



UNITED NATIONS  
INDUSTRIAL DEVELOPMENT ORGANIZATION

Montreal  
Protocol Unit



Workshop on Kigali Implementation Plans

Session 8: Recovery, Recycling, and Reclamation and  
proper end-of-life disposal of refrigerants

15 June 2023 Vienna, Austria

KIGALI in  
Acti  
ON





## Session 8



**Georg Bitarichvili**  
COB, Co-founder,  
EcoScandic, Finland



**Krzysztof Grzegorzczuk**  
RRR Expert, President of the Board  
Prozon, the Foundation for climate  
protection, Poland



**Maja Schmauser**  
Advisor,  
Division Climate Change,  
Environment,  
Infrastructure  
Proklima International

Moderator



**Alan Bastida**  
Expert in Road Map for Kigali Amendment,  
UNIDO



**Dustin Cherniawski**  
Director, Enviroserve, Dubai



**Rodrigo Serpa**  
Industrial Development Officer,  
UNIDO Montreal Protocol Unit



## Session Session 8: Recovery, Recycling, and Reclamation and proper end-of-life disposal of refrigerants



**Georg Bitarichvili**  
COB, Co-founder,  
EcoScandic, Finland

Circular economy and waste-to-value thinking has always been important to me and to our company Eco Scandic, which I have been running since its inception in 2015. The core of our strategy was to create an efficient, effortless and feasible solution for end-users to manage their F-gas waste. Today our volumes of recovered and reclaimed refrigerants are the highest in Northern Europe and we aim to make the Nordic countries self-sufficient by substituting virgin, imported F-gases with locally reclaimed product.

Our ambition is to iterate our model globally in order to minimize F-gas leakages with high global warming potential (GWP) to the atmosphere and maximize the recycling of recovered raw material. Our team of engineers and qualified specialists in the circular economy segment gladly share the experiences and knowledge gained to reach this goal.

Personally, I have been involved in several recovery, recycling and reclamation (RRR) projects with UNIDO as an international expert in different article V countries and regions, always with an emphasis on the business model development. I strongly believe that cleantech or “green business” do not automatically mean increased complexity or higher expenses. Instead, I see it as added value for end-customers which is a basis for every business model



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# Business models for RRR centers

In A5 countries



**Georg Bitarichvili**

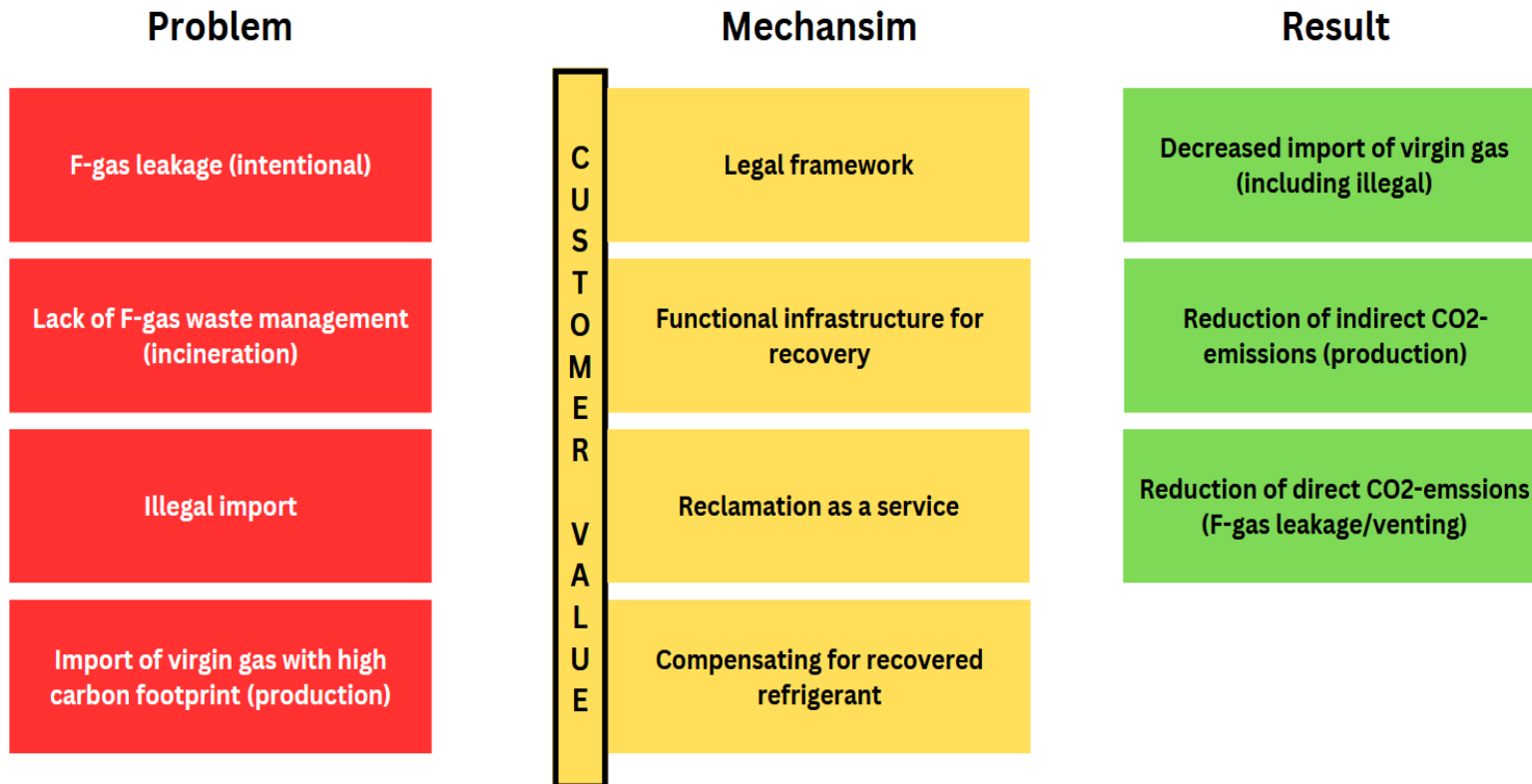
June 15, 2023

Vienna International Center





## Problems and main objectives





## Core pillars

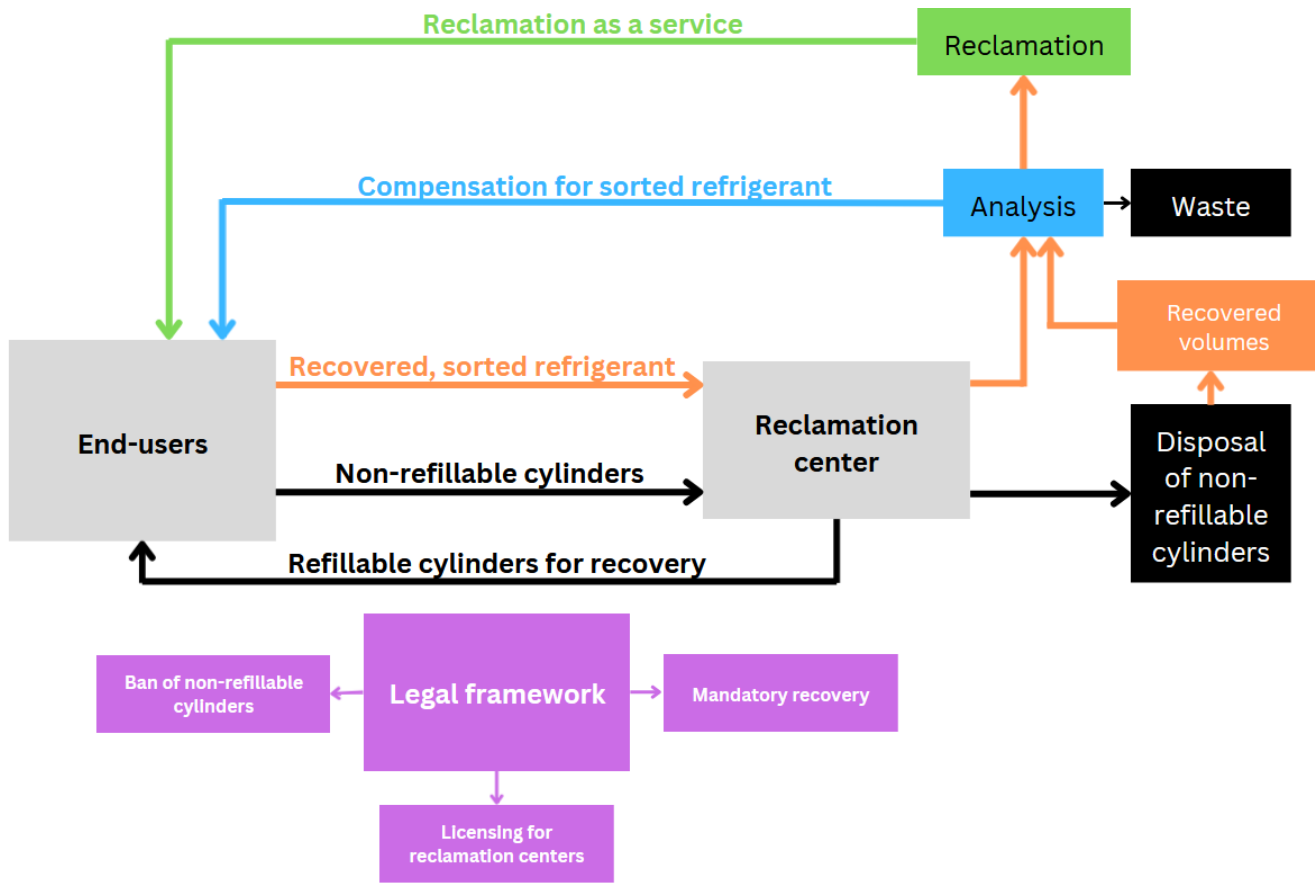
- 1) Incentivized raw material (sorted refrigerant) collection
- 2) Reclamation as a service (buy-back model)
- 3) Quality control (gas chromatography and AHRI-700)
- 4) Legal framework and norms in the host country
- 5) Training and commissioning of the equipment
- 6) Controlled and incentivized disposal of non-refillable (single use) cylinders

