

# **Emissions and mitigation potential – The significance of refrigeration, air conditioning and foam sectors**

**Dr. Jonathan Heubes  
GIZ Proklima**

**Mexico City, 9. December 2013**



# Agenda

**Inventory – the basis for emissions scenarios**

**The NAMA baseline: more than HFC emissions**

**Significance of the RAC&F sectors**

**Important sectors – potential NAMAs**

**Economic impact**



# Agenda

**Inventory – the basis for emissions scenarios**

**The NAMA baseline: more than HFC emissions**

**Significance of the RAC&F sectors**

**Important sectors – potential NAMAs**

**Economic impact**

NAMAs in the  
refrigeration,  
air conditioning  
and foam sectors.

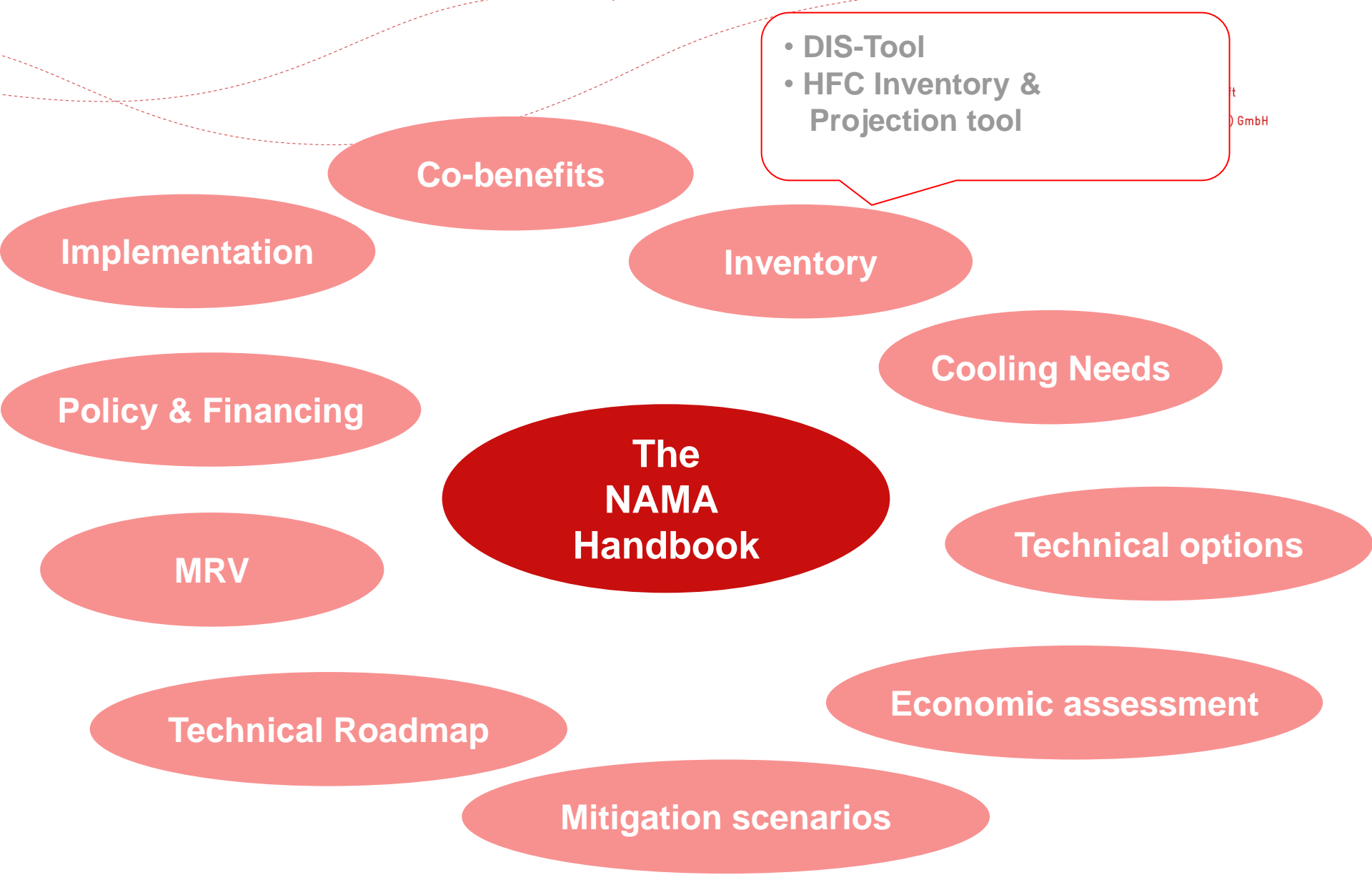


A technical handbook.

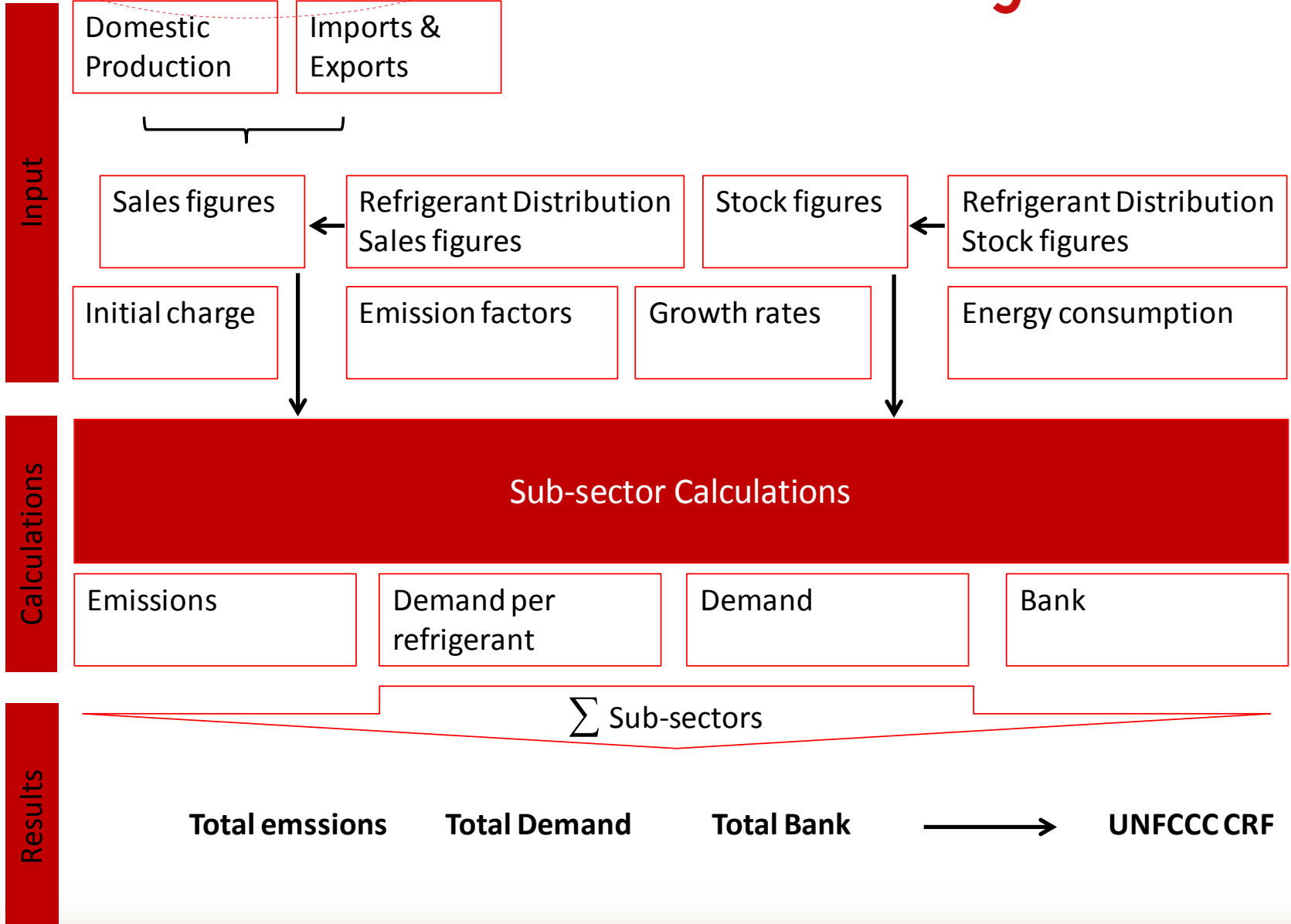
Download under:

