ENOUGH
EUROPEAN FOOD CHAIN SUPPLY TO REDUCE GHG EMISSIONS BY 2050

Factsheet 7
May 2023

# Environmental impact of a natural refrigerant (R744) and HFC (R134a) in transport refrigeration units

**Life cycle comparative approach**

The overall carbon footprint of a refrigeration system can be divided into direct emissions caused by refrigerant leakage, and indirect emissions caused by energy consumption and evaluated as $CO_2$ equivalent emissions.

Main result: Because of the large influence of direct emissions on the R134a unit's lifetime carbon footprint, the R744 unit had a significantly lower carbon footprint than the R134a unit (-26.2% of total lifetime $CO_2$ eq emissions).

In this study, the lifetime carbon footprint of two units was compared: one using a synthetic refrigerant (HFC – R134a), the other using a natural refrigerant ($CO_2$ – R744). Both units were designed to provide Medium-Temperature (MT) refrigeration in a medium size van for the preservation of fresh or perishable goods during road transport applications in urban environment.

A dynamic numerical modelling approach was used to evaluate the monthly performance and energy demand of both units employed in urban multi-drop delivery missions.

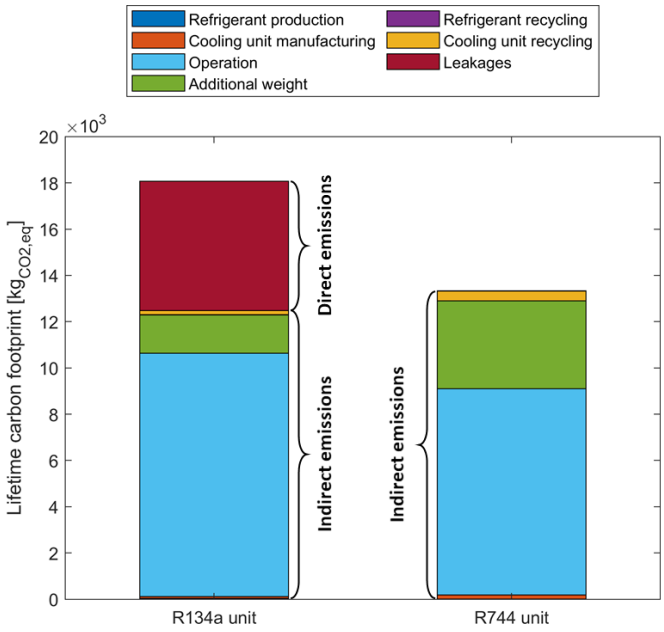
During on-road operations, the environmental impact was assessed in terms of both direct and indirect (higher COP) contributions.

**Direct emissions:**

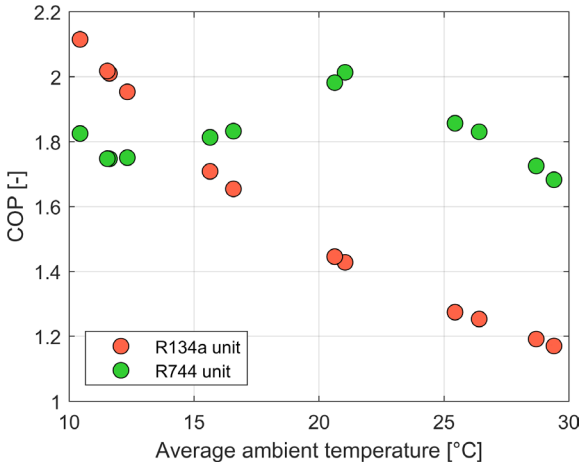
- The insignificant GWP of R744 led to almost null direct emissions whereas 30.9% of the total carbon footprint of the R134a unit was linked to refrigerant leakage, due to its high GWP.

**Indirect emissions:**

- Most of the lifetime carbon footprint of both units was linked to energy consumption during operation: 58.2% for the R134a unit and 66.9% for the R744 unit.
- The R744 unit had a higher COP during the hottest months of the year.
- The R744 unit mission COP was 27.5% higher than the R134a one on an annual basis, even though the COP of the R744 unit decreased during the coldest months of the year due to low duty cycle.




**Total life time carbon footprint of the R134a cooling unit and the R744 cooling unit**




**Average delivery mission COP for the R134a and the R744 cooling units as function of average ambient temperature**

*Find more about this study from the original publication: 10.18462/iir.nh3-co2.2023.0033*

ENOUGH webpage: https://enough-emissions.eu/
Authors: Francesco FABRIS, Monica FABRIZIO, Sergio MARINETTI, Antonio ROSSETTI, Silvia MINETTO.
Corresponding author: fabris@itc.cnr.it

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