

I Brief summary of the findings of the 2022 Assessment report:

Assumption

- Kigali Amendment can further mitigate global warming by 0.3 to 0.5 degrees. Synchronous improvements in energy efficiency of Refrigeration Air Conditioning and Heat Pump (RACHP) equipment could double this climate benefit.

Target

- Ensuring that new RACHP equipment is as efficient as possible, and that existing equipment is operated and maintained for high efficiency.

Barriers

- Efficient RACHP equipment is now available but not accessible in all countries.
- Phase-down schedules agreed under Decision XXVIII/2 allow for continued import of high GWP HFCs in RACHP equipment at present. That causes higher direct emissions over time, while those old equipment run inefficient compared to new technologies.
- Minimum energy performance standards are missing in many countries.
- Electricity generation carbon emissions factors differ between countries influencing mitigation potential of energy efficiency.

Potential solutions

- Early action through the Kigali Implementation Plans that enable A5 parties transition to new generation RACHP equipment (in a cost-effective way)?
- Adopting policies such as MEPS that require energy-efficient technologies.
- Both exporting and importing countries agree on a certain energy performance of equipment.
- Training of installation, servicing and maintenance to meet energy efficiency levels of new and existing equipment.
- Agree on framework to measure how enhanced energy efficiency of equipment contribute to reduced cumulative GHG emissions taking electricity generation carbon emission factors in account.

II Summary of supplementary EE Report and potential questions:

Chapter 2: Energy Efficiency: a System Approach

TEAP highlighted that in order to decarbonise heating and cooling in a cost-efficient manner, energy efficiency needs to go beyond a pure product-based approach.

Q: How could the Montreal Protocol (Parties, Secretariat and Scientific Assessment panels) support such a (needed) systemic approach to decarbonise heating and cooling in a cost effective manner?

Q: Could TEAP provide some examples of how the energy efficiency could be enhanced while phasing down HFC and what role the Montreal Protocol could potentially play in implementing such energy-saving measures?

TEAP mentioned that RACHP and MAC equipment below the global average efficiency levels are still being manufactured and sold posing a problem to the adoption, implementation, and compliance of Minimum Energy Efficiency Performance Standards (MEPS) in many countries.

Q: How could the Montreal Protocol react to this?

TEAP highlighted that governments, industry, academia and finance need to work together to decarbonise the cold chain, which includes (apart from energy efficient equipment and low GWP refrigerants) renewables-based electricity generation and increased use of electric vehicles.

Q: How could the Montreal Protocol contribute to this cross-sectoral approach that requires “system-level thinking”?

TEAP highlights that Implementing building codes and regulations, working with industry associations and standards bodies, and considering lifecycle costs are all critical for encouraging the adoption of energy-efficient equipment.

Q: What role can the Montreal Protocol community play to implementing building codes and regulations that are key to enable energy efficiency gains?

Chapter 3: Energy Efficiency Associated with Improvements in Foams

TEAP states in its report that HFO blowing agents are significantly more expensive than hydrocarbons. We seek to understand why HFO is an option even though they are more expensive than other low GWP alternatives such as hydrocarbons.

Q: Could you explain how the thermal conductivities of blowing agents such as HFO and hydrocarbons influence the overall energy performance of buildings? How important is the blowing agent in the overall energy performance calculation? What is the relationship to other factors such as the building concept etc.?

Chapter 4: Availability, accessibility and cost of equipment containing low- or zero-global-warming-potential refrigerants

TEAP states that

- RACHP and MAC equipment below global average efficiency levels are still being manufactured and sold posing a problem to the adoption, implementation, and compliance of Minimum Energy Efficiency Performance Standards (MEPS) in many countries.

- The availability of high energy efficiency technology in manufacturing countries does not automatically result in accessibility at the importing countries
- Upgrading technicians' capacity and awareness of customers could help in achieving the energy efficiency benefits.

Chapter 5: Testing equipment and procedures for validation of energy efficiency claims to enforce minimum energy efficiency standards and labels, and voluntary labelling programmes

TEAP highlights that energy test methods are central to appliance standards and labelling programs to validate efficiency claims by manufacturers before products enter markets, while certifying and enforcing compliance is critical to safeguard climate and cost savings.

Q: How could the Montreal Protocol and its bodies contribute to robust, cost-effective, and well-rounded compliance processes that protect markets from inefficient and low-quality products?

Chapter 6: Barriers to consumer and business acceptance of the adoption of more energy-efficient products and equipment containing low- or zero-global-warmingpotential refrigerants, including barriers related to electrical compatibility of such products and equipment, and possible solutions for sustainable transition to such products and equipment

TEAP highlights that dumping of low energy efficient products in low-income countries coupled with the lack of knowledge and higher cost of purchase of energy efficient products contribute greatly to their low uptake.

Q: How could the Montreal Protocol and its bodies help to overcome barriers?