<http://www.giz.de/expertise/html/4809.html>



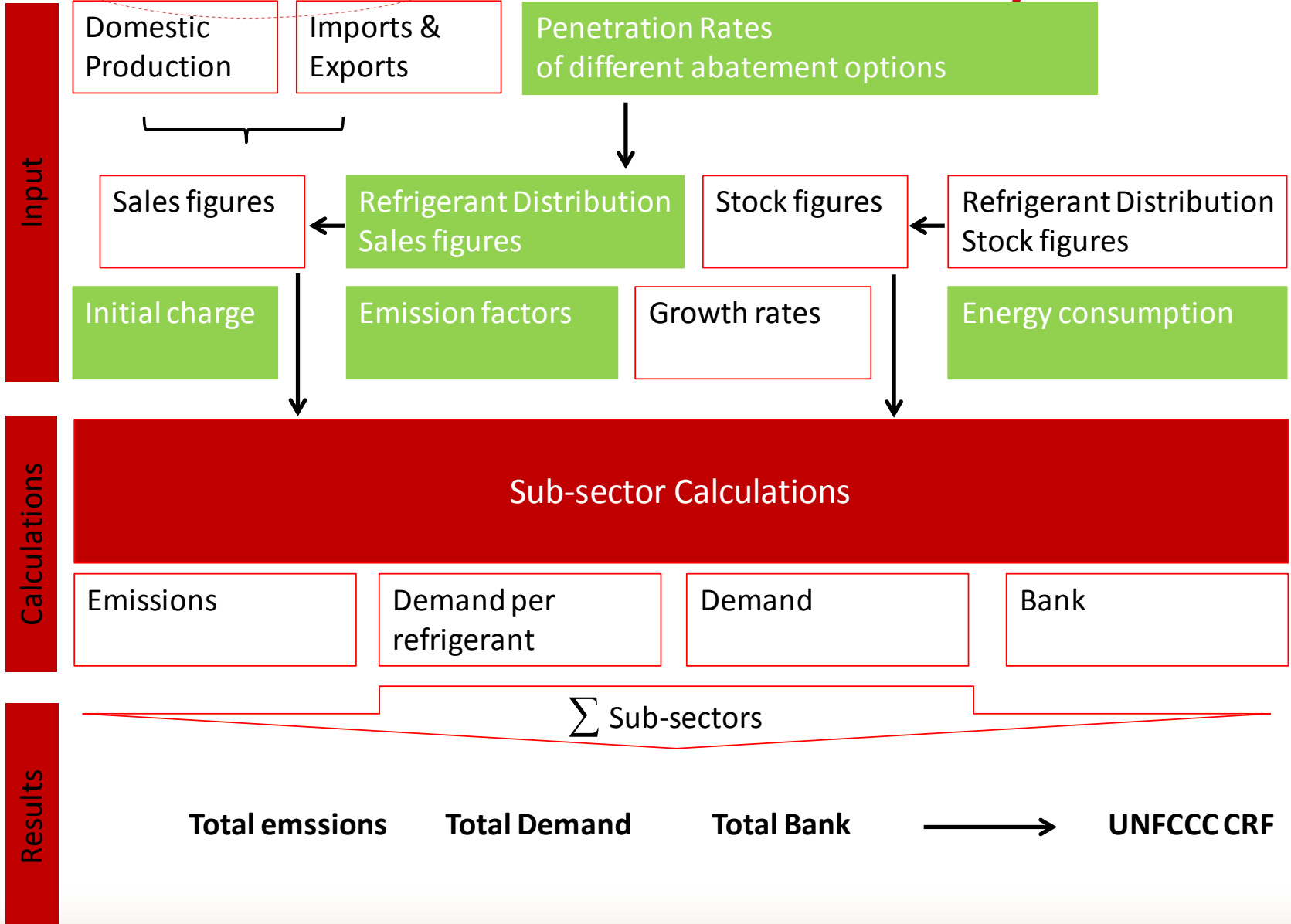


t  
D GmbH



# Technical Options in the RAC sectors

- Leak reduction (design/constr)
- Leak reduction (maintenance)
- Charge size reduction
- Recovery and recycling
- **HC R600a**
- **HC R290/ R1270**
- **R717**
- **R744**
- **unsat-HFC**
- **HFC/unsat-HFC blends**
- **Low-GWP + liquid secondary (centralised)**
- **Low-GWP + evap secondary (centralised)**
- **Low-GWP + cascade (centralised)**
- **Low-GWP + liquid secondary (discrete)**
- **Low-GWP + distributed water-cooled (centralised)**
- **Low-GWP + district cooling**







# Agenda

**Inventory – the basis for emissions scenarios**

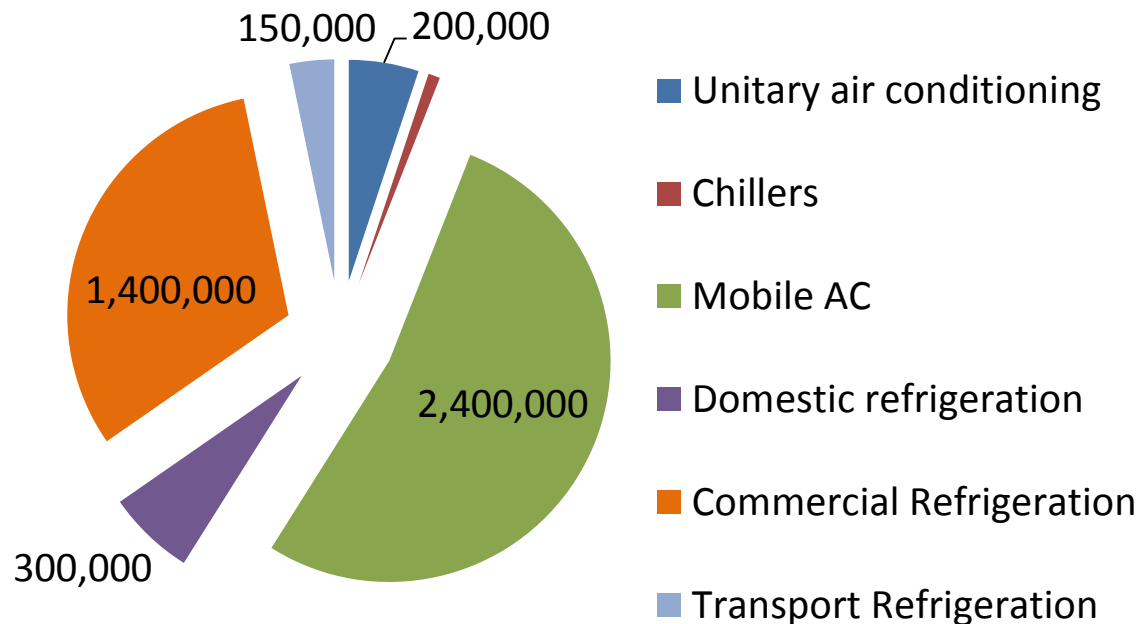
**The NAMA baseline: more than HFC emissions**

