

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

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for National Ozone Officers  
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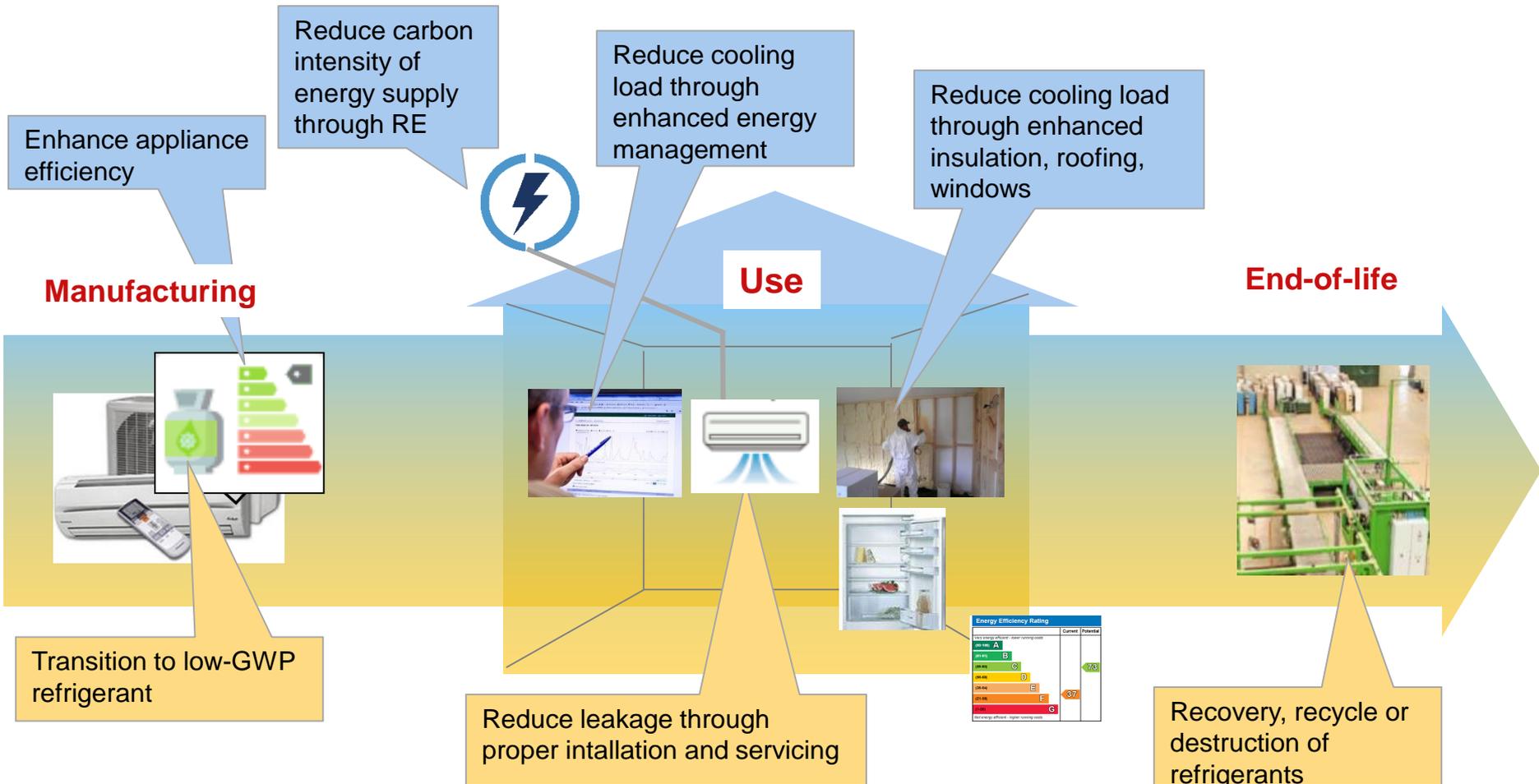


