

EFFICIENCY AND RENEWABLE COOLING

ENERGY EFFICIENCY: THE NEW ISSUE

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Until the Paris agreement (2015) and the Kigali amendment (2016) related to the phase down of hydrofluorocarbons, attention was focused on refrigerants and their impact on the stratospheric ozone layer and on climate change. The refrigerants issue should thus be largely solved. But the energy consumption of refrigeration systems is still huge and it is thus now our main challenge.

Refrigeration, including air conditioning, represents more than 17% of the overall electricity used worldwide (IIR IN, 2015). According to our latest estimations (future IN, 2019), this figure should be about 20%.

Chart 1: Distribution of the global refrigeration sector's electricity consumption (%)

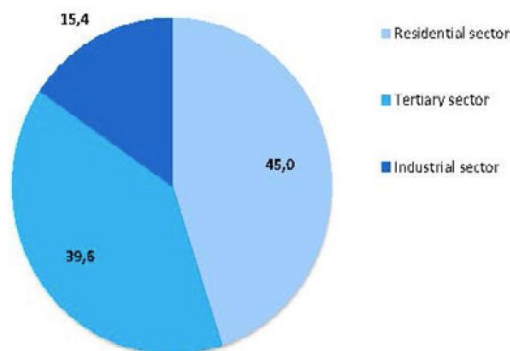


Chart 1 shows the distribution of the global refrigeration sector's electricity consumption between the residential, tertiary and industrial uses (as estimated by the IIR).

Chart 2: Distribution of electricity consumption for refrigeration (kWh/year/capita) between world regions*

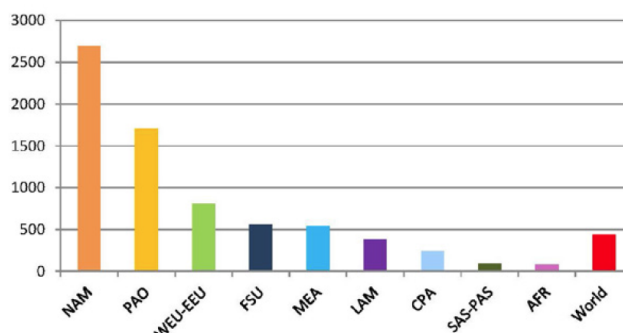


Chart 2 demonstrates differences in the refrigeration-sector electricity consumption regions with different development levels and climatic conditions.

Globally, 440 kWh/year/capita are spent for refrigeration purposes; however, this figure varies from 76 in Sub-Saharan Africa to 2,697 in North America.

NAM: North America

PAO: Pacific OECD

WEU-EEU: Western, Central and Eastern Europe

FSU: Independent states of the former Soviet Union

MEA: Middle East and North Africa

LAM: Latin America and the Caribbean

CPA: Centrally planned Asia and China

SAS-PAS: South Asia – Other Pacific Asia

AFR: Sub-Saharan Africa

* According to IPCC definition of SRES World Regions ⁽¹⁷⁾

This 20% figure is constantly rising.

- Electricity is mainly produced from fossil fuels, and indirect CO₂ emissions have a higher impact from a long-term perspective than refrigerant emissions: they constitute **63% of greenhouse gas emissions related to the refrigeration sector, which represents 7.8% of global greenhouse gas emissions** (IIR Informatory Note).
- We can use renewable energy or waste energy, co- or trigeneration
- We can improve the energy efficiency of systems:
 - Insulation
 - Choosing a refrigerant and a system with a better efficiency: choice of lubricant; compressor, expansion devices, evaporators, interconnecting piping designs
 - Reducing refrigerant leakage and refrigerant charge
 - Labelling and banning equipment: the average efficiency of an Indian AC is far below those of Europe, the USA and even China (1/3 less efficient than in China)
 - Better control