**Significance of the RAC&F sectors**

**Important sectors – potential NAMAs**

**Economic impact**

## Share of HFC emissions (CO<sub>2</sub>eq) in the year 2010



- **4.5 MtCO<sub>2</sub>** out of 750 MtCO<sub>2</sub>eq
- Contribution of HFC emissions to overall GHG emissions: **0,6 %**

## The NAMA baseline is a complex thing

- We also have HCFC
- NAMA baseline takes into account current implementation of HPMP
- Non-static baseline
  
- We have indirect emissions from energy consumption
- Baseline may account for the decarbonisation

**HFC emissions**

**HFC & HCFC emissions**

4.5 MtCO<sub>2</sub>eq



9 MtCO<sub>2</sub>eq

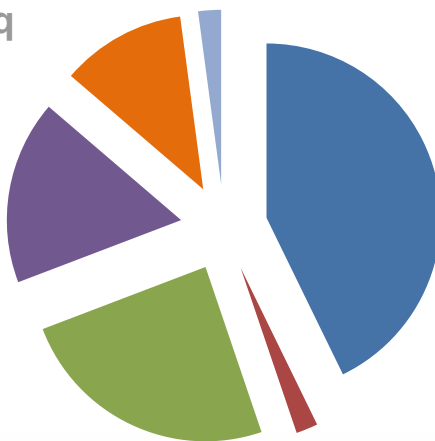


- Unitary air conditioning
- Chillers
- Mobile AC
- Domestic refrigeration
- Commercial Refrigeration
- Transport Refrigeration

**Total emissions**

**Indirect emissions**

43 MtCO<sub>2</sub>eq



34 MtCO<sub>2</sub>eq





# Agenda

**Inventory – the basis for emissions scenarios**

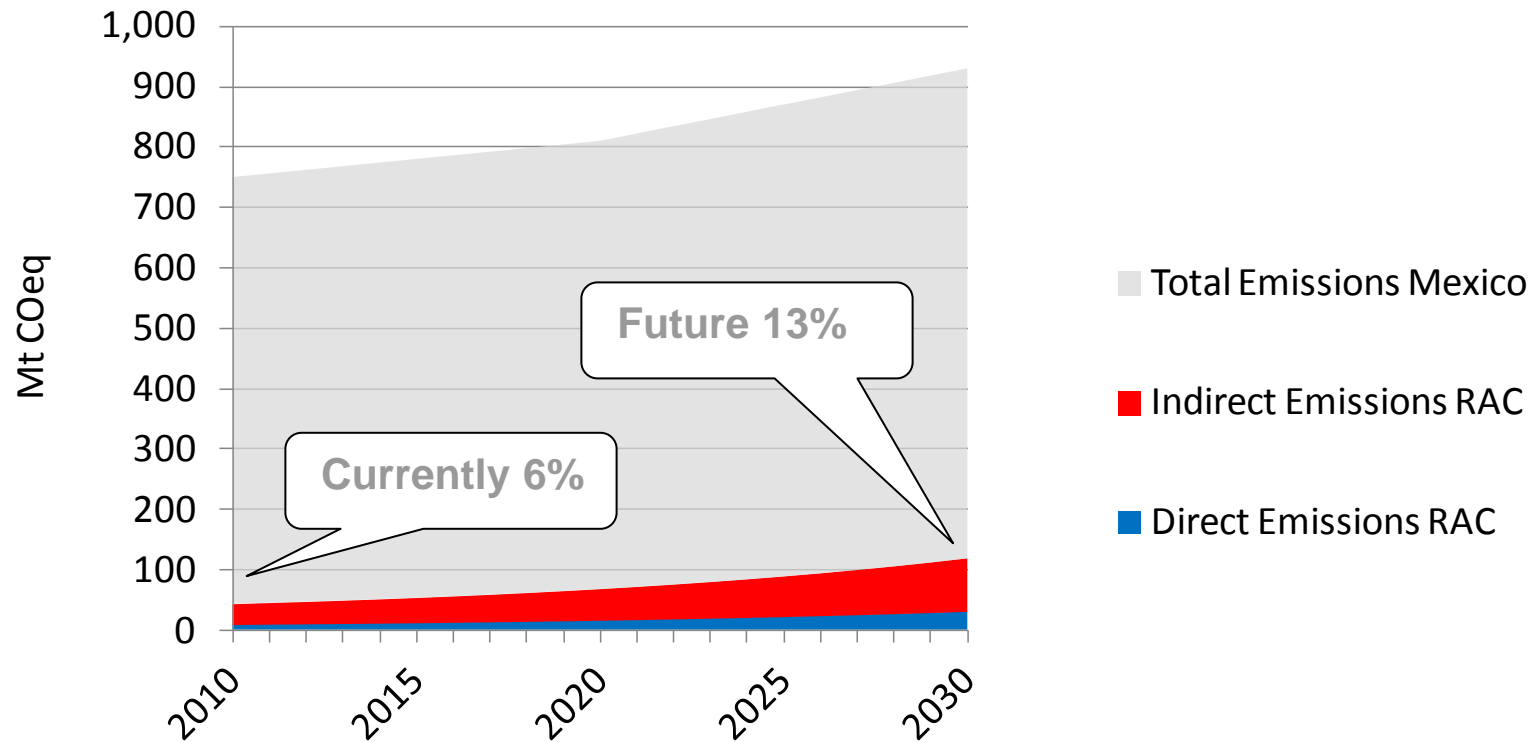
**The NAMA baseline: more than HFC emissions**

