



UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Montreal
Protocol Unit



46th OEWG meeting

**Side event: Setting the Path Forward Towards
Environmentally Responsible Vehicle Thermal Management
with Future Fluids and System Designs, Including Professional
Service Practices and Equipment**

11 July, 2024 Montreal, Canada

Dr. Yunrui ZHOU, Industrial Development Officer, UNIDO

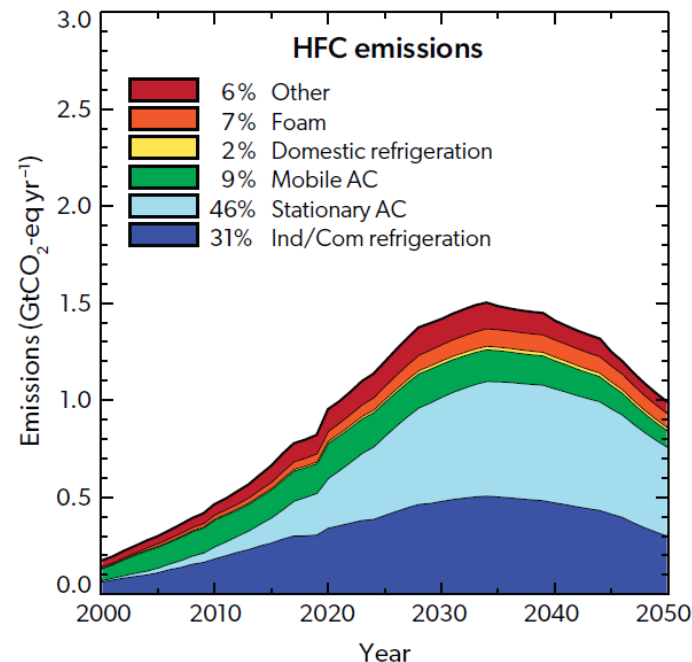
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Global HFC emissions in MAC sector

- Light and heavy-duty vehicles use for 0.3 kg to **1.4 kg refrigerant**, buses up to 16 kg.
- **Today: 1.3 billion road vehicles** ca. worldwide: **1 million tonnes of refrigerant**.
- Mostly and commonly used refrigerants: **HFC-134a and HFO-1234yf**
- **HFC emissions from MAC sector** was estimated as **126 Megatonne CO₂ eq** in 2022 according to the **Scientific Assessment report**, account for **9% of total HFC emissions**.

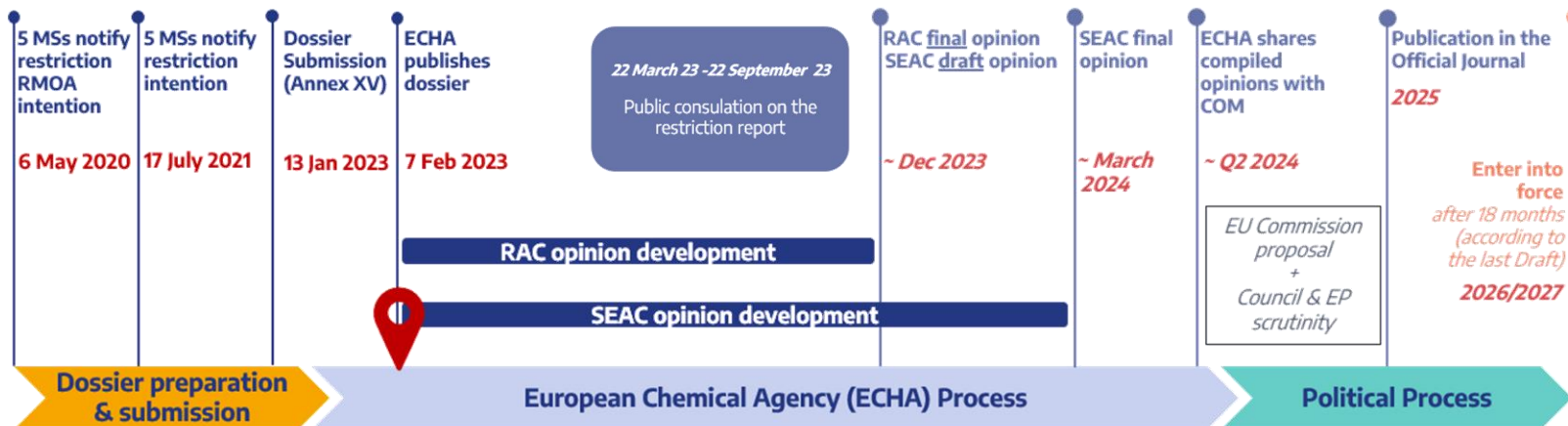


Source: Scientific Assessment of Ozone Depletion: 2022, page 142, WMO and UNEP, Geneva, 2022