TEAP: Barriers to the introduction of EE RACHP equipment can be overcome by:

- education and consumer awareness campaigns,
- reducing the investment risk through incentive schemes such as rebates and innovative financial mechanisms for the consumer,
- stringent regulations and enforcement such as bans on the import of used equipment and products; the development of regulatory frameworks including MEPS for new and used equipment; investment in testing to provide consistency and clarity for consumers and businesses
- upgrading/ developing of training materials/ programs for RACHP technicians in vocational institutions and national associations, to incorporate the specialised knowledge and skills needed to install and maintain EE refrigeration systems.

Chapter 7: Analysis of the potential benefits of introducing more energy-efficient refrigeration, air-conditioning and heat pump equipment, including costs and related

climate benefits while phasing down HFCs

TEAP highlights that reduction in the indirect energy related CO₂ emissions from RACHP systems will be driven by efforts to reduce cooling demand (e.g., through better building design), improved equipment efficiency and improved operation and maintenance. The decarbonisation of the electricity supply is also a crucial factor.

Q: What role can the Montreal Protocol play to address the factors that influence the energy efficiency?

TEAP highlights that modelling the costs of energy efficiency improvement can be difficult.

Q: How could you measure actual climate benefits resulting from energy efficiency measures such as improving the equipment efficiency?

Chapter 8: The range of, and trends, in refrigerants' global warming potential and energy efficiency of refrigeration, air-conditioning and heat pump equipment, for which there are available data

TEAP states that there is a general trend toward increasing adoption of Minimum Energy Performance Standards (MEPS) and Labelling programs globally for RACHP equipment, while highlighting that many Parties lack regulatory capacity and testing infrastructure to design, implement and enforce stringent MEPS programs.

Q: How could the Montreal Protocol enhance the capacity and testing infrastructure to design, implement and enforce stringent MEPS programs?

TEAP states that costs of more efficient equipment and components tend to come down over time as a new technology becomes mainstream and due to economies of scale.

Q: How big will be the price differences when energy efficient technology becomes mainstream? What are the parts that are more expensive of a EE AC/heat pump/refrigerator?

Chapter 9: Estimation for EE Cost while Phasing Down HFCs

TEAP presents additional costs associated with improving the energy efficiency of equipment alongside conversion to HFC alternatives as Additional Capital Cost (ACC) and Additional Operating Cost (AOC) to differentiate from the Incremental Capital Cost and Incremental Operating Cost.

III General Assessment

- **Efficiency Improvement-Linked Incentives** is an interesting approach (see also short background below) that should be further developed. It applies the opportunity costs for acquiring EE technologies, rather than the incremental cost principle. This model should be suitable for introduction of sustainable energy efficient cooling technologies replacing HFCs. Until now the MLF has gained only limited experience with incentive systems mainly in end user programs. Those experiences have shown that local markets have their own rules, making it quite complex to introduce incentive schemes. It is important that the model is adaptable to the specifics of consumer and market behavior in individual countries.
- EE can be under certain circumstances a strong **incentive for consumers** to buy specific equipment, e.g. with superior climate and environmental characteristics. Limiting EE to eco and climate sustainable refrigerants (< GWP 150) could avoid the lock-in of equipment with refrigerants that are only medium term “solutions” as they are regulated under the Montreal Protocol.
- It is not clear what is meant by the term **low GWP refrigerants**. In this respect we think it is important to seek a common understanding, as low GWP refrigerants in A5 may be considered as high GWP refrigerants in Europe.
- There is reported evidence from the HPMP and literature indicating that average **leakage** from RAC and MAC in the A5 could be up to 20 times higher compared to Non-A5. This is not just a matter of maintenance, but of harsh climatic and operational conditions and the quality of products and their installation. If not taken into account, any assumption on the **LCCP** remains obsolete.
- **Integration with the HFC Phase down:** It is argued at various places in the report that HFC phase down and energy efficiency should be mutually supportive. However, the document lacks practical guidance on how energy efficiency could enhance and accelerate the phase down of HFCs in sustainable manner.
- **MRV:** There is no reference to relevant processes under the UNFCCC and existing methodologies for assessing the impact of EE and CO₂ mitigation. Parties of the UNFCCC have invested many efforts to develop methodologies and assist parties on their reporting processes, this should be given it due consideration.
- **Cooperation** with multilateral, national and local institutions is of enormous importance and should be institutionalized.
- **Sustainability:** There are more than 20 references to sustainability in the document, which is a very important aspect. However, a clear definition also in the context of EE is missing. EU should work on our understanding in order to be able set conditions.

Background: Further discussion on Efficiency Improvement-Linked Incentives

- TEAP EEWG proposes to link EE funding to the level of efficiency improvement, compared with the best-available technology (BAT):
- This could be an interesting approach.
- This approach could potentially also be used for introducing “sustainable = PFAS free” energy efficient cooling technologies replacing HFCs/HCFCs
- Idea: Improvements from lowest efficiency to higher efficiency and future proven (sustainable) technologies (refrigerants) would receive a greater incentive.
- if we cannot agree on naturals as “sustainable” (future proven), we could agree that “substances regulated under the Montreal Protocol” should not receive highest incentive in such a funding scheme
- Until now the MLF has gained only limited experience with incentive systems, but experiences have shown that it is important that the applied model also reflects the specifics of the receiving countries.