**Significance of the RAC&F sectors**

**Important sectors – potential NAMAs**

**Economic impact**

## RAC sectors contribute to Mexico's overall emissions !



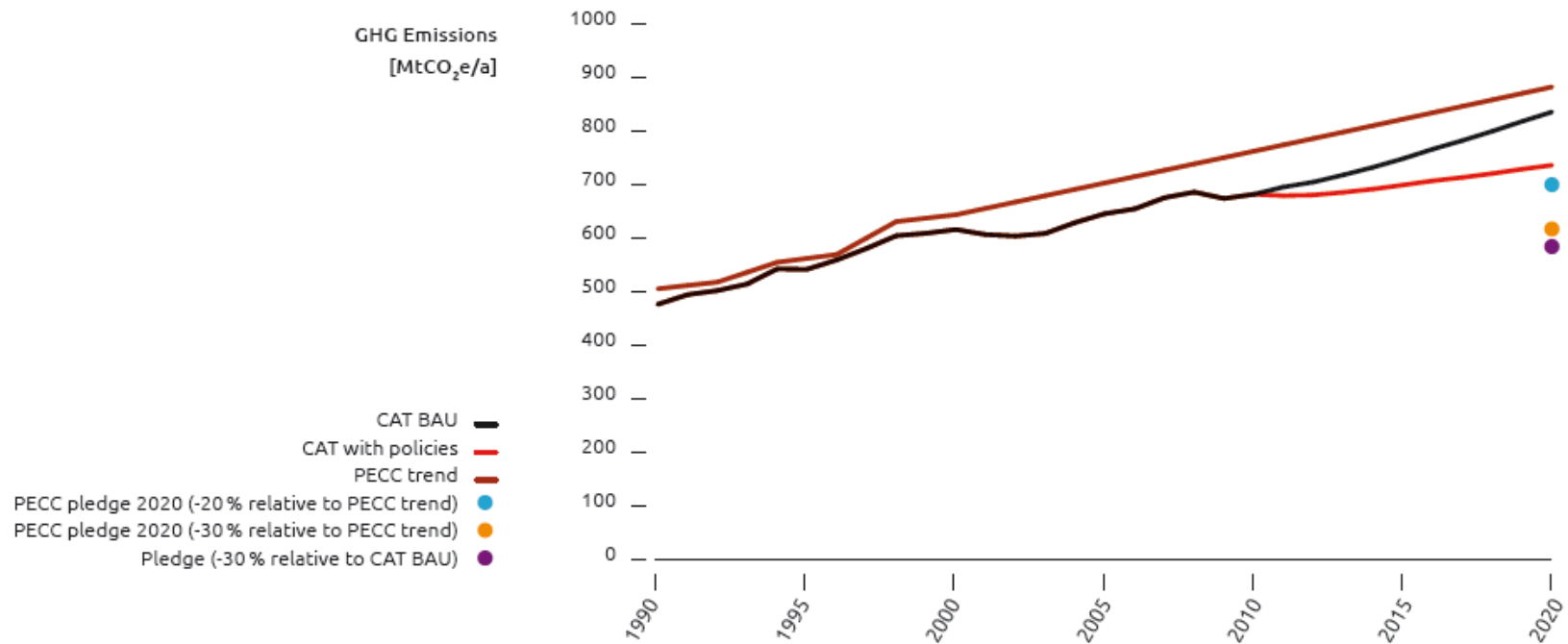
Mexico's total emission scenario accounts for current policies  
(<http://www.climateactiontracker.org>)



# Mexico pledged to reduce emissions by 30% below business as usual by 2020

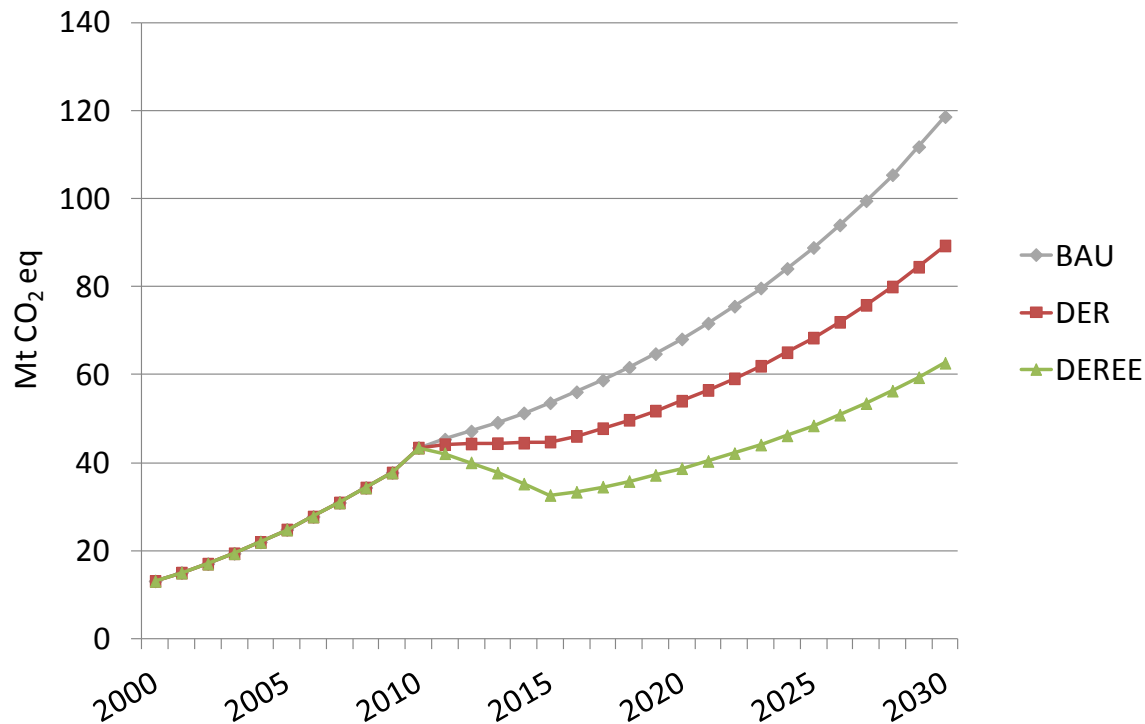
**Figure A**

Emissions and emission reductions for the policy scenario up to 2020 in comparison to Mexico's Copenhagen pledge





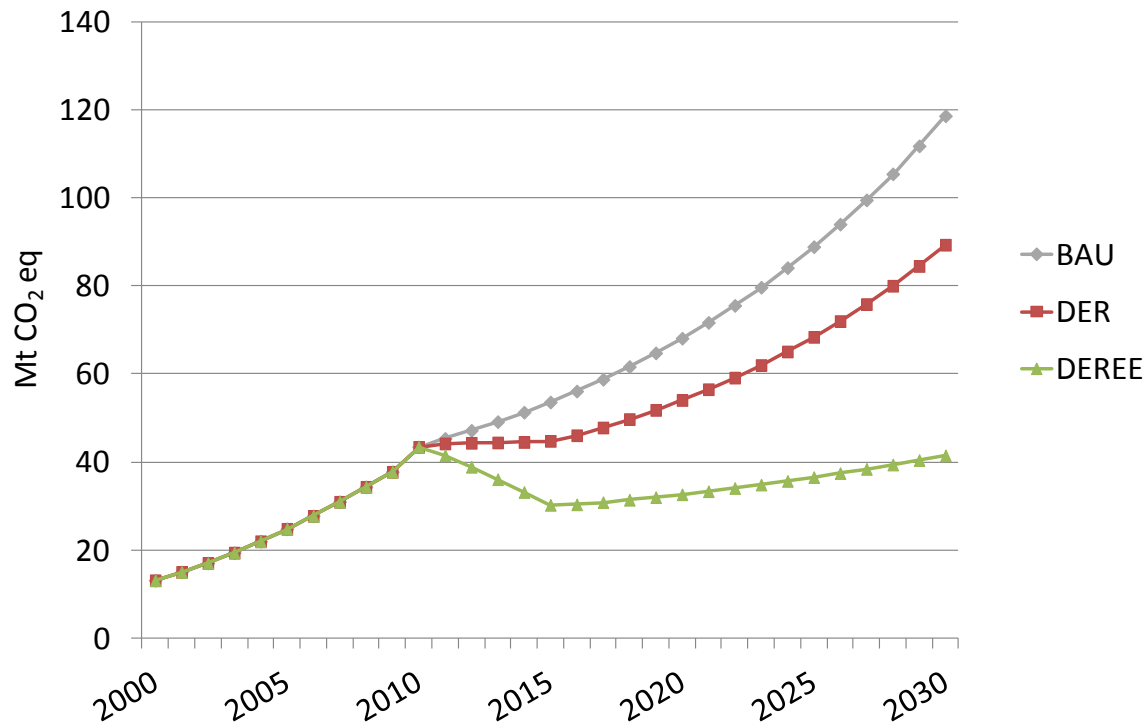
In the RAC sectors we can reduce emissions by > 40% below business as usual by 2020