## Terminology

- **Recovered refrigerant**: used, contaminated refrigerant collected from old cooling or heating appliances
- **Recycled refrigerant**: recovered refrigerant recycled without quality control (composition or contaminants not tested)
- **Reclaimed refrigerant**: recovered refrigerant processed to meet specifications of a new refrigerant gas (AHRI-700 standard)

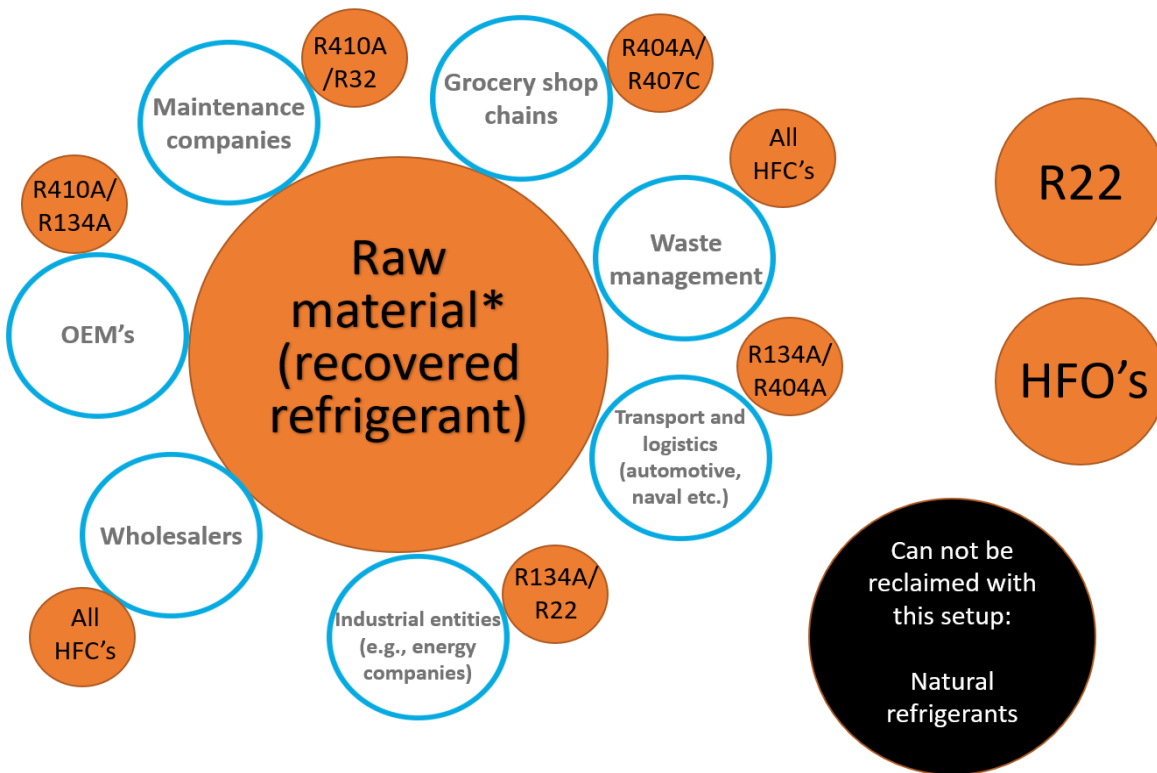


CASE  
STUDY





## Raw material - sources of recovered refrigerant



## Topics for discussion

- **F-bank** - cumulative volumes of refrigerant filled in cooling & heating appliances in one specific country
- **In-situ reclamation** vs. alternatives
- **Incineration, export and distillation**
- **Current trends** for import of refrigerants in A5 countries





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## About us



**+300t**

Recovered  
refrigerant  
processed

**+7200**

Fleet of  
recovery  
cylinders  
and drums

**+160t**

Refrigerants  
reclaimed

**~70%**

Recycling  
rate in 2022  
(reclaimable  
material)



Inspecta Sertifiointi Oy



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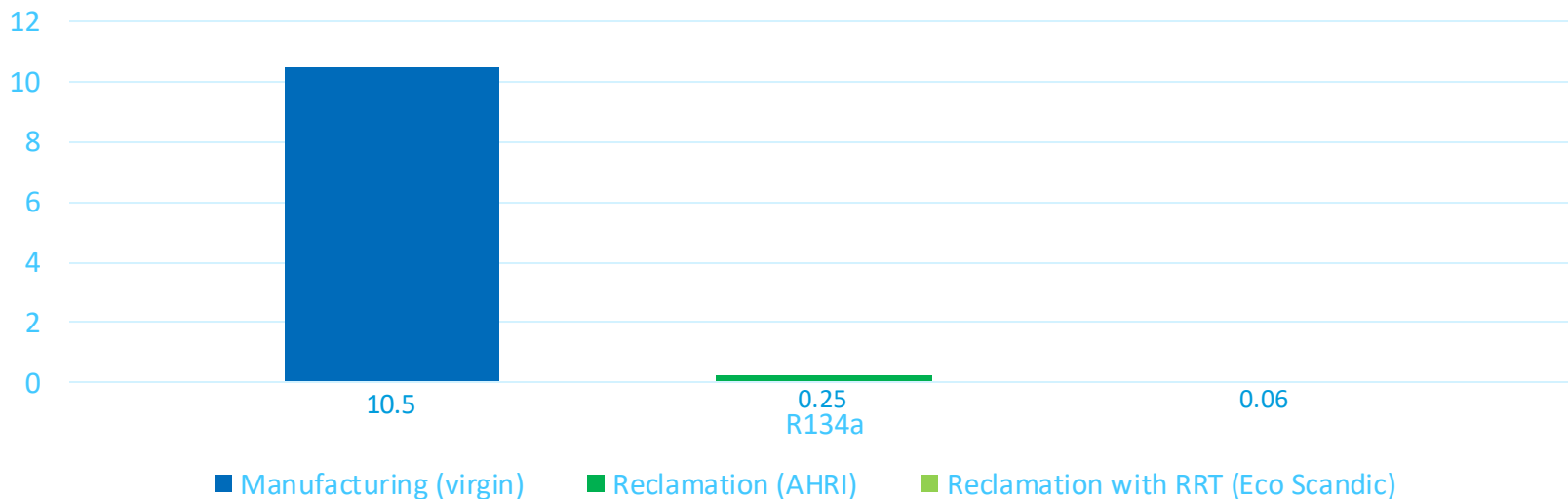
- Operational since 2016
- Offices in Helsinki (HQ) and Stockholm
- LCA-assessment pending
- The only company in the Nordics with an Environmental permit and End-of-Waste license for processing F-gases

**ECOSCANDIC**  
CLEANTECH OF TOMORROW



## LCA-assessment (pending)

Potential climate impacts of R134a per kg produced (kgCO<sub>2</sub> eq.)  
Virgin vs. reclaimed (emissions from manufacturing)



\* Data for manufacturing is retrieved from Yasaka et al. (2023) and relates to manufacturing of virgin gas in Europe. Numbers for reclamation are from Mustaniemi (2023) and relates to reclamation in Finland.



Thank you!

