

Towards energy-efficient HVAC&R equipment and enhanced building efficiency

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Philipp Munzinger
Project Manager, GIZ Proklima

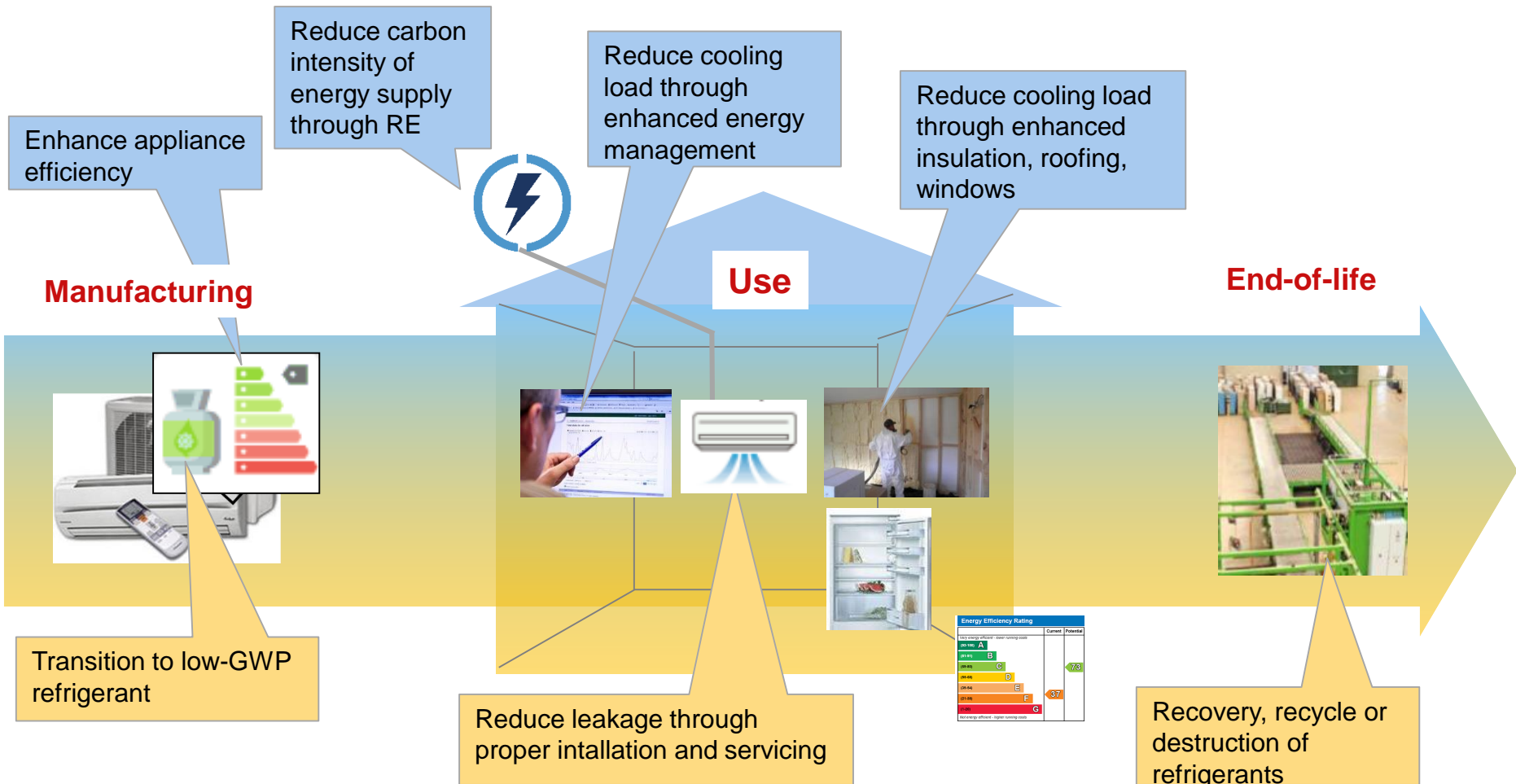


Energy Efficiency in buildings – global trends

- Buildings, including activities within them, accounted for approximately 32% of final energy consumption worldwide in 2014 (IEA 2016)
- More than half of this energy demand comes from heating and cooling, whilst the remainder is accounted for by lighting, appliances and cooking.
- Buildings are responsible for 18.4% of global GHG emissions and represent the single largest contributor to indirect emissions (Riahi 2014).
- Energy demand in buildings is set to increase by 50% by 2050. This will be accompanied by a growth in the number of building-related appliances and use of air-conditioning (IEA 2016) as living standards improve.