Timing of PFAS actions in Europe

PFAS Restriction – Official expected timeline from ECHA



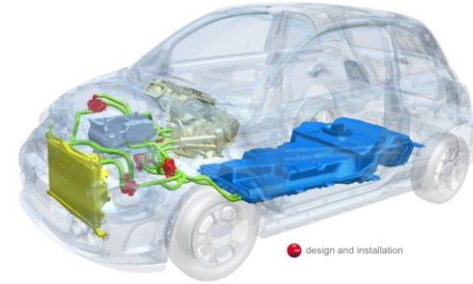
ECHA: European Chemicals Agency
 MS: Member State
 RAC: Risk Assessment Committee
 REACH: Registration, Evaluation, Authorisation, Restriction of Chemicals
 RMOA: Regulatory Management Option Analysis
 SEAC: Socio-Economic Assessment Committee

- Risk of HFC/HFO ban/restriction from 2030
- Industry needs a transition period: new MAC systems on automotive platforms need 8-10 years



Manufacturing Sector: Alternative Technologies

The development and deployment of a new generation of MAC system requires **at least 10 years**: component development and automotive platform adaptation and industrialization



OPTEMUS
OPTEMUS EU project
Demo car

R-744 PROs

(CO₂)



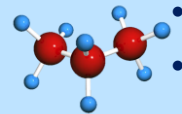
- Natural (no patent)
- Efficient in winter conditions (heat pump)
- Direct and Indirect expansion
- Already in use (low volumes)

CONs

- Expensive
- Requires a new generation of components
- Less efficient in severe summer conditions
- High pressure, difficult electronic leak detection

HC-290 PROs

(Propane)



- Natural (no patent)
- Compatible current HFO/HFC techn. (low cost)
- Efficient in mild/severe conditions

CONs

- Flammable: it requires dual loop
- Less efficient in severe winter (heat pump)
- Not in use



Technical Assistance: MAC servicing sector

- Policy and regulatory framework
 - Ban import/use of HFCs in the MAC sector;
 - Regulations on the trade of vehicles containing HFCs
 - Mandatory inspection of equipment of MAC system
- Capacity building
 - Training of trainers
 - Training and certification mechanism for MAC technicians
 - Provisions of equipment to training institutes
- Awareness raising
 - Awareness-raising champions
 - Outreach materials
- Recovery, Recycling and Reclamation of Refrigerants
 - Establishment of RRR centers and training centers
 - Provision of tools and equipment for RRR
 - RRR guidebook





Case study: Pilot Projects of R-744 & HC-290 Refrigerant Substitution Technology For Electric Vehicles

Objective: is to accelerate traditional and EV, away from HFC-134a to R-744 or HC-290.

Outcomes:

- ❖ Outcome 1: Pilot project for a standardized R744 air-conditioning system for Electric Vehicles in China
- ❖ Outcome 2: Pilot project for updating the HC-290 air-conditioning system for vehicles in India
- ❖ Outcome 3: Dissemination of best environmental practices in the servicing sector

Key stakeholders:

- ❖ Foreign Economic Cooperation Office Ministry of Ecology and Environment of China
- ❖ China Automotive Technology And Research Center CO. Ltd (CATARC).
- ❖ TATA Motors
- ❖ MACs and IGSD

Donor: Climate and Clean Air Coalition

Budget: USD 800,000

Duration: 2 years

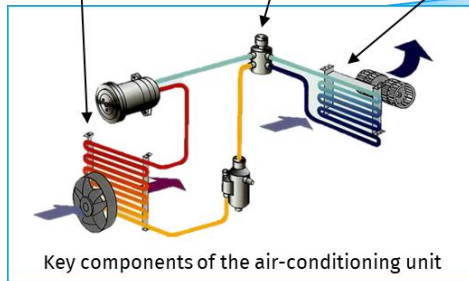


Three prototypes (two R290 based system, one R-744)

