

green<sup>❄️</sup>  
cooling initiative



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Promoting R290 Air-Conditioners  
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**giz** Deutsche Gesellschaft  
für Internationale  
Zusammenarbeit (GIZ) GmbH

On behalf of



Federal Ministry for the  
Environment, Nature Conservation  
and Nuclear Safety

of the Federal Republic of Germany

## Benefits and Challenges of R290 AC

### Benefits:

- Almost zero emissions (R290 has a GWP of 3)
- Higher cooling capacity and coefficient of performance than conventional refrigerants (energy saving benefits)
- Low incremental costs and costs of refrigerants
- Availability - R290 can be produced locally

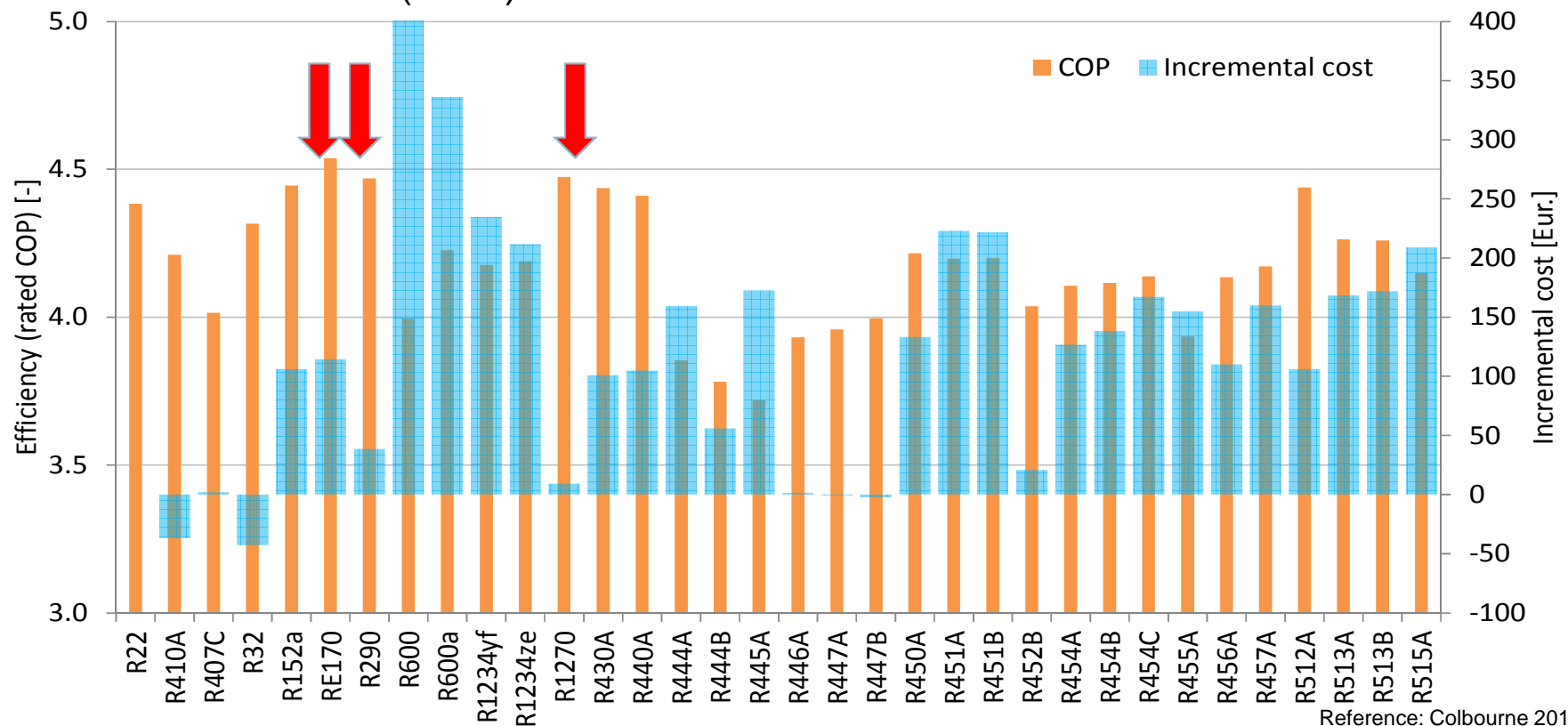
### Challenges:

- Flammability
- Restricted standards and building codes (charge sizes)
- Capacities of technicians and certification schemes
- Lack of supply chains and aftersales service (spare parts)