## Energy Efficiency in buildings – global trends

- 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

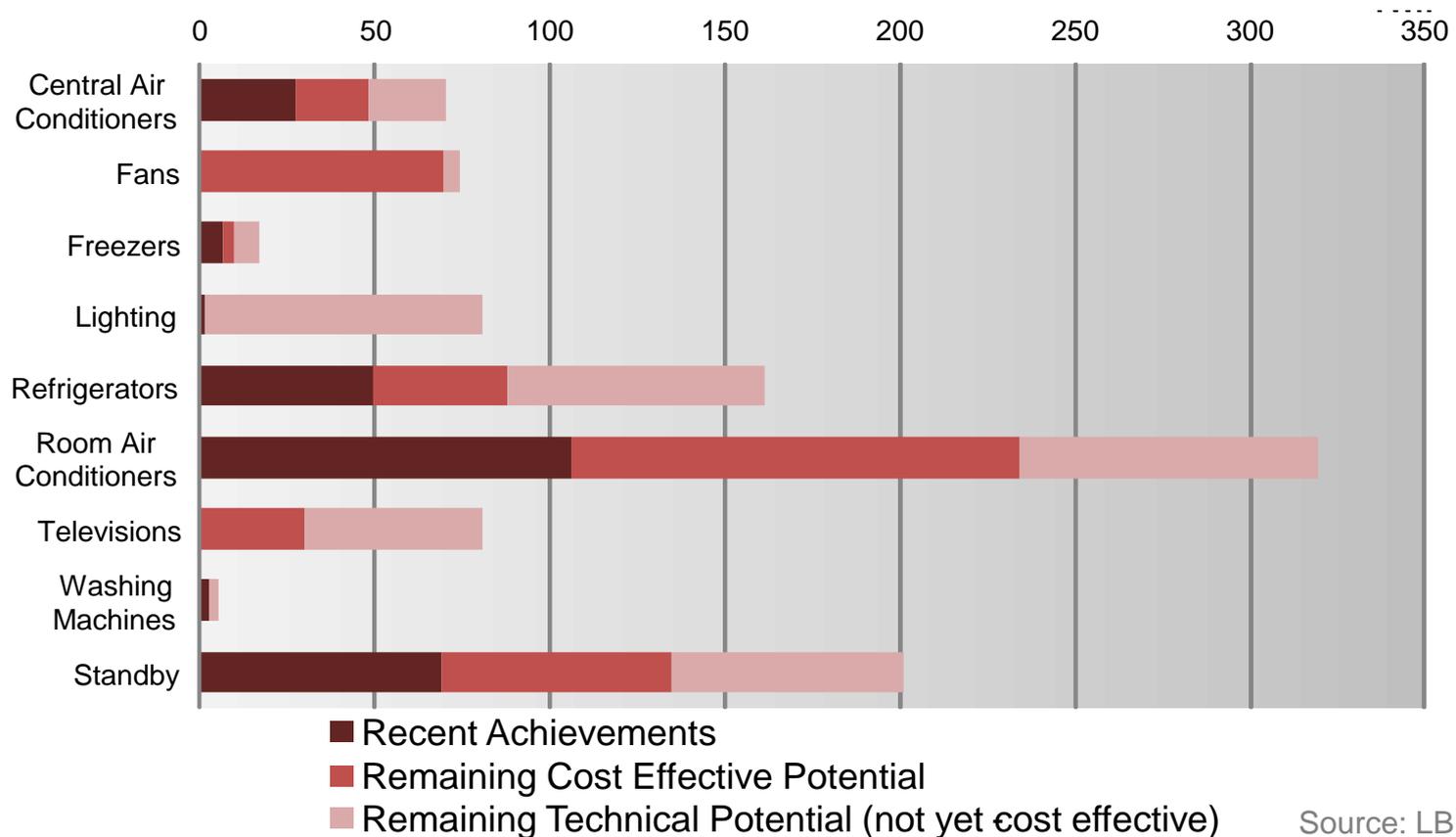


Energy Efficiency Rating	Current	Possible
A		
B		
C		
D		
E		
F		
G		

= 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)