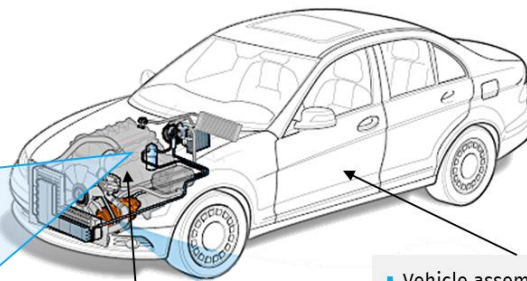
- Efficient heat regenerator development

- Improvement on the seals between joints and pipes

- Efficient heat exchanger development



- Air-conditioning system construction
- Simulation test on system environment
- Control strategy development
- Optimal filling amount development

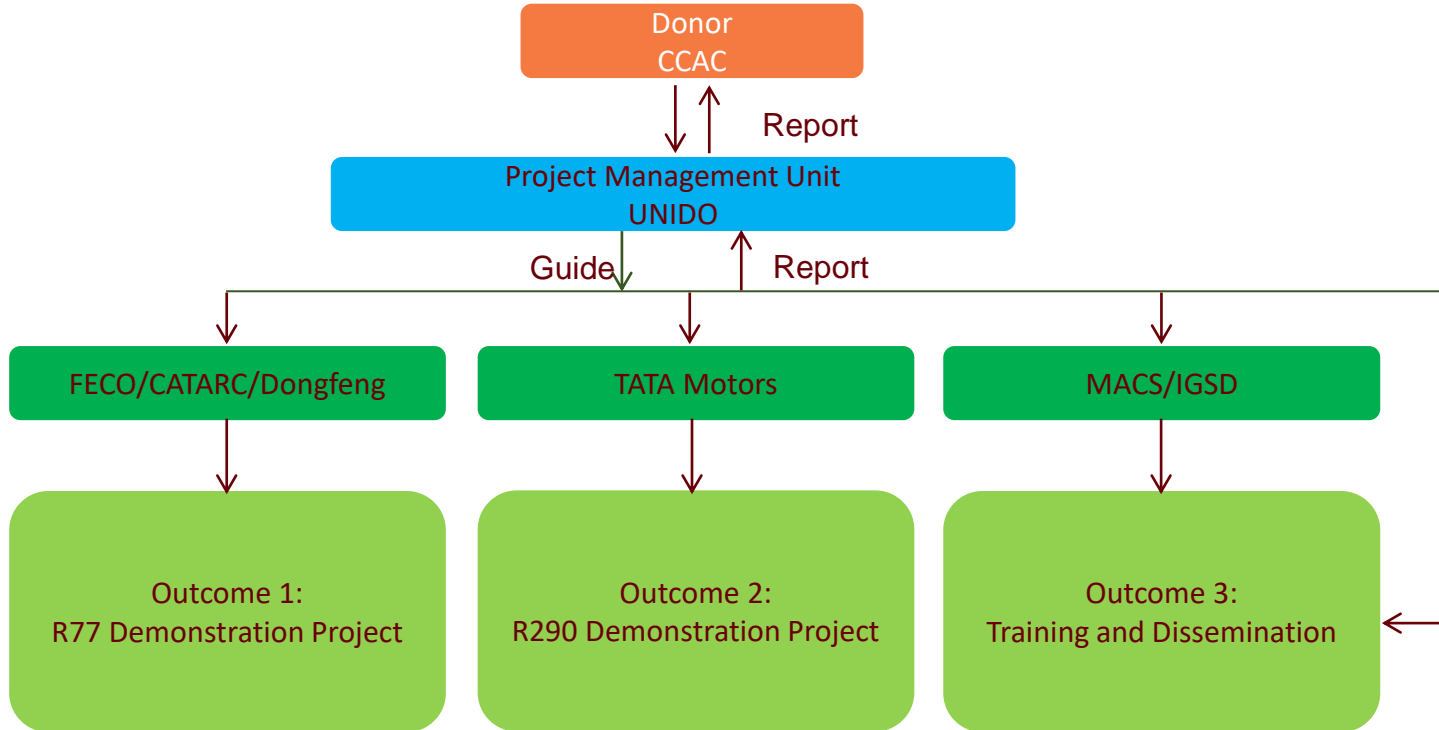


- Vehicle assembly
- Vehicle product calibration
- Vehicle road test





Implementation structure





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THANK YOU!