*There are solutions!*

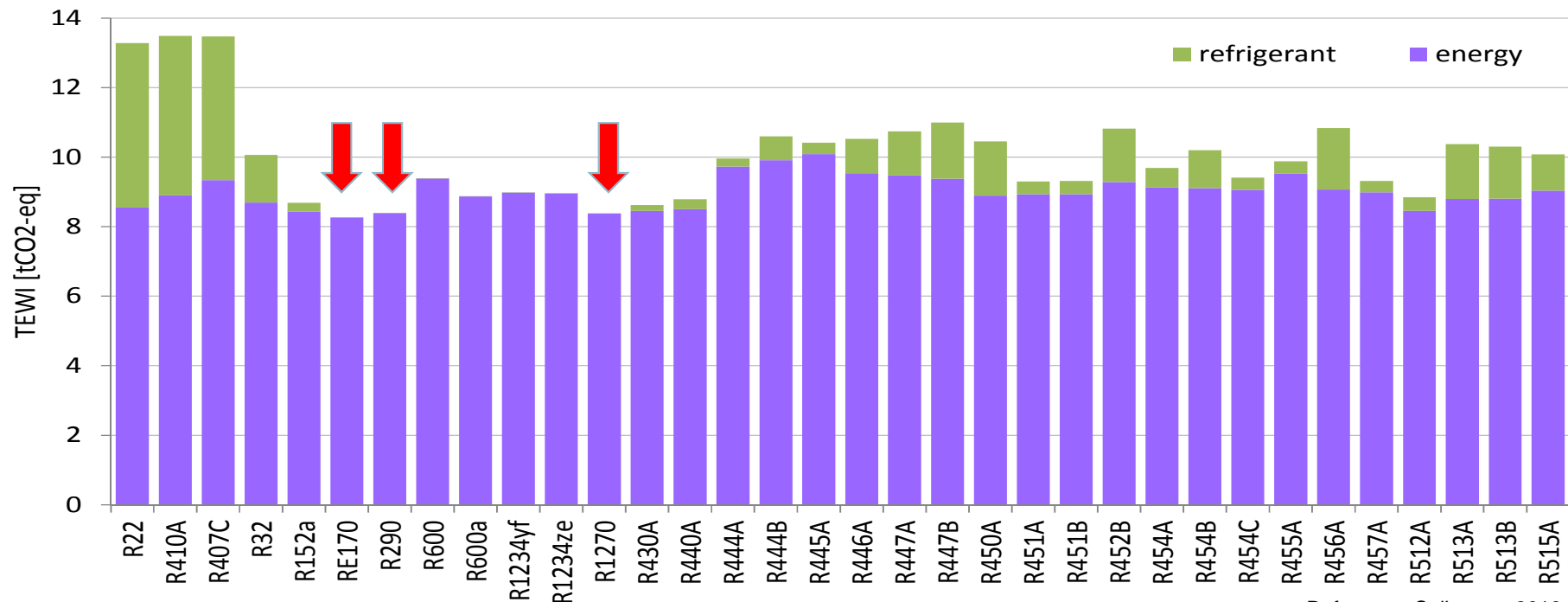
## On-going evaluation of various alternatives

- Assessment of all new/proposed low- and medium GWP alternatives
- Out of all of them, hydro carbons offer the highest Coefficient of Performance (COP) for least incremental cost



## On-going evaluation of various alternatives

- Assessment of all new/proposed low- and medium GWP alternatives
- Also hydrocarbons have lowest Total Environmental Warming Impact (TEWI) of all alternatives
- HFCs/u-HFCs with close TEWI also have very high incremental costs



Reference: Colbourne 2016

## Actively involved with safety analysis

→ Helping to evolve technical understanding, to help moving on from archaic and obstructive requirements

### GG.2 Requirements for charge limits in unventilated areas

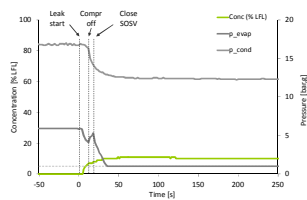
The maximum charge in a room shall be in accordance with the following:

$$m_{\max} = 2,5 \times (LFL)^{(5/4)} \times h_0 \times (A)^{1/2}$$

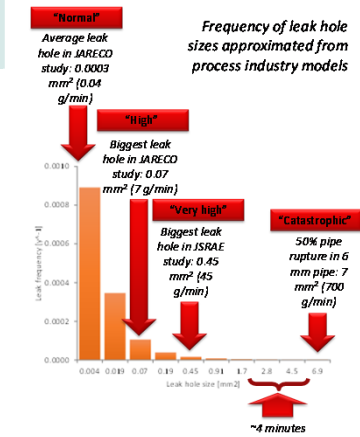
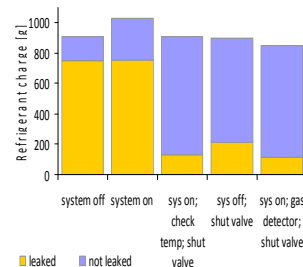
or the required minimum floor area  $A_{\min}$  to install an appliance with refrigerant charge  $M$  (kg) shall be in accordance with following:

$$A_{\min} = (M / (2,5 \times (LFL)^{(5/4)} \times h_0))^2$$

E.g., AC on, 900 g R290, 2.5 mm hole (= 180 g/min), airflow 0.31 m<sup>3</sup>/s, 12 m<sup>2</sup>