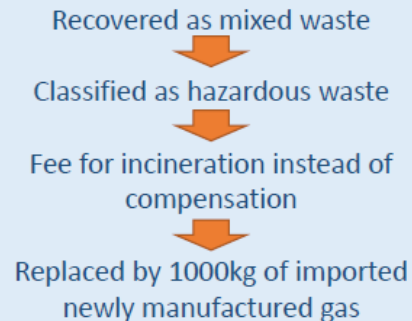
### Circular economy



**Total emissions:** <0.1 tons CO<sub>2</sub>-eq.



### Linear economy



**Total emissions:** 11.7 tons CO<sub>2</sub>-eq.



## Session Session 8: Recovery, Recycling, and Reclamation and proper end-of-life disposal of refrigerants



**Krzysztof Grzegorzczak**

RRR Expert, President of the Board Prozon, the Foundation for climate protection, Poland

Krzysztof Grzegorzczak, M.Sc., PROZON The Foundation for Climate Protection; President of the Management Board He graduated from the Agricultural University in Krakow (General Faculty, Faculty of Horticulture) and 2-year Executive Master of Business Administration studies at the Warsaw School of Economics and Minnesota University. He is one of the founders of the PROZON Foundation (managing national RRR network in Poland) and the President of the Management Board since 2014. He has many years of experience in managing projects and issues related to climate protection and in the refrigeration and air conditioning industries. He also has extensive experience in managing teams, introducing new services to the market, creating and implementing sales strategies and creating a multi-brand marketing strategy. He has knowledge of logistics processes, production planning and company finances. He supports state institutions in creating and enforcing environmental protection law. He has participated in many projects, e.g. REAL Alternatives 4 LIFE (e-learning platform on low GDP refrigerants). From 07/2019, he is Director of the Refrigerants LIFE Cycle Project (implementing high-end technical solutions for separating refrigerants mixtures), where he is responsible for making key, strategic decisions to ensure its proper implementation.



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PROZON

THE FOUNDATION FOR CLIMATE PROTECTION

# Lessons learned from a successful RRR operation in Poland

Krzysztof Grzegorzczak

# KIGALI in Acti ON





## PROZON The Foundation for Climate Protection

is a self financed, non-government organisation (NGO), an entrepreneur working for refrigeration and air-conditioning sector

- 3 000 partners
- 15 000 special cylinders in the market
- 2 000 ton refrigerants collected and reclaimed
- 3 000 personel trained for certification
- 2 000 person examined for F-gas certificated
- 150 examined for SF6 certificated,
- 50 employes
- reporting to The Ministry of Environment & Climate



## Definitions

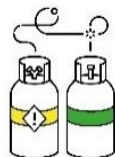
REGULATION (EU) No 517/2014 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL  
of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No  
842/2006



### Recovery

„means the collection and storage of fluorinated greenhouse gases from products, including containers, and equipment during maintenance or servicing or prior to the disposal of the products or equipment;”

**Evacuation of refrigerant from AC or HP or refrigeration unit**



### Reclamation

„means the reprocessing of a recovered fluorinated greenhouse gas in order to match the equivalent performance of a virgin substance, taking into account its intended use;”

**removing impurities above AHRI 700 standards**



### Recycling

„recycling’ means the reuse of a recovered fluorinated greenhouse gas following a basic cleaning process;”

**Basic cleaning proces means nothing in practice**

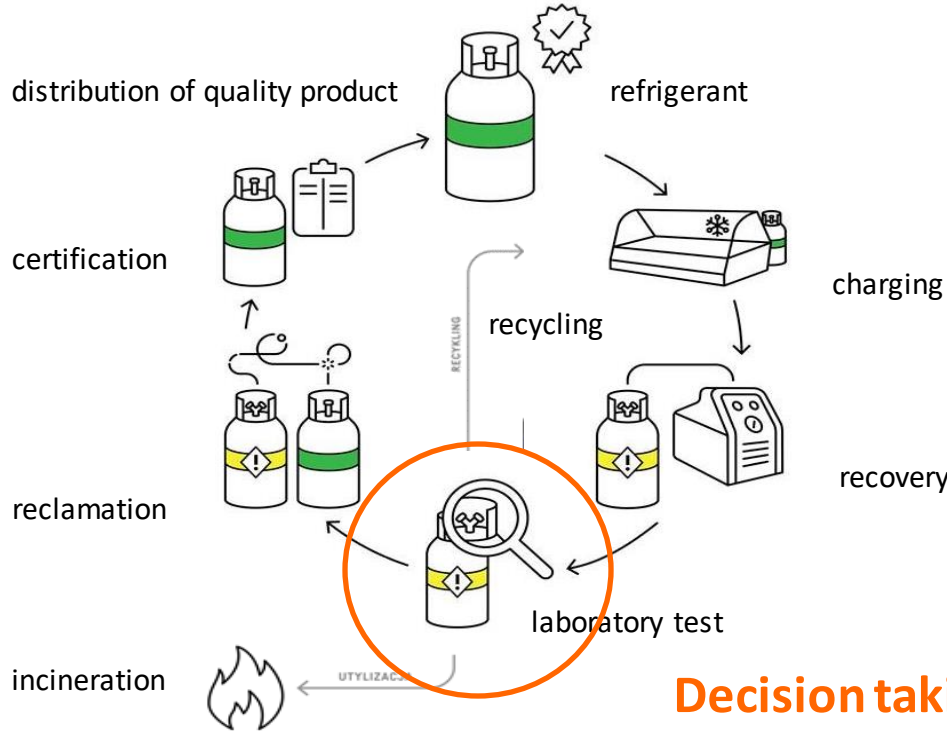


### Destruction

„means the process of permanently transforming or decomposing all or most of a fluorinated greenhouse gas into one or more stable substances that are not fluorinated greenhouse gases;”

**incineration**

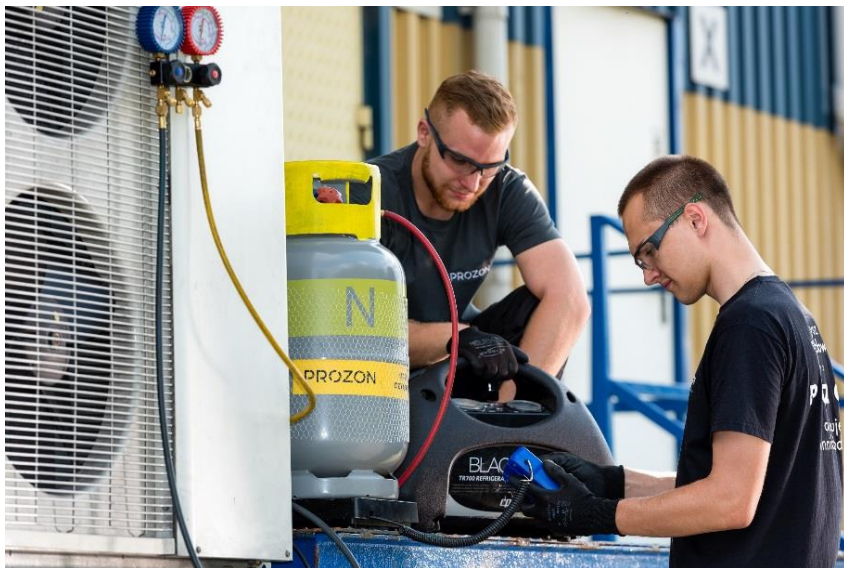
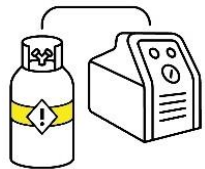
# Life cycle of refrigerants