HVAC&R equipment and building efficiency

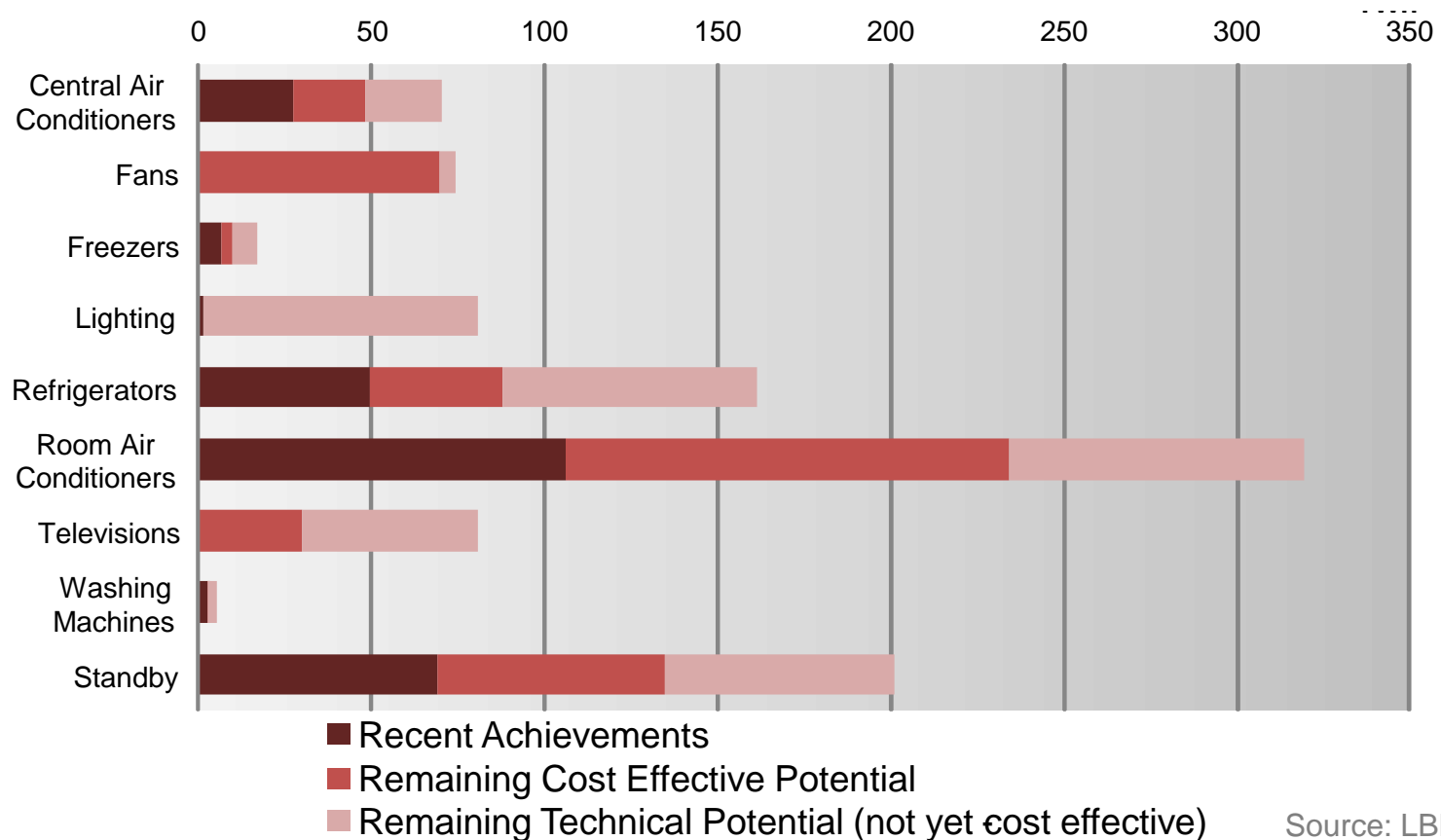


= Reduction of direct emissions: refrigerant avoidance

= Reduction of indirect emissions (energy efficiency)



