705 kgCO_2eq**	**13.430 kgCO_2eq**

VEHICLES SERVICED IN THE WORKSHOP FOR THE YEAR 2023



RESULTS FOR THE HARSON WORKSHOPS

Variable	BAU Scenario (Baseline)	Workshop Scenario 1	Workshop Scenario 2
Refrigerant recycled (R_{rcyl})	0 kg	677.8 kg	620.7 kg
Virgin refrigerant (VR)	957.7 kg	279.7 kg	336.1 kg
Refrigerant emissions (Em) or Potential refrigerant for recovery (PR_{rcov})*	692.0 kg	37.1 kg	50.2 kg
Refrigerant emissions (Em)	1,058,757 kgCO2eq	56,755 kgCO2eq	76,856 kgCO2eq
Total avoided emissions (AvEm)	-	1,002,001 kgCO2eq	981,901 kgCO2eq

RESULTS FOR THE CITY OF GUANGZHOU

Variable	BAU Scenario (Baseline)	Workshop Scenarios 1 & 2 (average)	Mitigation Scenario (MIT)
Refrigerant recycled (R_{rcyl})	0 kg	236.268 kg	252.255 kg*
Refrigerant emission in the workshops Em_w	252.255 kg	15.988 kg	0 kg
Refrigerant emission on the road Em_{road}	92.360 kg	92.360 kg	92.360 kg
Refrigerant emissions (Em_{mac}) or Virgin refrigerant (VR)**	344.615 kg (BL)	108.348 kg	92.360 kg
Refrigerant emissions (Em_{mac})	**527.261 tCO_2eq (BL)**	**165.772 tCO_2eq**	**141.311 tCO_2eq**
Total avoided emissions ($AvEm_{mac}$)	-	**361.489 tCO_2eq**	**385.950 tCO_2eq**

CONCLUSIONS FORM THE RESULTS

- The emissions are slightly lower in WS1 than in the WS2 when the technicians had received proper training.
- A possible explanation for the venting of refrigerant is that the refrigerant was too polluted to be recycled.
- The most critical point for reducing refrigerant emissions of passenger cars in China is by addressing the refrigerant servicing practices in the workshops.
- If all workshops in the metropolitan area of Guangzhou reach the high rates of refrigerant recycling seen during the data collection campaigns, the reduction will be very **(significant around 94% reduction of emissions).**

Questions?

Thank you for your attention!


ANY QUESTIONS?

COPA MATERIALS ONLINE: WWW.COPALLIANCE.ORG

- **Todays' session is recorded and will be uploaded on the COPAs website, together with the report publication as a pdf-file.**
- Already there are other cool and informative materials available on the COPA website.
- Webinar Sessions **(video recording)**
- **Guidelines** – e.g. on ODS/HFC banks Inventory
- **Virtual Study Tour on Reclamation & Destruction Technology** (live-session-series)
- **COPA studies and Reports**

SCAN ME

09.11.2024

COPA
Cutting refrigerant emissions

THANK YOU FOR YOUR PARTICIPATION!