**Decision taking**





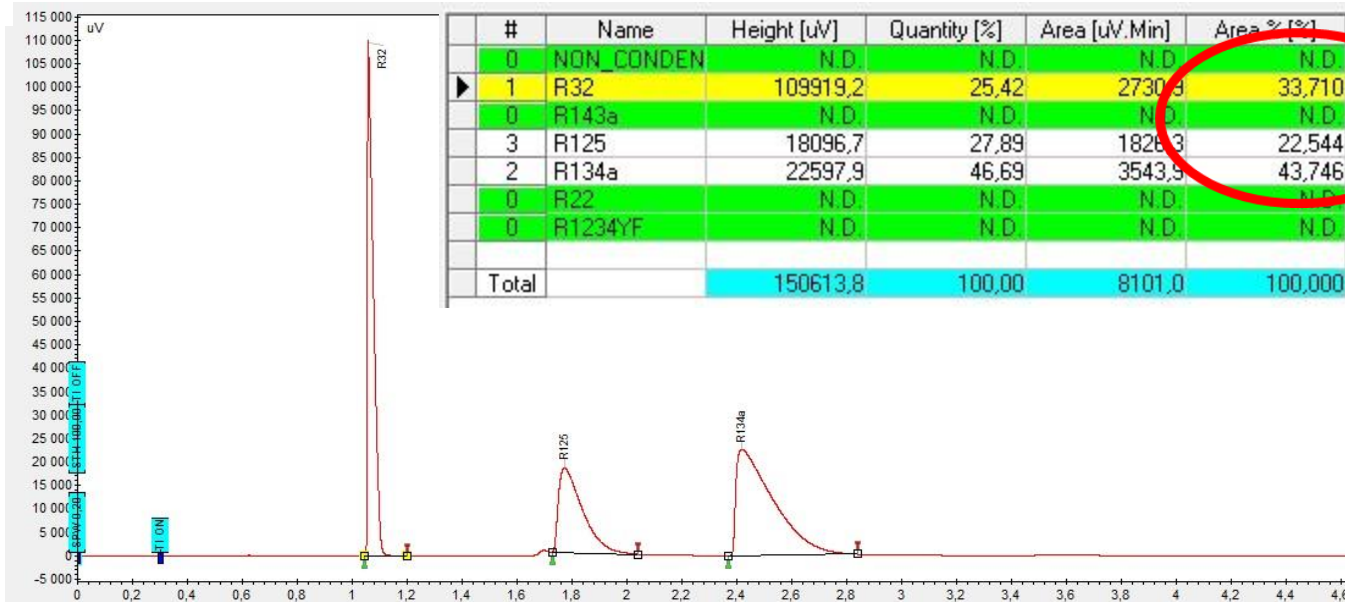




# Testing refrigerants



Gas chromatograph



## Karl Fisher - coulometer

```

Nr seryjny 711978
22 November 2017

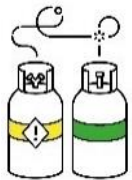
Prg: 1 12:55:36 F
Licz. netto 618.51ug
Dryft: 3
Format wyniku ppm
Tryb obliczen W/w
M. calkow. 609.1700 g
Masa tary 600.8200 g
Masa probki 8.3500 g
Wynik: 74.07 ppm

Nr przebiegow 1
Maksimum 74.07 ppm
Minimum 74.07 ppm
Srednia 74.07 ppm

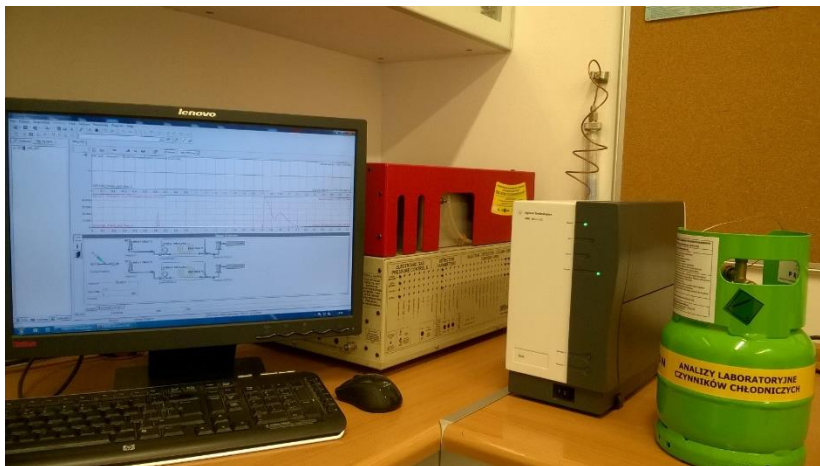
Aquamax KF 2.7d
Nr seryjny 711978
22 November 2017

Prg: 1 13:04:53 F
Licz. netto 604.20ug
Dryft: 3
Format wyniku ppm
Tryb obliczen W/w
M. calkow. 600.8300 g
Masa tary 592.8100 g
Masa probki 8.0200 g
Wynik: 75.34 ppm

Nr przebiegow 1
Maksimum 75.34 ppm
Minimum 75.34 ppm
4.8 5
    
```



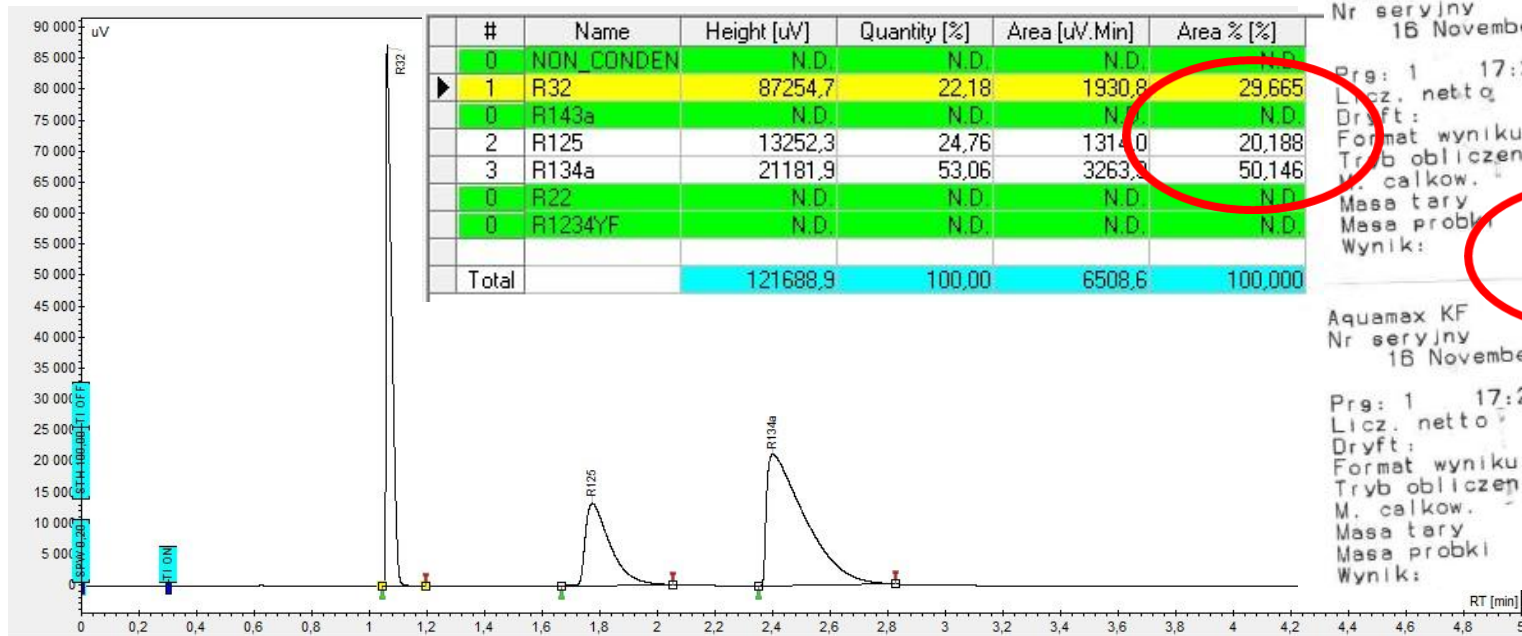
distillation, filtering, condensing  
removing non-condensable gases  
adding missing components  
homogenizing



Nominal Composition  
Water content  
Acidity  
High boiling residues  
chloride  
Non-condensable gases  
Solid particles



## Quality products after reclamation



Aquamax KF v2.7d  
Nr seryjny 711978  
16 November 2017

Prg: 1 17:21:03 F  
Licz. netto 47.92ug  
Dryft: 0  
Format wyniku ppm  
Tryb obliczen W/w  
M. calkow. 610.6800 g  
Masa tary 602.4700 g  
Masa probki 8.2100 g  
Wynik: 5.84 ppm

Aquamax KF v2.7d  
Nr seryjny 711978  
16 November 2017

Prg: 1 17:29:04 F  
Licz. netto 46.28ug  
Dryft: 1  
Format wyniku ppm  
Tryb obliczen W/w  
M. calkow. 602.5000 g  
Masa tary 594.2000 g  
Masa probki 8.3000 g  
Wynik: 5.58 ppm



## Reclamation and separation plant, Poland





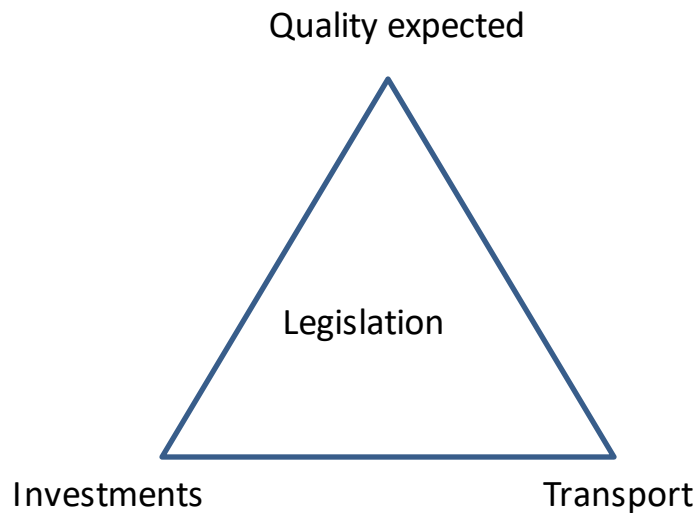


24h





## Designing RRR model



### Legislation

1. You have to recover!
2. Need to have a certificate

### Social responsibility

1. To understand ozone layer
2. To be professional

Why should I recover?