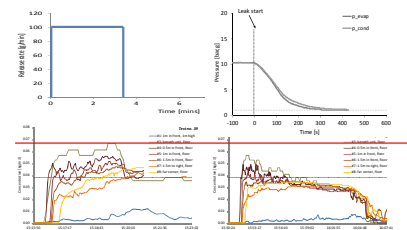


Safety valves closed by gas detection in IDU (SP = 18% LFL) within 12 s, 120 g released,  $C_{\max} < 15\%$  LFL



When a leak happens, it either

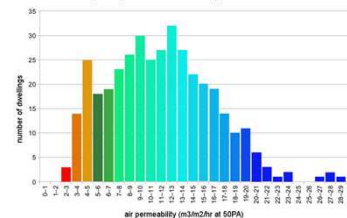
- Grows larger over time (from nothing)
- Occurs instantaneously and pressure decays over time



Decaying leak always results in lower concentration

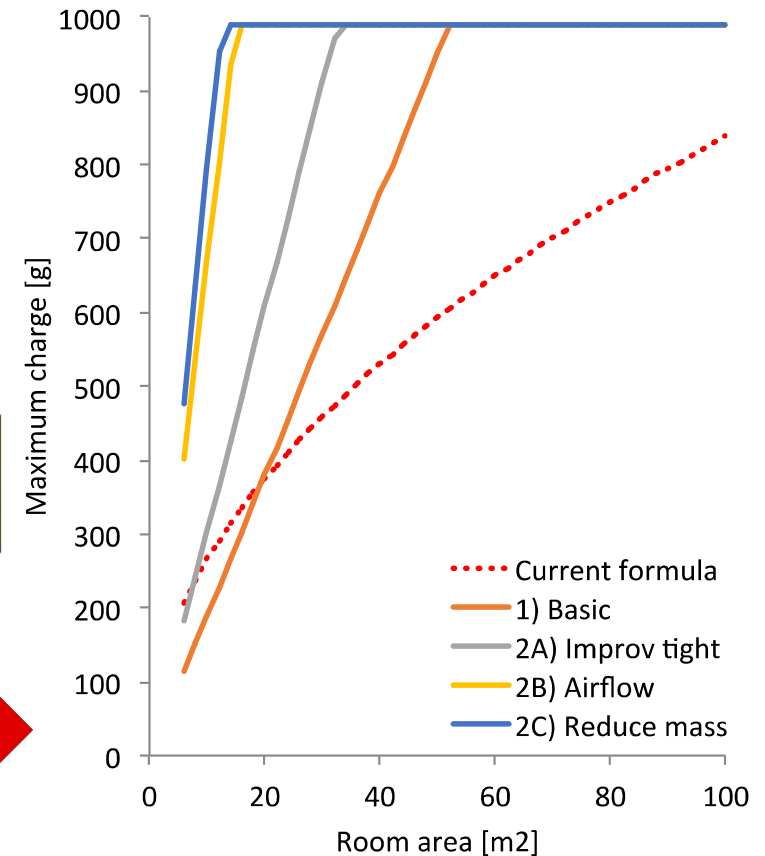
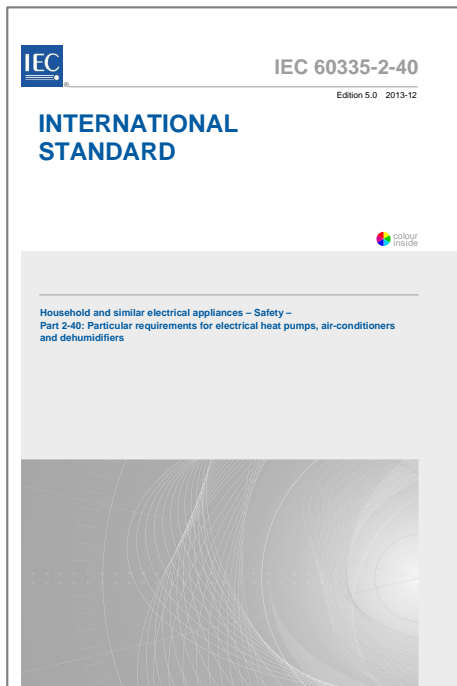
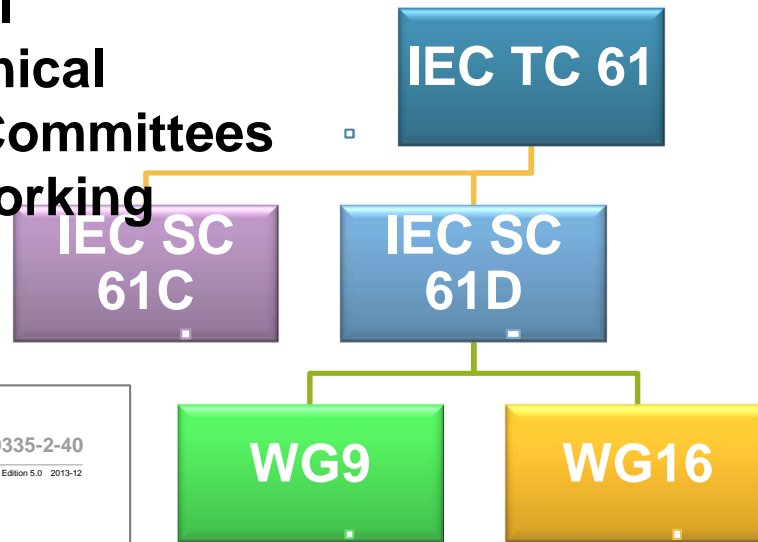
No occupied spaces are ever tight!