Energy saving potential by appliance in major economies by 2030



Source: LBNL
BUENAS



Energy Performance of Buildings Directive (EPBD)

- Currently, the 2010 [Energy Performance of Buildings Directive](#) and the 2012 [Energy Efficiency Directive](#) are the EU's main legislation covering the reduction of the energy consumption of buildings.
- **Objective:** Efficient, careful, rational and sustainable use of energy.

Mineral oil, Petroleum gas and solid fuels are recently the most important energy sources but they also cause the majority of GHG emissions.



Energy Performance of Buildings Directive (EPBD)

Energy Performance of Buildings Directive - EPBD Recast (Directive 2010/31/EU):

- Establishes requirement for all new buildings must be **nearly zero energy buildings** by 31 December 2020 (public buildings by 31 December 2018)
- Agrees a **definition** of very low energy building as: "nearly zero energy building"- NZEB. It means a building that has a very high energy performance
- Sets out a **harmonised calculation methodology** for minimum energy performance requirements towards a cost-optimal level
- Requires **monitoring** strategies to ensure that an **Energy Performance Certificate** is issued when buildings are constructed, sold or rented out and penalties for non-compliance



Energy Performance of Buildings Directive (EPBD)

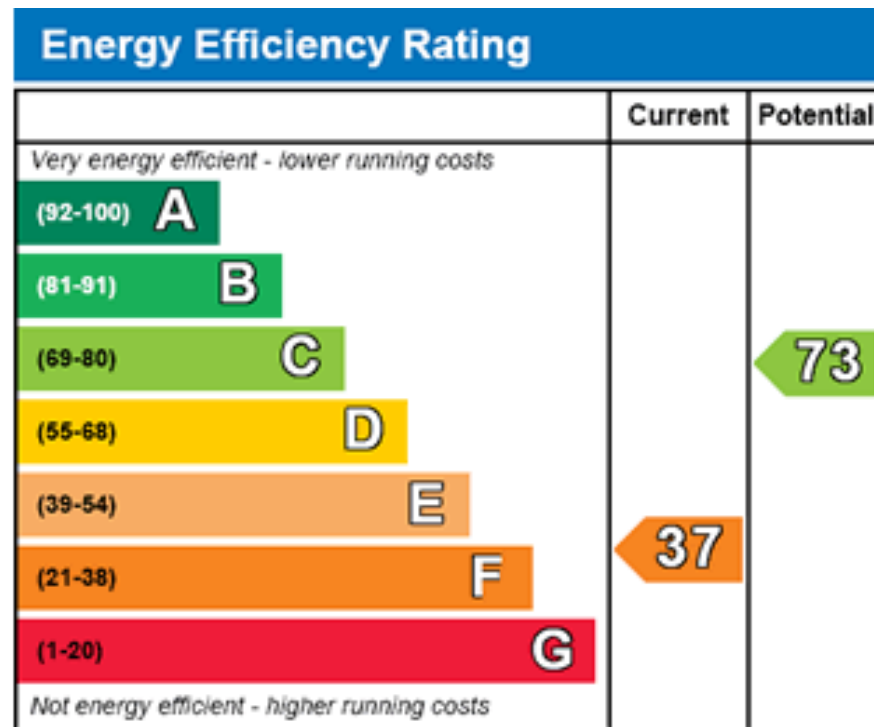
- energy performance certificates are to be included in all advertisements for the sale or rental of buildings
- establishes **inspection schemes for heating and air conditioning systems** or put in place measures with equivalent effect
- sets **minimum energy performance requirements for new buildings**, for the major renovation of buildings, and for the replacement or retrofit of building elements (heating and cooling systems, roofs, walls and so on)
- EU countries have to **draw up lists of national financial measures** to improve the energy efficiency of buildings.
- EU countries make energy efficient renovations to at least 3% of buildings owned and occupied by central government
- EU governments should only purchase buildings which are highly energy efficient