### Customers expectations

1. Green card advantages
2. Public contracts under rules
3. Industry standards

### Equipment available

1. Recovery unit
2. 2 way valve cylinders
3. Reclamation & incineration places

### Incentives

1. Avoid penalties
2. Earn money - \$/kg
3. Get valuable product

## Key success factors for RRR network

1. Supporting legislation
2. Dedicated Laboratory
3. Reclamation Center
4. Incineration facility
5. Pull of equipment for recovery
6. Collecting points network
7. Good logistic
8. Technical trainings for personel
9. Public awareness





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PROZON

THE FOUNDATION FOR CLIMATE PROTECTION

Thank you!

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prozon@prozon.org.pl

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## Session Session 8: Recovery, Recycling, and Reclamation and proper end-of-life disposal of refrigerants



**Maja Schmauser**

Advisor,

Division Climate Change, Environment,

Infrastructure

Proklima International

Maja Schmauser is an advisor at the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) programme Proklima. GIZ Proklima is a globally active programme that has been promoting environmentally friendly and energy-efficient cooling technologies since 1995. Proklima's services comprise policy advice and capacity development for governments, training and qualification, as well as pilot projects for industry partners. To date, the programme has implemented more than 250 projects in approx. 45 countries worldwide.

As part of the Climate and Ozone Protection Alliance (COPA) secretariat, Maja supports national and international decision-makers in the energy, environment and waste sector in creating effective greenhouse gas mitigation through ODS and HFC banks management. Within the global project Cool Contributions fighting Climate Change II (C4 II), Maja works on designing and implementing more ambitious NDCs in the cooling sector. Her regional focus is Latin America and the Caribbean.



# Climate and Ozone Protection Alliance (COPA)

Maja Schmauser, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH



# 1. Introduction



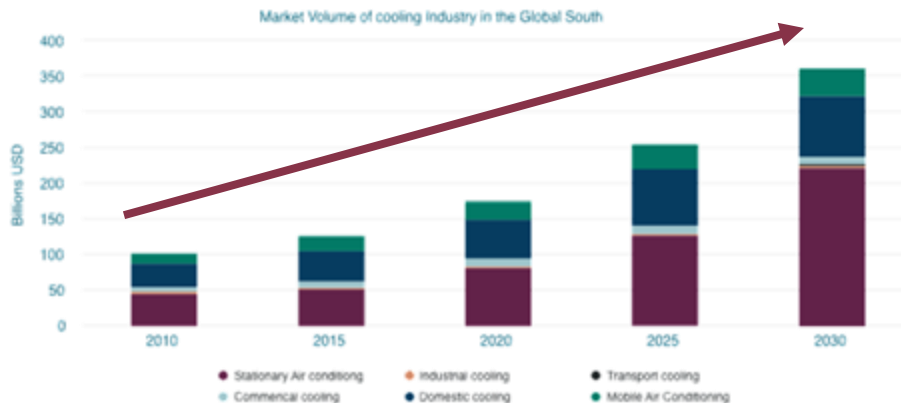
## INTRODUCTION OF COPA

### *Heating up our planet by cooling down our lives – the issue*

**Demand for cooling and air conditioning units is rising sharply.**

The excessive use of ozone depleting substances (ODS) and climate-damaging hydrofluorocarbons (HFCs), which are found in existing and old cooling equipment, insulation foam or cylinders, has led to the **accumulation of large ODS and HFC banks globally.**

When old cooling devices are not maintained and disposed of in an environmentally friendly way, the legacy **ODS and HFC banks release emissions freely into the atmosphere.**



# INTRODUCTION

## Approach

COPA works jointly with partner countries and diverse actors across private and public sectors to advance the holistic solutions needed to reduce ODS and HFC banks, and ultimately complete the shift in the cooling sector to sustainable refrigerant management.

Implemented by:



In cooperation with:



Supported by:



on the basis of a decision  
by the German Bundestag

## ACTIVITIES

### Global level

Setting up of an international Alliance

Establishment of Working Groups

Promoting international dialogue and knowledge transfer



### Partner Country level

Financed by current project

Pilot project development

- Status Quo Analysis
- Concept development
- Assistance in acquiring international finance

Additional funding required

Pilot project implementation

- Establishment of HFC / ODS banks management in selected metropolitan regions
- Services and infrastructure
  - Training of technicians
  - MRV systems

Pilot projects advance...

1. Technical and financial capacities (reclamation and destruction technologies, skilled servicing industry, recovery and collection infrastructure)
2. Policies and regulations on sustainable ODS / HFC banks management
3. NDCs inclusion of HFC (ODS) banks management & emission reduction ambitions

Year  
1

Year  
2

Year  
3

Year  
4

Year  
5

## COPA PILOT ACTIVITIES IN



Ghana



China



Tunisia



Mexico



Ecuador

## COUNTRY MEMBERS



Grenada

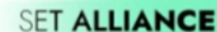


Dominican  
Republic



The Gambia

# COPA MEMBERS



## BECOME A MEMBER

Find more Information on our [Website](#)



- COPA is open to all countries and organisations, willing to support the global shift to sustainable refrigerant management and closing the loop to a circular economy in the cooling sector.
- Members gain access to a global network of knowledge and resources
- Match-making between actors and a flexible array of services
- The network will amplify the reach of actors and enhance the impact of activities in the field of ODS and HFC banks management.

[Join COPA and become a member](#)



## 5. COPA's offer for complementary action to the MLF

## MLF AND COPA

### MLF

- Supporting activities on a national level
- Development of Inventories and action plans; no implementation
- USD \$70,000 up to \$100,000 per country
- Submission of proposals earliest for Dec 2023 – Dec 2025
- Funding available earliest 2024

### COPA

- Focussing on **metropolitan regions** and **sub-sectors**
- Development of **concrete mitigation measures** ready for financing
- Targeting **additional funding** for **implementing** measures
- **Demonstration of feasibility** of different ODS and HFC banks management **approaches**
- Support **available now**

Challenge: Relevant to act now and not wait for completed inventories and action plans  
→ COPA activities will not hinder the full use of the funding window



## COPA COUNTRY LEVEL SERVICES

### COPA member countries will be supported by:

1. Providing standard methodology for inventories and national action plans funded by MLF decision 91/66 funding window
2. Complementing national inventories with status quo analyses in selected urban areas and sub-sectors:
  - Identifying the amounts and location of ODS and HFC banks
  - Analyse existing **regulations** and collection, transport, storage and destruction / reclamation **infrastructure** and **capacities**
  - Determine the gap between amounts of ODS & HFC banks at EOL and current collection, transport & destruction / reclamation capacities
3. Supporting mitigation project design based on inventories and status-quo analyses
4. Formulating NDC mitigation target for ODS / HFC banks sector
5. Mobilizing international finance for implementation
6. Implementing projects



## 5. Overview of ODS/HFC Destruction Technologies

## TECHNOLOGIES FOR THE DESTRUCTION OF ODS/HFCs

Approved destruction technologies		Advantages for developing countries	Disadvantages for developing countries
Thermal Oxidation technologies*	Cement kilns	<p>Already exist in many countries.</p> <p>Already established for hazardous waste treatment.</p> <p>Adjustments are easy and relatively cheap.</p>	<p>Low to high emissions,</p> <p>Measuring the emissions can be challenging.</p>
	Municipal solid waste incineration (MSWI)	<p>Useful if there are already operating plants in the country/area.</p>	<p>High investment and operational cost for new plants.</p> <p>Not very effective as destruction method for ODS/HFCs.</p> <p>Risk of high emissions</p>
	Rotary kiln incineration	<p>Already exists in developing countries.</p> <p>Only approved technology for the destruction of all ODS/HFCs**.</p> <p>Low emissions.</p>	<p>Useful only if already established (e.g., by chemical companies).</p> <p>High investment and operational costs.</p>
Plasma technologies	Argon plasma arc	<p>Compatible with the chemical industry.</p> <p>Effective destruction method.</p>	<p>Very low emissions.</p> <p>High costs and high requirements</p> <p>Low availability for acquisition, including spare parts</p>

\* Previously called "Incineration Technologies".

\*\* This technology was approved for the destruction of all molecules under the Montreal Protocol except for methyl bromide.

## TECHNICAL OVERVIEW OF THE TECHNOLOGIES

Technology	Cement Kiln	MSWI	Rotary kiln Incineration	Argon Plasma Arc
Accessibility	High	Low	Low to medium	Low to medium
Degree of operational complexity	Low	High	High to medium	High
Building/adjustment costs	Low (liquid feeding lines to kiln, storage facilities)	High	High (Ghana – Zeal over 3 million USD) <sup>1</sup>	High (4.2 million USD + installation and transportation) <sup>2</sup>
Destructions Costs USD/Kg	6.0	5.2-6.2	1.9-2.5 (non-Article 5) 8.0-29.8 (Article 5)	7.5

<sup>1</sup> From exchange with the chief operations officer of Zeal Environmental Technologies Ghana

<sup>2</sup> Cost for a PDU in 2008 bought by Quimobasicos.