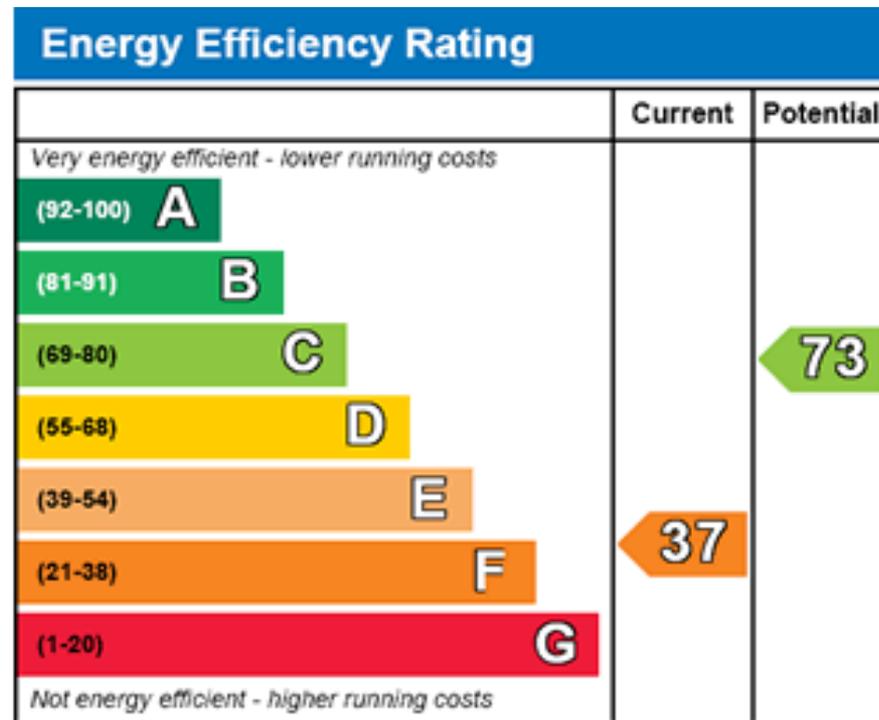
- energy performance certificates are to be included in all advertisements for the sale or rental of buildings
- establishes **inspection schemes for heating and air conditioning systems** or put in place measures with equivalent effect
- sets **minimum energy performance requirements for new buildings**, 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

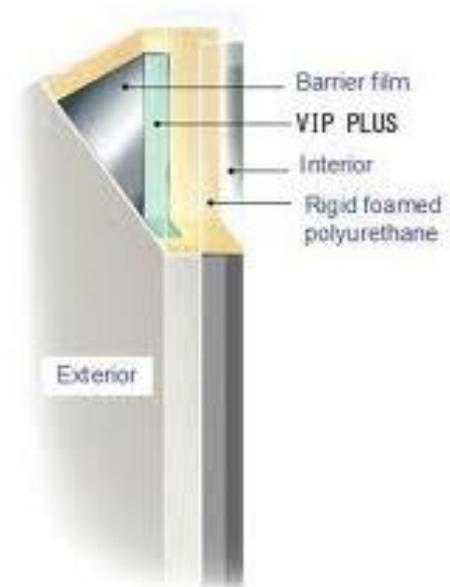
- Categories A-G giving  $W/m^2 \cdot yr$
- Information about current status and potential improvement
- Obligatory for every house/apartment (for rent/sale)





# 1. Reducing Cooling demand in buildings

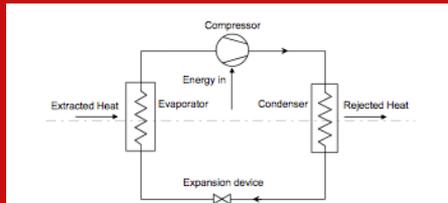
- In buildings, conduction of heat takes place through the roof, walls and windows.
- Less controlled heat transfer results in increased cooling demand load to maintain thermal comfort, which again increases energy consumption of RAC equipment
- Not directly related to efficiency, but can reduce energy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



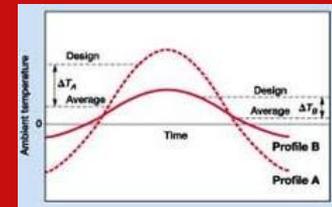


## 2. Reducing energy consumption of HVAC&R equipment

### 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!

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On behalf of



Federal Ministry for the  
Environment, Nature Conservation  
and Nuclear Safety

of the Federal Republic of Germany