Energy Performance of Buildings Directive (EPBD)

Energy Efficiency Rating

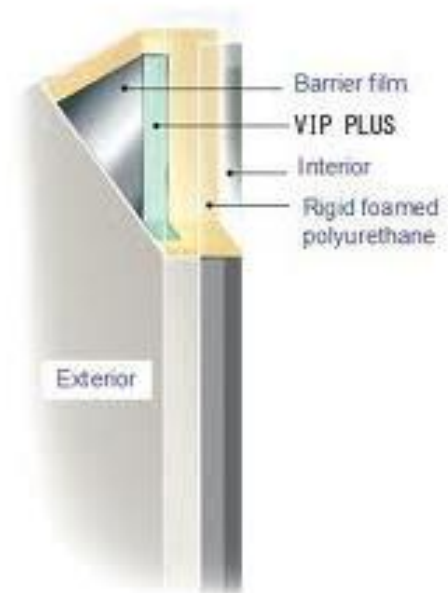
- Categories A-G giving $W/m^2 \cdot yr$
- Information about current status and potential improvement
- Obligatory for every house/apartment (for rent/sale)





1. Reducing Cooling demand in buildings

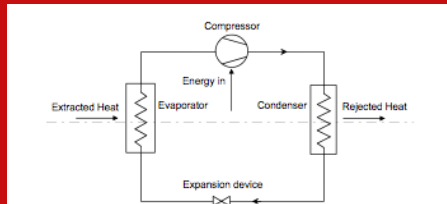
- In buildings, conduction of heat takes place through the roof, walls and windows.
- Less controlled heat transfer results in increased cooling demand load to maintain thermal comfort, which again increases energy consumption of RAC equipment
- Not directly related to efficiency, but can reduce energy use
 - Quality of insulation
 - Amount of infiltration
 - Solar gain
 - Electrical loads
 - Product temperature
 - Use patterns



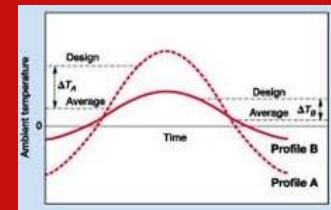


2. Reducing energy consumption of HVAC&R equipment

Improve the Refrigeration Cycle



Optimize Transient Effects



Behavioural Changes



Reduce Parasitic Losses



Servicing/ Training





3. Introduce low GWP alternatives for refrigeration appliances' and building insulation

Substance	ODP	GWP
CFC-11	1	4,680
HCFC-141b	0.11	713
HCFC-22	0.055	1,780
HFC 134a	0	1,410
HFC-152a	0	122
HFC-227ea	0	3,140
HFC-245fa	0	1,020
HFC-365mfc	0	780
n-pentane	0	<25
iso-pentane	0	<25
c-pentane	0	<25
CO2	0	1



4. Introduce low GWP alternatives as refrigerants in RAC appliances



Domestic Refrigeration

Commercial Refrigeration

Industrial Refrigeration

AC

Foams



HC



**CO2/
HC**



NH3



HC



**CO2/
HC**



Example: Green Cooling Roadmap for Jetwing Hotels Group, Sri Lanka

- Refrigeration and AC is responsible for more than 50% of energy consumption in hotel buildings
- High electricity rates led Jetwing to to install renewable energy based cooling system
- Green Cooling Roadmap introduces strategic steps and set of measures towards low carbon buildings:



Reduce Cooling
Load

Transition to
enhanced appliance
efficiency

Transition to low GWP
refrigerants

Introduce renewable
energy sources for
cooling

- Access here: [Green Cooling Roadmap for Jetwing Hotel Group](#)



Thank you for your attention!

Contact: Philipp.Munzinger@giz.de

On behalf of



Federal Ministry for the
Environment, Nature Conservation
and Nuclear Safety

of the Federal Republic of Germany