## CONCLUSIONS AND RECOMMENDATIONS FOR ARTICLE 5 COUNTRIES ON DESTRUCTION

A detailed analysis of the costs of destruction in the country compared to exporting these gases for destruction abroad is recommended.

The adaptation of technologies that have previously been used for the destruction of other types of waste should be subject to testing and emission control.

Destruction facilities should focus not only on ODS/HFCs but also diversify on the type of waste that they can destroy.

Appealing to the environmental and social responsibility of large companies to collect and manage their used ODS/HFCs.

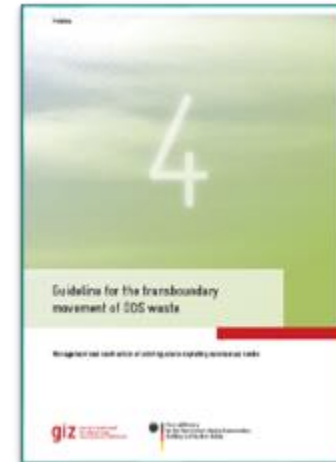
The establishment of an EPR system that allocates responsibility for the proper end-of-life management of ODS/HFCs to importers or producers.

For Destruction of ODS/HFCs is financed with carbon credits in the voluntary market, it is crucial to ensure that there are buyers for these credits and there is both a destruction facility and enough substances available for destruction.



## 5. Further information

# RELEVANT PUBLICATIONS AND TOOLS



Global roadmap on ODS bank management ([Download](#))

Updated Guideline to conduct an ODS bank inventory ([Download](#))

Guideline on policy measures for the management and destruction of ODS ([Download](#))

Guideline to establish a collection system for equipment containing ODS ([Download](#))

Guideline for the transboundary movement of ODS waste ([Download](#))

## RELEVANT PUBLICATIONS AND TOOLS



Design of a Financing Mechanism for the Climate and Ozone Protection Alliance  
([Download](#))



Global Banks of ozone depleting substances. A country-level estimate  
([Download](#))



Thermal destruction of (H)CFCs and HFCs  
([Download](#))



Banks and Emissions of CFC-11 and CFC-12  
([Download](#))



Guideline on the Manual Dismantling of Refrigerators and Air Conditioners  
([Download](#))



# MEET & GREET COPA!

*The Climate and Ozone Protection Alliance*

*when & where?*

Reception:

6th July at 6:30 pm  
at the OEWG

Meeting room MR-E  
for an interesting and informal  
exchange!

Our website:

<https://www.copalliance.org>

Contact us:

Email: [contact@copalliance.org](mailto:contact@copalliance.org)

## About COPA

Together with its members from partner countries, intergovernmental organizations such as UNDP and UNIDO, civil society organizations, academia and the private sector, COPA accelerates the mitigation measures urgently needed to address accumulated amounts of Ozone Depleting Substances and Hydrofluorocarbons.



*Raising awareness* about the excessive use of ozone-depleting and climate-damaging substances in the cooling sector



*Working together* to advance holistic solutions



*Bringing together* and establishing a global alliance to reduce GHG emissions globally



*Promoting a global shift* to sustainable refrigerant management

***We look forward to meeting you!***

## RELEVANT PUBLICATIONS AND TOOLS



Poster: Appropriate  
Dismantling of  
Refrigerators  
([Download](#))



Poster: Appropriate  
Dismantling of Air  
Conditioners  
([Download](#))



Poster: Key processes  
to manage ODS  
banks ([Download](#))



Video: ODS Banks –  
An unseen threat  
([Download](#))



Video: A simple step  
with great impact:  
The reclaim process  
of refrigerants  
([Download](#))



**Thank you for your kind attention!**



*Learn more about COPA & upcoming events by  
visiting our website: <https://www.copalliance.org>*

*Contact:*

Maja Schmauser – Advisor, Deutsche Gesellschaft für Internationale  
Zusammenarbeit (GIZ)

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COPA Secretariat

*Email: [contact@copalliance.org](mailto:contact@copalliance.org)*



## Session Session 8: Recovery, Recycling, and Reclamation and proper end-of-life disposal of refrigerants



**Dustin Cherniawski**  
Director, Enviroserve, Dubai

Hailing from Canada but living in Dubai since 2008, Dustin has a unique background that includes, Professional Sports, Commercial Real Estate, Sustainability Consulting, Finance, Electronic Waste Recycling, and Event Management.

15 years in the extreme climate of the Middle East has provided large scale and varied experience with HVACR systems including performance analysis, energy saving technologies, electronic waste recycling, and refrigerant gas recovery & reclaim.

Dustin is a Director at Enviroserve, one of the world's most advanced eWaste treatment facilities that also boasts one of the region's only refrigerant recovery and reclaim facilities.



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Protocol Unit



Somewhere between Policy & Perfection.  
Tales from the front line of refrigerant  
reclaim in the Middle East.



KIGALI in  
Acti  
ON

**DUSTIN CHERNIAWSKI**

June 15, 2023

Vienna International Center



Somewhere between Policy and Perfection.



Tales from the front line of refrigerant reclaim in the Middle East.



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حماية الطبيعة من طبعنا.



**enviroserve**

Saving the planet. Naturally.















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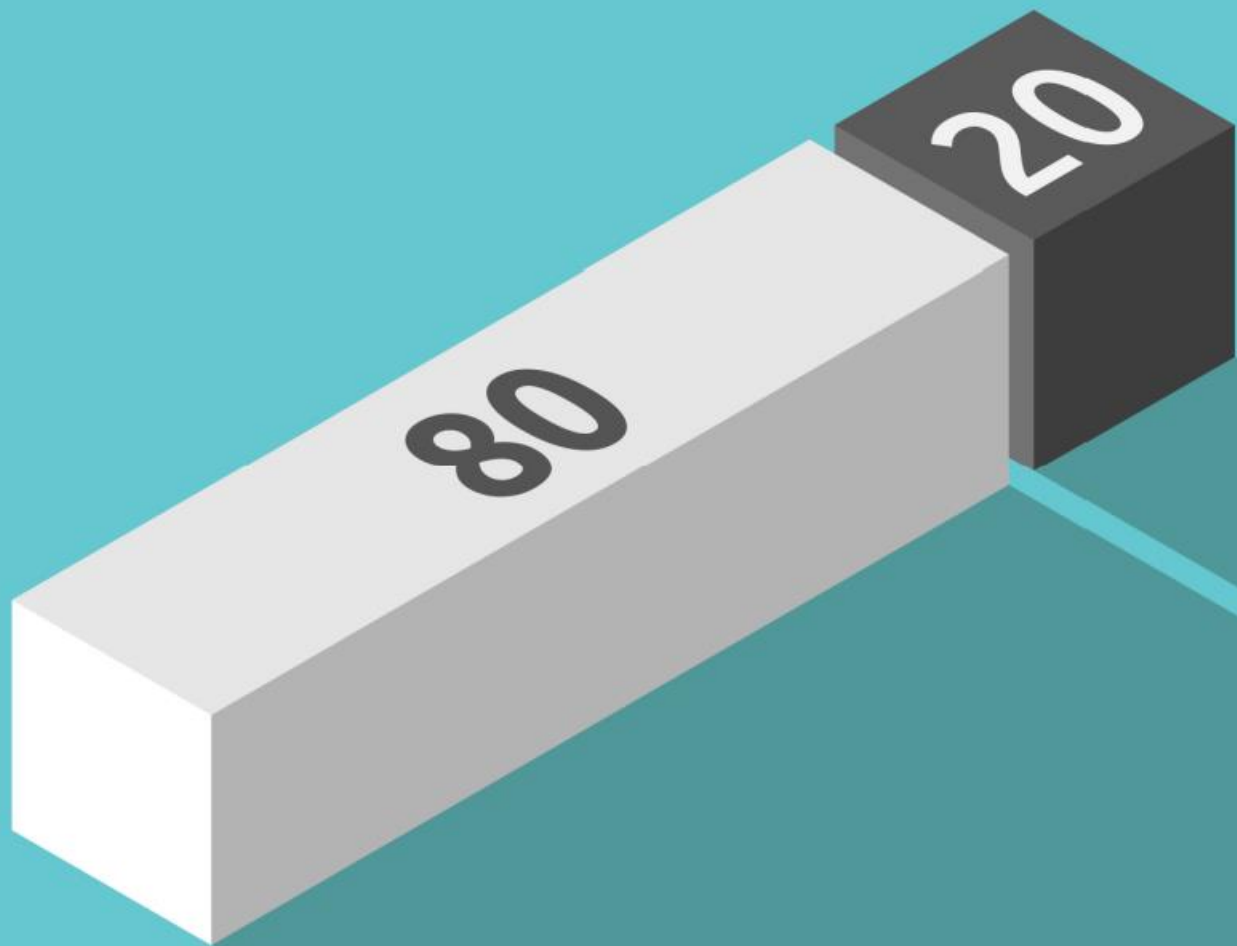