# With decarbonisation, Mexico could achieve a freeze of emissions in the RAC sector !





# Agenda

**Inventory – the basis for emissions scenarios**

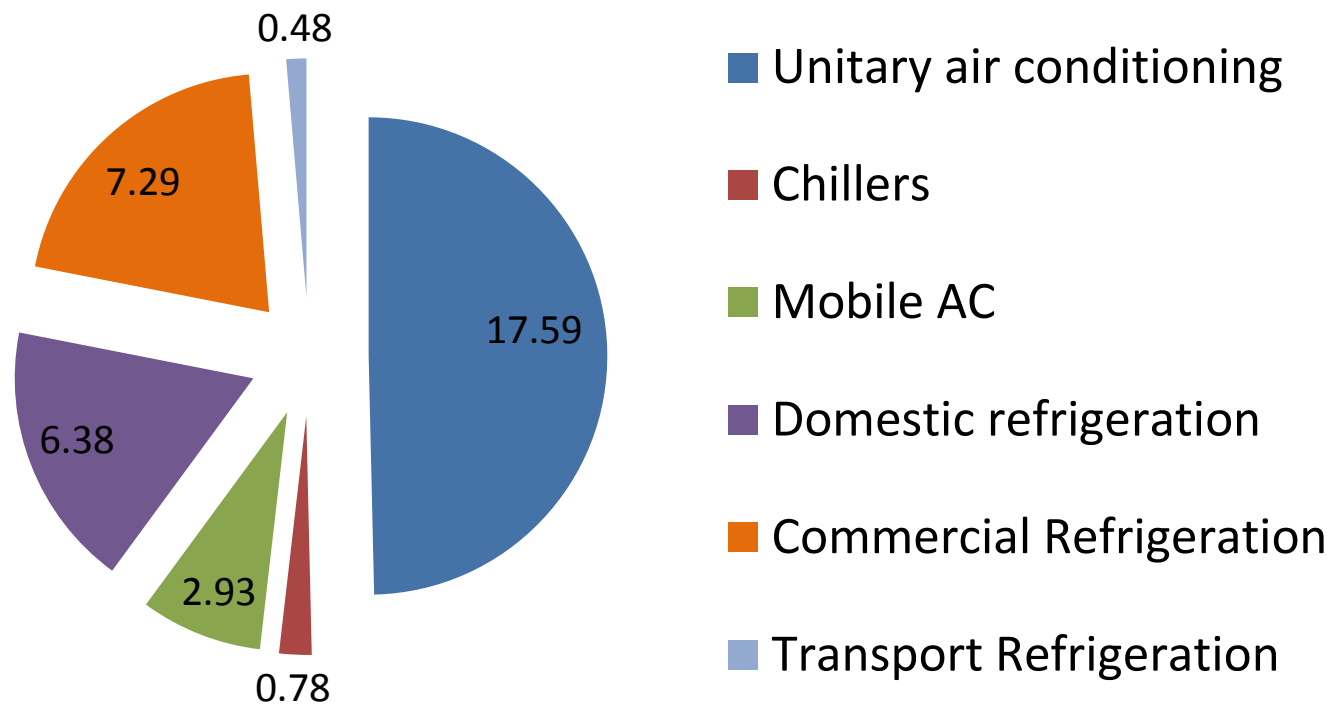
**The NAMA baseline: more than HFC emissions**