- Not only very difficult, also against the law



Building Research Establishment database; air leakage results for 471 dwellings

## International Electrotechnical (standard) Committees (IEC) and Working Groups



**Support more flexible charge size limits and safety requirements to improve level of safety and enable more flexible design and application of HC ACs**

## **Promotion of R290 AC by PROKLIMA**

Introduced R290 AC to the following countries so far:

- India, conversion of Godrej production line (200.000 units sold)
- China, conversion of GREE production line
- Colombia
- Ghana
- Kenya
- Mauritius
- Namibia
- Seychelles

Introduction will follow in these countries:

- Mexico
- Indonesia
- Thailand
- Grenada, etc.

## **Example 1: Promoting R290 ACs in Ghana**

- Under Green Cooling Initiative (BMUB funded)
- Trained technicians on natural refrigerants at Cool Training, Germany
- Imported two ACs and tools for vocational training centers and trained 25 technicians and ToT in Ghana
- Developed training curricula and introducing certification schemes
- Installed further 30 units for demonstration purposes and monitoring (performance, energy, emissions)
- Developing an incentive/market driven upscaling strategy
- Installation and monitoring of approx. additional 200 ACs
- Adjust national regulatory framework (e.g. standards)

## **Summary of Proklima R290 AC Approach**

Step 1: Increase technical capacities of technicians (e.g. Cool Training)

Step 2: Import ACs and tools for vocational training centres, adjust curricula, introduce certification schemes

Step 3: Training of trainers (ToT) and technicians of AC companies

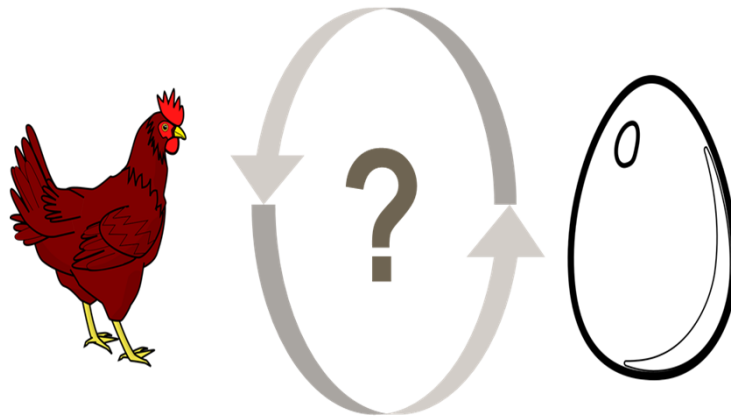
Step 4: Installation of ACs in controlled environment (demonstration project) by trained/certified technicians and monitoring of performance, energy, emissions

Step 5: Set up supply structures and incentive upscaling schemes

Step 6: Adjust national regulatory framework (standards) and policy (incentive schemes)

Step 7: Promote market driven upscaling. Only certified technicians are allowed to install and maintain R290 ACs

## Supply and Demand Challenge



- Mutual influence between market supply and demand
- No demand = no supply!
- No supply = no demand!
- Increasing demand with growing market penetration
- Decreasing unit costs with increasing demand (**economies of scale**)

Thank you!

Questions?

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GIZ Proklima International

[www.giz.de/proklima](http://www.giz.de/proklima)

[www.green-cooling-initiative.org](http://www.green-cooling-initiative.org)