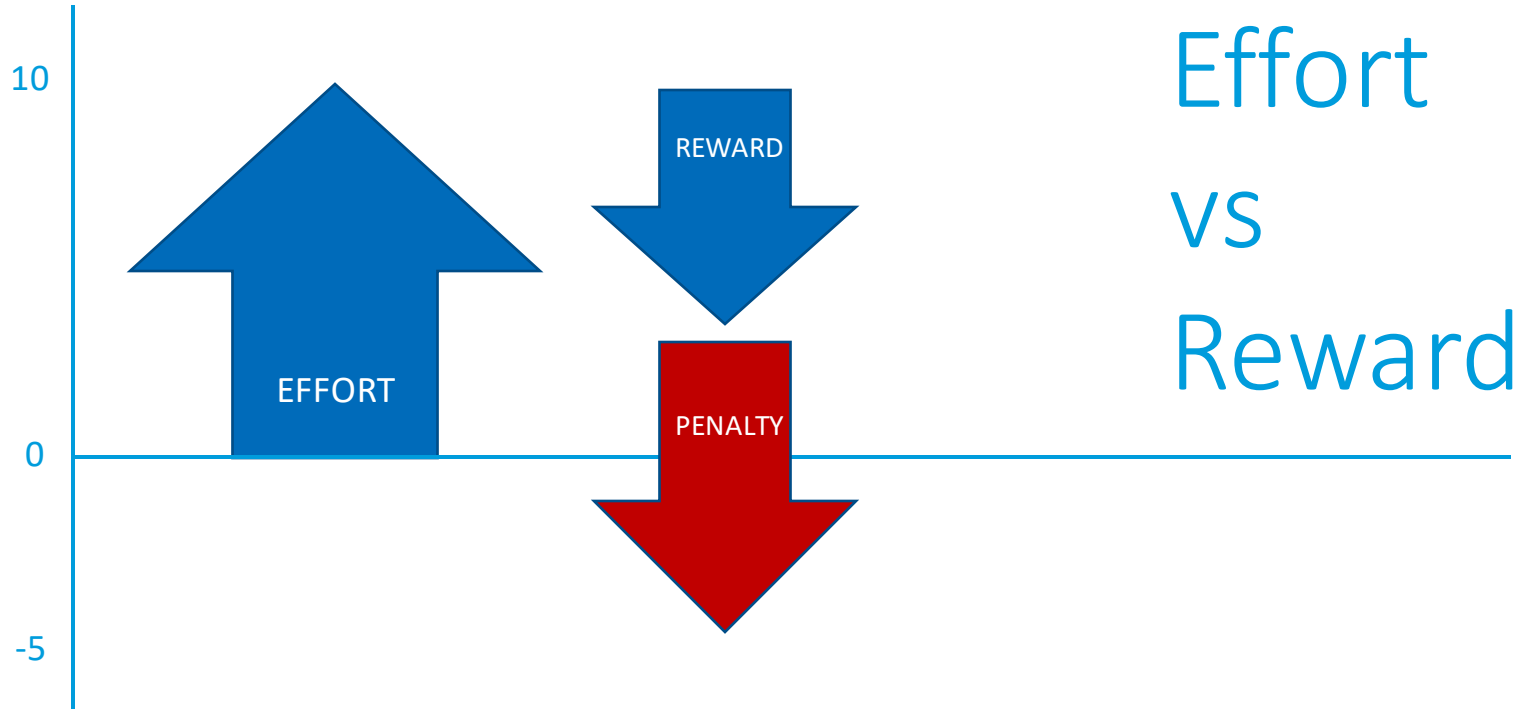














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Effort & Reward... and little force





## Recommendation:

### Stay the Course

- Commitment
- Legislation
- Training
- Certification
- Monitoring
- Enforcement
- Reporting







# Thank You

and see you soon!



## Session Session 8: Recovery, Recycling, and Reclamation and proper end-of-life disposal of refrigerants



**Alan Bastida**  
Expert in Road Map for Kigali  
Amendment,  
UNIDO

Alan Bastida is an enthusiastic and creative professional working for UNIDO. He has 18 years of progressive experience and holds a master's degree in project management and a bachelor's degree in environmental engineering. Prior to joining UNIDO, during 16 years of his professional career, he was part of the National Ozone Unit of Mexico serving as a national focal point and project coordinator, working in collaboration with all implementing and bilateral agencies of the Montreal Protocol.

His work involved the coordination of the HFC implementation projects and related activities such as the conversion from HFC-134a to R-600a in the manufacture of domestic refrigerators at Mabe-Mexico and the conversion from HFC-134a & R-404A to R-290 in the manufacture of stand-alone commercial refrigerators at Imbera. Also, he was involved in the design and technical negotiation of the HFC-23 destruction project at Quimobásicos Plant.

Alan led the design and elaboration of the Kigali Amendment Road Map for Mexico and coordinated the Sustainable and climate-friendly Phase out of ODS project within the country. His work also included the coordination of the Demonstration Project for Disposal of Unwanted ODS in Mexico and the implementation of customs activities to prevent the illegal traffic of controlled substances. He is currently collaborating with UNIDO as an expert on road map for the Kigali Amendment. Since 2021, Alan has been leading the design of the road maps to phase down the HFCs, and the preparation of the Kigali Implementation Plans for Latin American countries.



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## Handling and Disposal of End-of-Life ODS and HFCs



# KIGALI in Acti ON

**ALAN BASTIDA**

June 15, 2023

Vienna International Center





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## End-of-Life ODS and HFCs:

Virgin, recovered or confiscated substances out of specifications that cannot be reused, recycled or reclaimed.



Source: NOU of Guatemala 2023



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# EOL ODS & HFCs





## International and National Regulations

Regulation unwanted ODS and HFCs	Applicable legislation	Description
Handling	Local applicable norms, DOT regulations, EU legislations, and MP guidelines.	Classification and identification.
		Collection and aggregation.
		Packaging and labeling
		Transportation.
Disposal / Destruction	Technology and Economic Assessment Panel of the MP and local applicable norms.	Cement kilns, Argon plasma arc, Liquid injection incineration, Gaseous/Fume Oxidation, Rotary kiln incineration, etc.
		DRE, D&F, HCl, HF, Particulates and CO.
Import and export	Basel & Rotherdam Convention and local applicable norms	Trans-boundary movements of hazardous waste (International treaty).



# Potential EOL ODS & HFCs Banks

**Source 1.**  
**Virgin Liquids & Gases**  
**Stockpiled**



Source: Fluorotech

**Source 2.**  
**Mixed recovered gases**



Source: NOU of Guatemala 2023

**Source 3.**  
**Falsified refrigerant**



Source: UNEP ozone action 2014





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**Source 1.**  
**Virgin Liquids & Gases**

**Banks generated as a result of the prohibitions in the ODS phase-out programs**

**Expired CFC- 11 and CFC-12 stockpiled.**  
**Existing HCFC-141b storage.**



**Source: Fluorotech**



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**Source 2.**  
**Mixed recovered gases**

**CFCs, HCFCs and HFCs  
contaminated or mixed recovered  
from RAC technicians, R&R&R  
centers, End users, EOL appliances  
programs, etc.**



Source: NOU of Bolivia 2023



**Source 3.**  
**Falsified refrigerant**

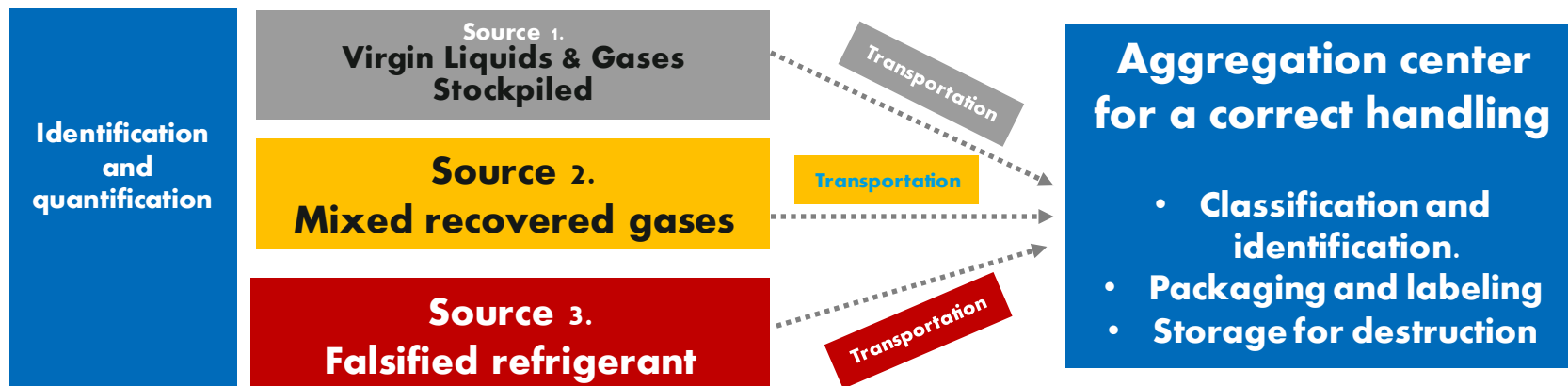
**Falsified HCFCs and HFCs  
contaminated or mixed and  
confiscated by customs  
officers.**





## Handling

### Recommended Approach





List of approved destruction processes under decision XXX/6.