**Significance of the RAC&F sectors**

**Important sectors – potential NAMAs**

**Economic impact**

## Emission reduction potential in 2020 (Mt CO<sub>2</sub>eq per year)

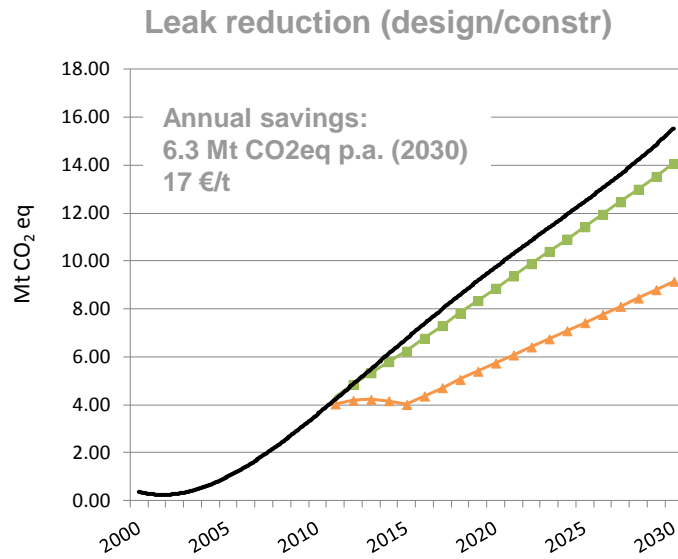


## Emission split: unitary air conditioning

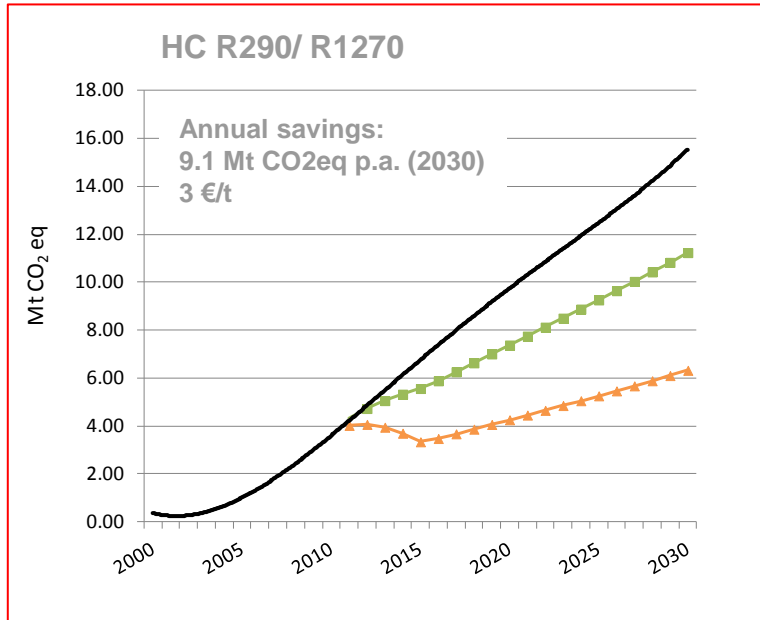


# Split residential air conditioners – The effect of technical options

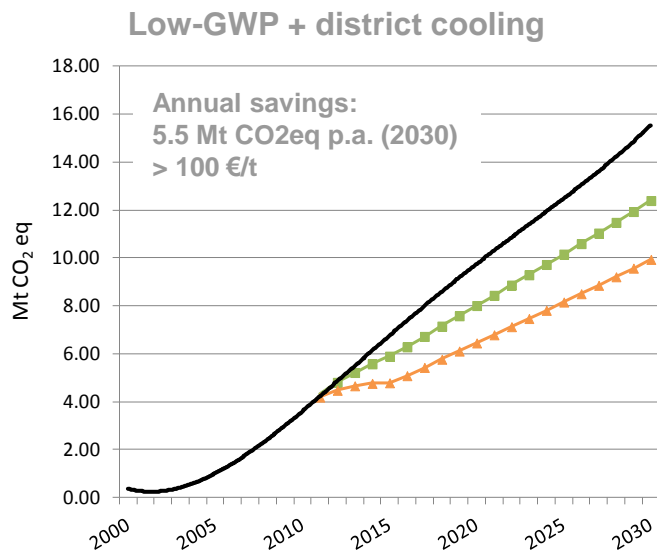
1)



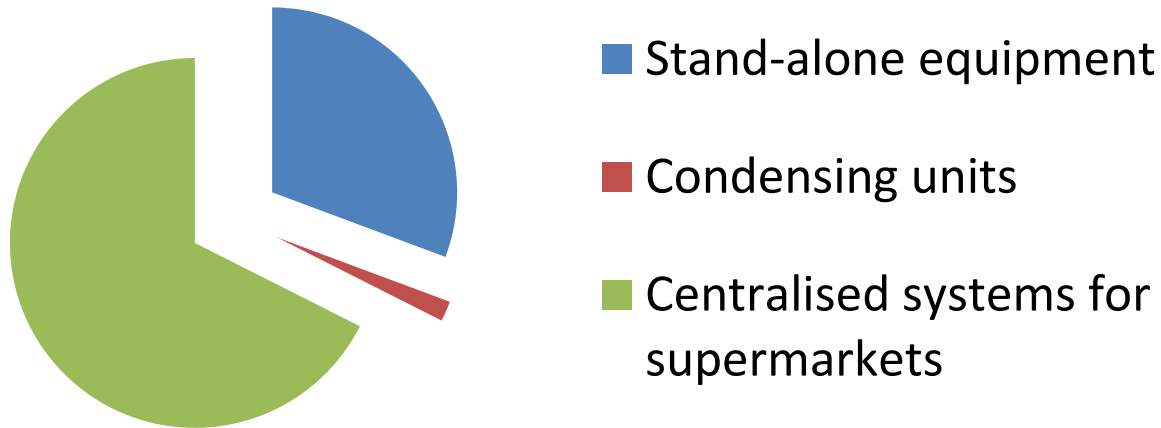
2)



3)

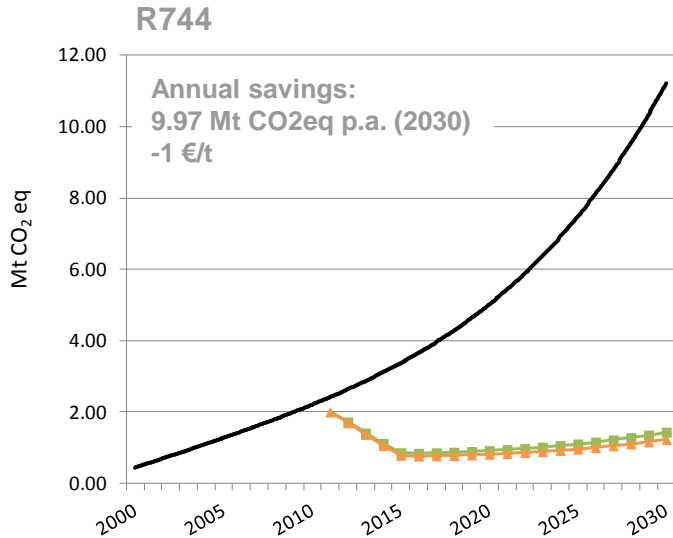


## Emission split: commercial refrigeration

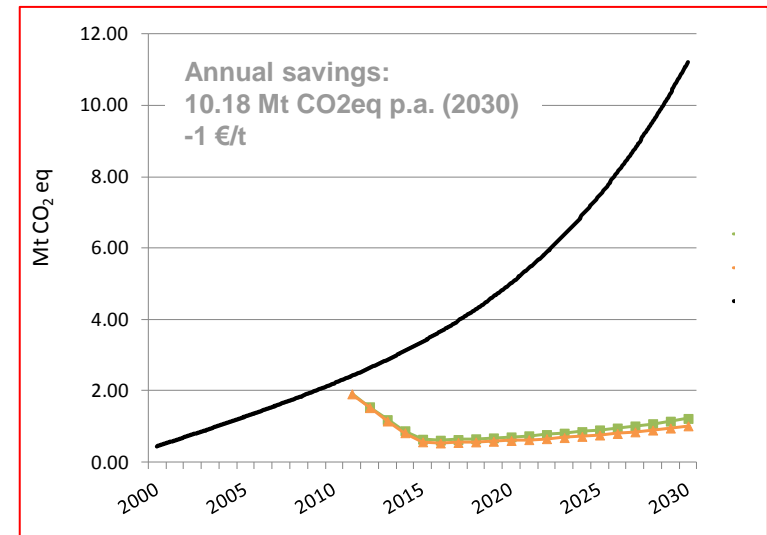


# Centralised systems supermarkets – The effect of technical options

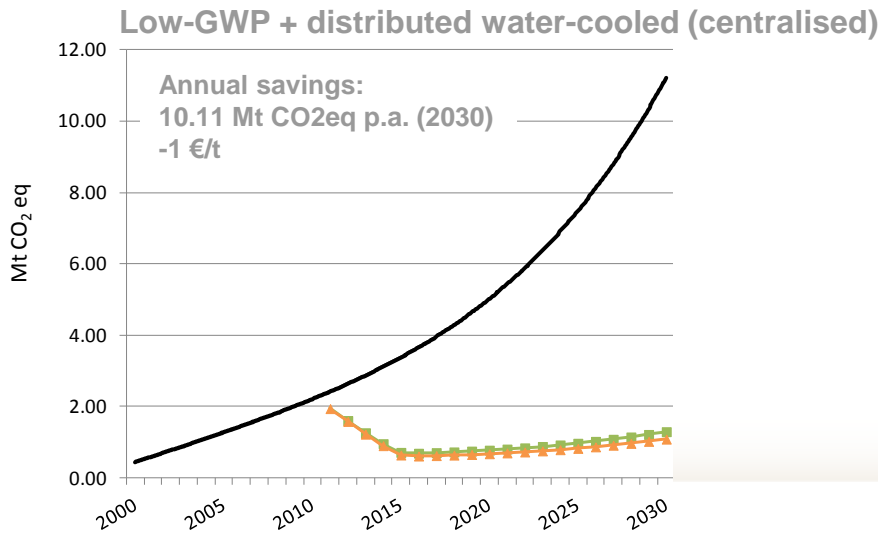
1)