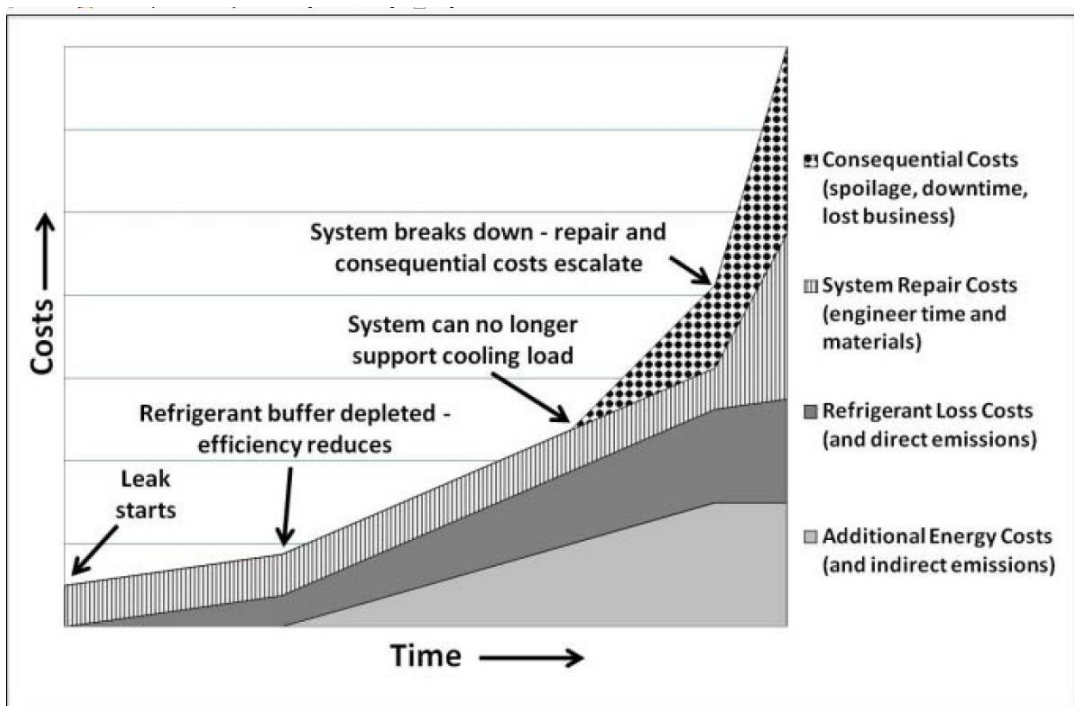
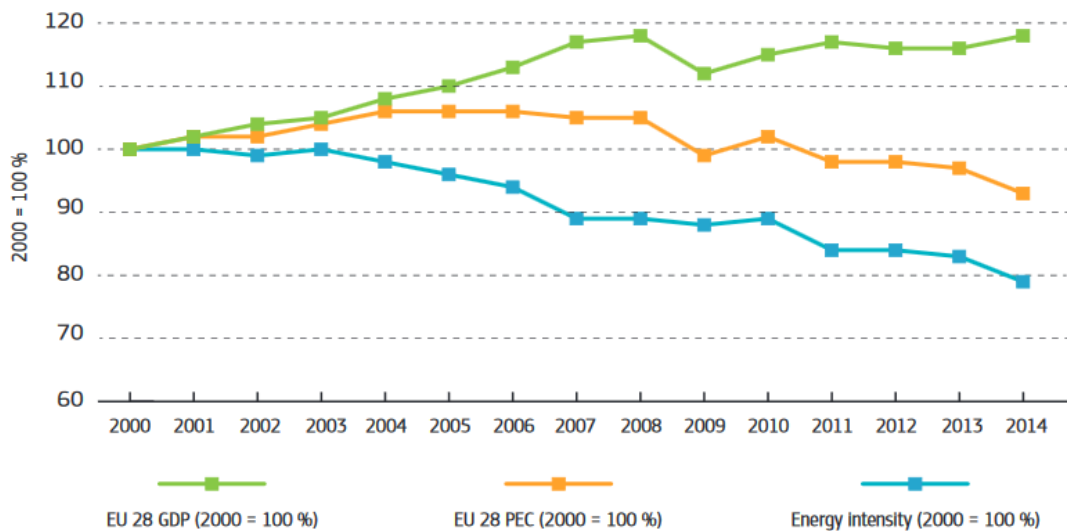


Figure 1 . Escalating cost of an unchecked refrigeration system leak⁸

Improvements of 20-30% are still possible. The EU case:

Figure 2: Gross Domestic Product (GDP), Primary Energy Consumption (PEC) and energy intensity in the European Union from 2000 to 2014



Source: Eurostat

(1) Energy intensity is the primary energy consumption divided by GDP.

Conclusions:

- Reducing the energy consumption impacts of all refrigeration systems is necessary. It becomes a major challenge all over the world. Just like more and more countries, the IEA and the UN are now considering that the increasing energy needs of air conditioning and the cold chain are not sustainable.
- Using renewable energies is a solution (solar energy, evaporative cooling, ...), but decarbonising the energy production will take time: we thus need to increase the energy efficiency of refrigeration systems: components as well as whole systems (district cooling, buildings, vehicles...)
- The Paris agreement (2015) on climate change is based on national strategies. These strategies shall soon be reviewed: the energy consumption of refrigeration systems, especially air conditioning should be part of these strategies.
- The phase-out of HCFCs shall be achieved in 2030 and the phase-down of HFCs has already begun. General frameworks are being adopted. Some measures still have to be adopted, especially regarding subsidies in developing countries for HVACR projects: the energy efficiency of the new systems should be a criteria for the selection and the level of the subsidies: there should be a new policy for the Multilateral Fund (MLF).
- The cold chain must be improved in order to reduce post-harvest losses without heating the planet: new IIR Informatory Notes in preparation for this topic.
- The coordination among the various policies, at national, regional, (ie. the EU), international levels must be improved.

- Some measures should be soon adopted (labelling of small air conditioning units...).
- Research and development of new systems should be developed. More information via publications, conferences and congresses is needed
- Training is necessary.

Refrigeration is necessary for life and its use will continue to grow.

Environmental issues are still challenging, but solutions already exist
or will be developed for a sustainable development:
the sector has already proven its adaptability