Technology	Diluted sources	
	ODS and HFCs	HFC-23
DRE*	99.99%	99.99%
Cement Kilns	Approved	Not determined
Gaseous/Fume Oxidation	Approved	Approved
Liquid Injection Incineration	Approved	Approved
Porous Thermal Reactor	Approved	Not determined
Reactor Cracking	Approved	Approved
Rotary Kiln Incineration	Approved	Approved
Argon Plasma Arc	Approved	Approved
Nitrogen Plasma Arc	Approved	Approved
Portable Plasma Arc	Approved	Not Determined
Chemical Reaction with H <sub>2</sub> and CO <sub>2</sub>	Approved	Approved
Gas Phase Catalytic De-halogenation	Approved	Not determined
Superheated steam reactor	Approved	Approved



## Options for destruction

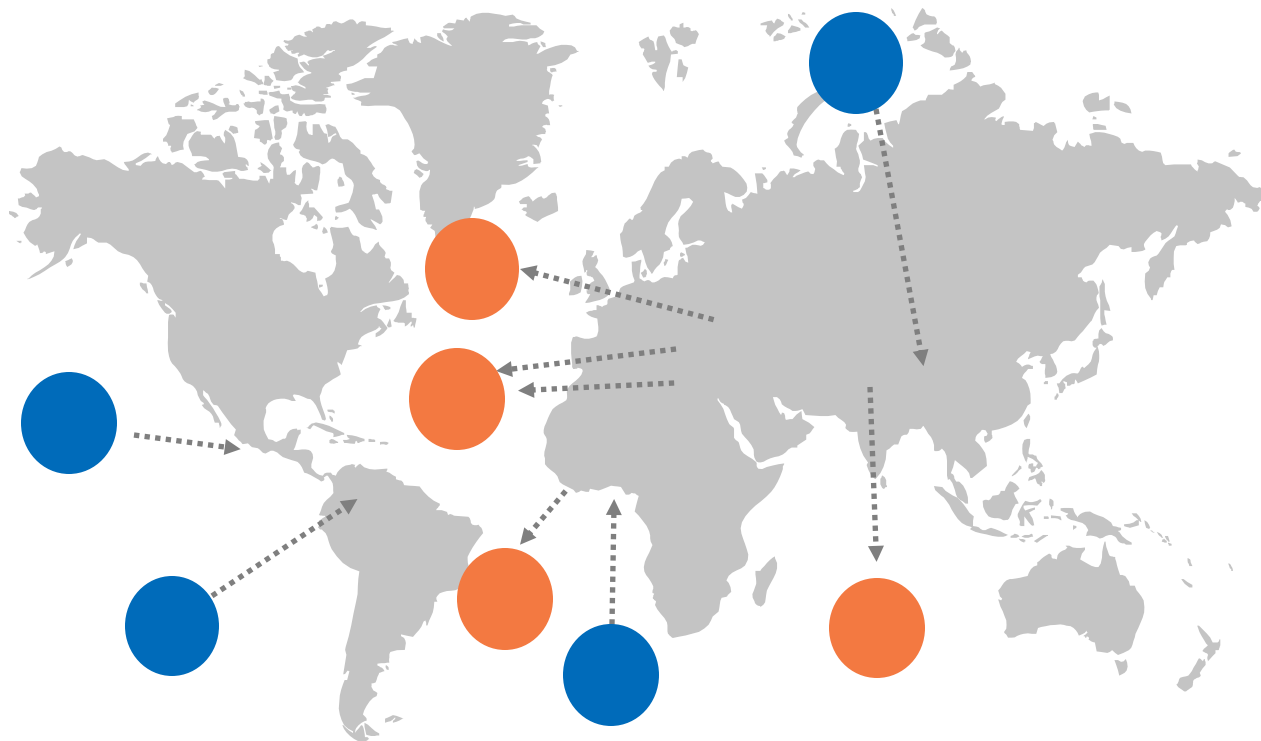




# Completed ODS disposal demonstration MLF projects

## SYNTHESIS REPORT ON THE PILOT ODS DISPOSAL PROJECTS (DECISION 79/18(e))c

The two most common approaches to destroy ODS waste implemented through the pilot projects were domestic destruction through a cement or rotary kiln, or use of plasma arc technology (China, Colombia, Mexico and Nigeria); and exporting the ODS waste to a destruction facility that met international standards (ECA region, Georgia, Ghana, Nepal and Turkey).





## Disposal in cement kiln



### Cement kiln parameters

**Availability of facilities**

**Different plants worldwide**

**Environmental performance**

**DRE >99.99%**

**Technical performance**

**Comply with local and TEAP Emission parameters**

**Destruction rates between 10 to 150 kg/h.**

**Economic performance**

**From 1 to 6 USD per kg**





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# Destruction in Cement Kiln

**Japan**

**Indonesia**

**Costa Rica**

**Ecuador**

**Mexico**

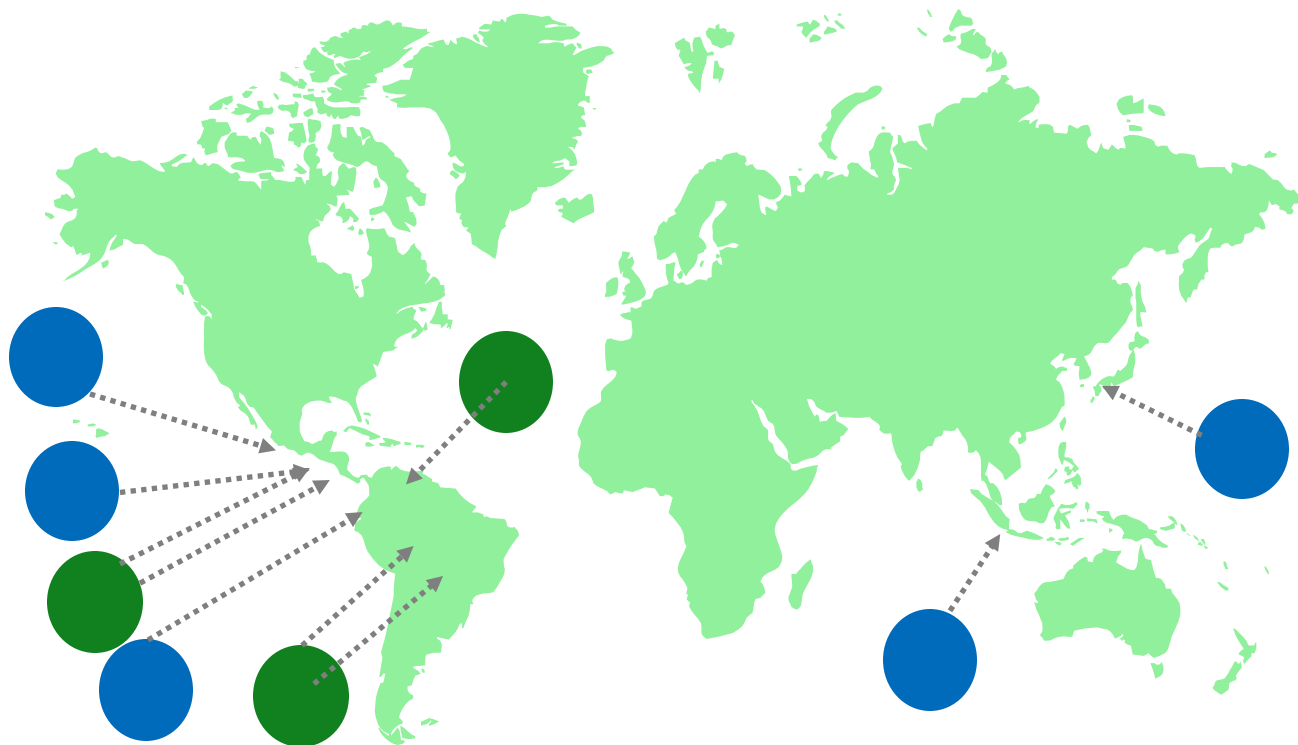
**Venezuela**

**Bolivia**

**Guatemala**

**Honduras**

**Paraguay**





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**The establishment of a sustainable and integral EOL ODS and HFCs management model should include the articulation and strengthening of the MP projects, the commitment of the private sectors and the development and implementation of regulations to promote the recovery and correct handling of MP controlled-substances.**

**The preparation of the KIPs offers an excellent opportunity to design a strategic management plan for all the life cycle management of controlled Substances.**

## Key Lessons learned





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**Thank you for your attention**



**Multilateral  
Fund**  
for the  
Implementation of  
the Montreal Protocol