2)



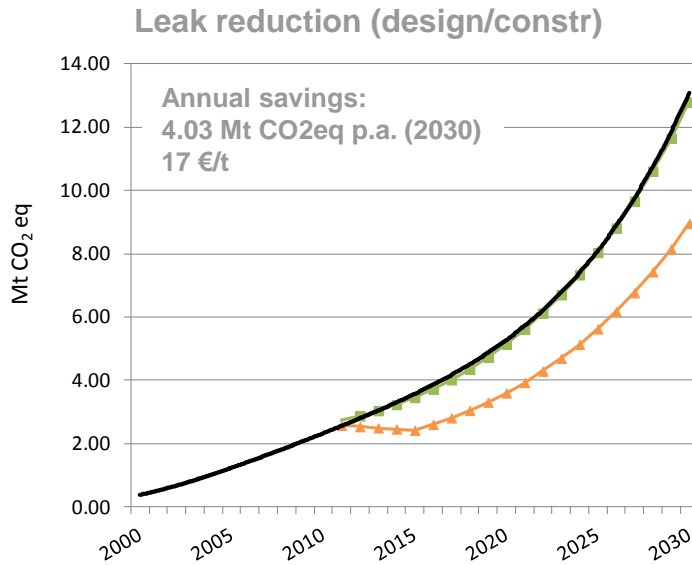
3)



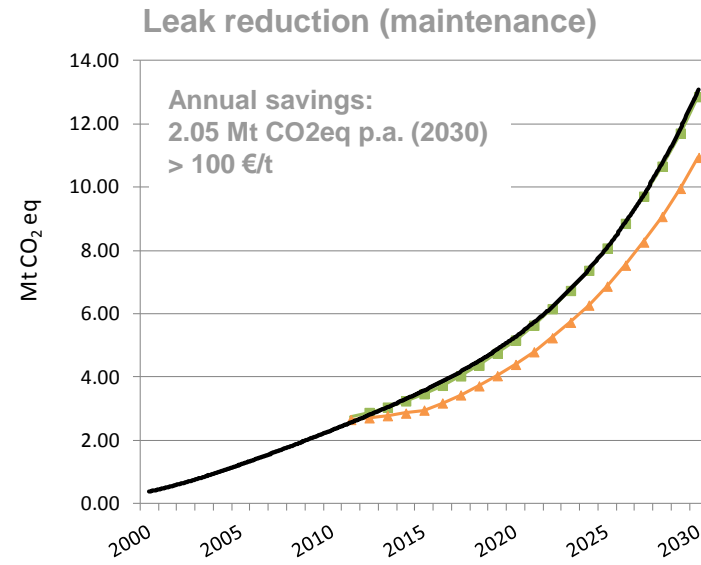
- DER
- ▲ DERE
- BAU

# Stand-alone units – The effect of technical options

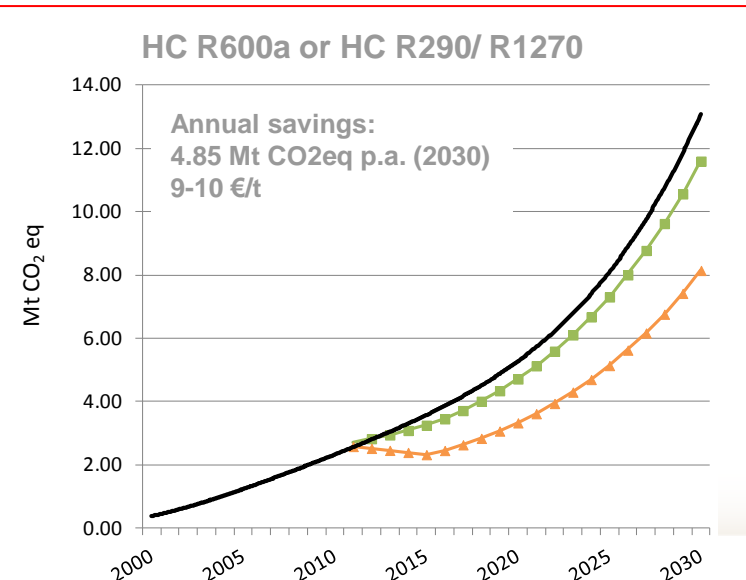
1)



2)



3)

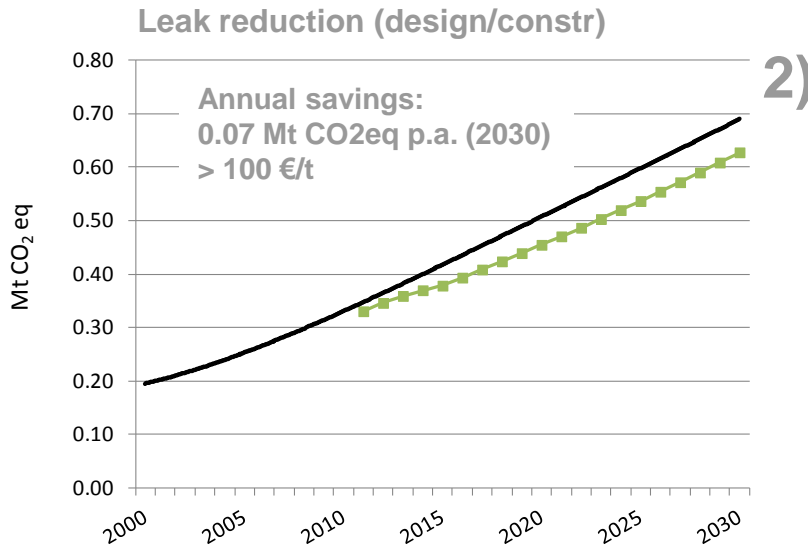


- DER
- ▲ DERE
- BAU

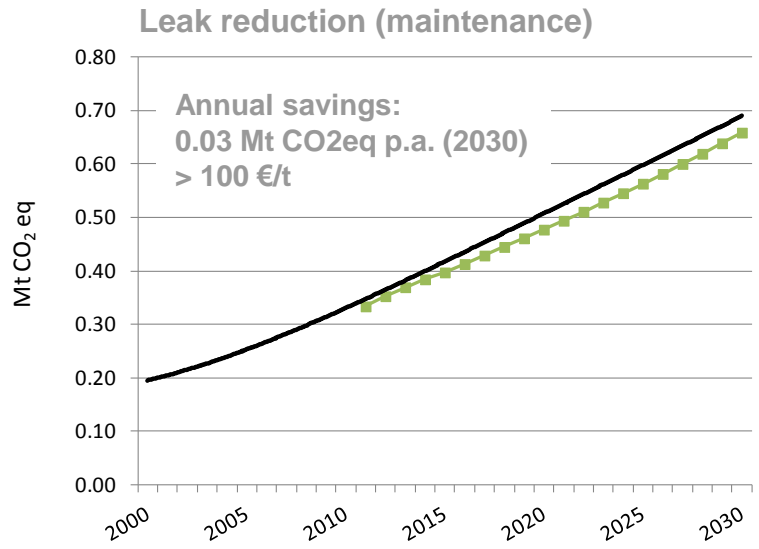


# Domestic refrigeration: Direct emissions – The effect of technical options

1)

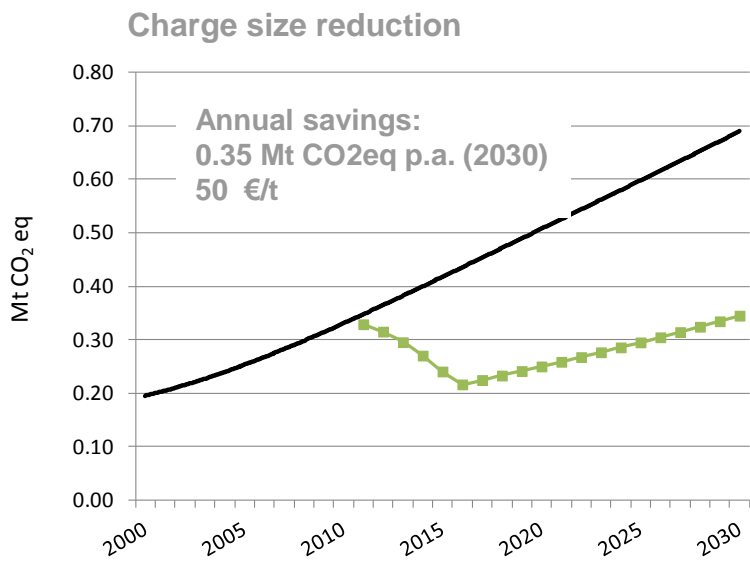


2)

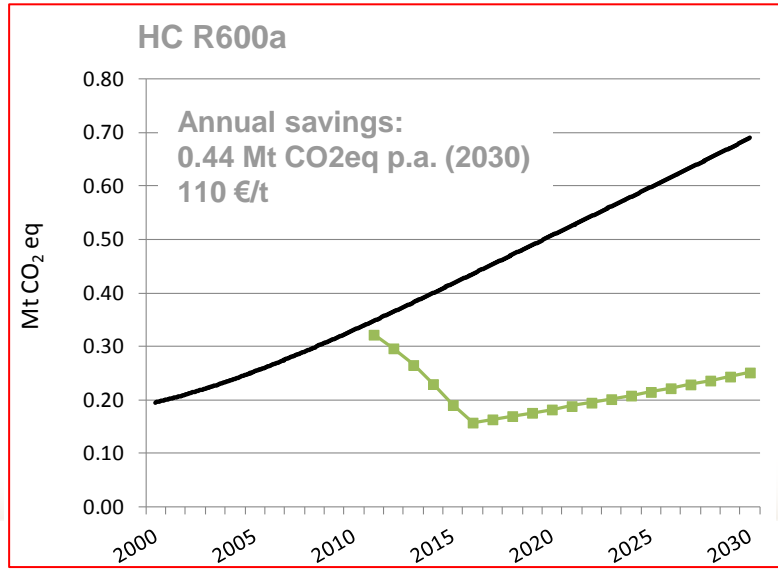


— | BAU  
—■— | DER

3)

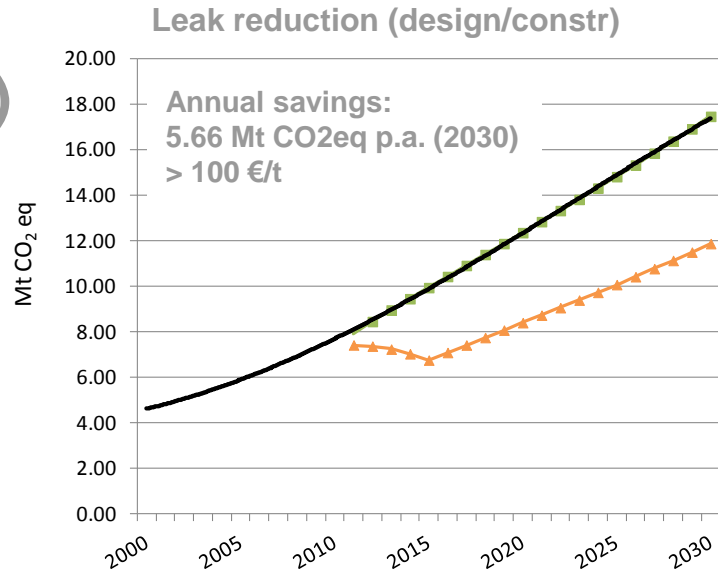


4)

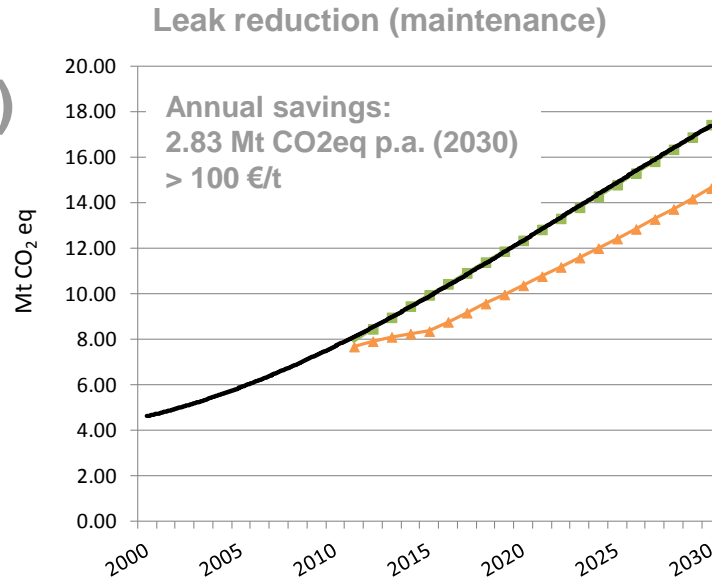


# Domestic refrigeration – The effect of technical options

1)

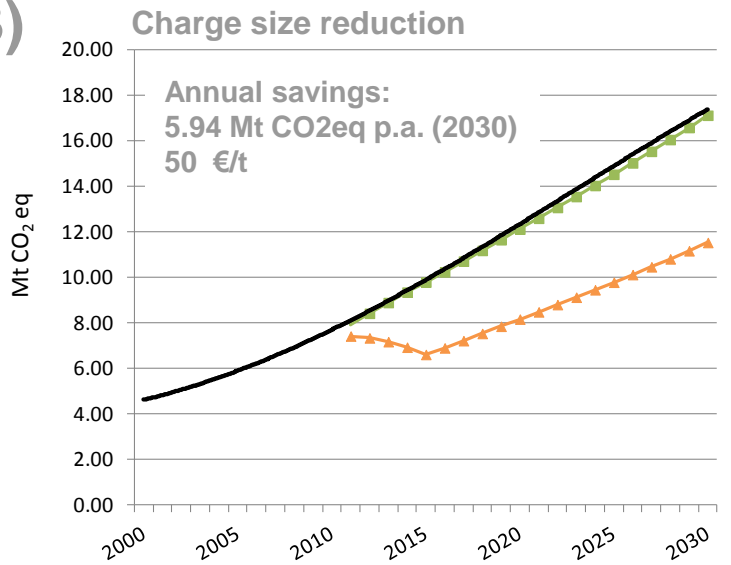


2)

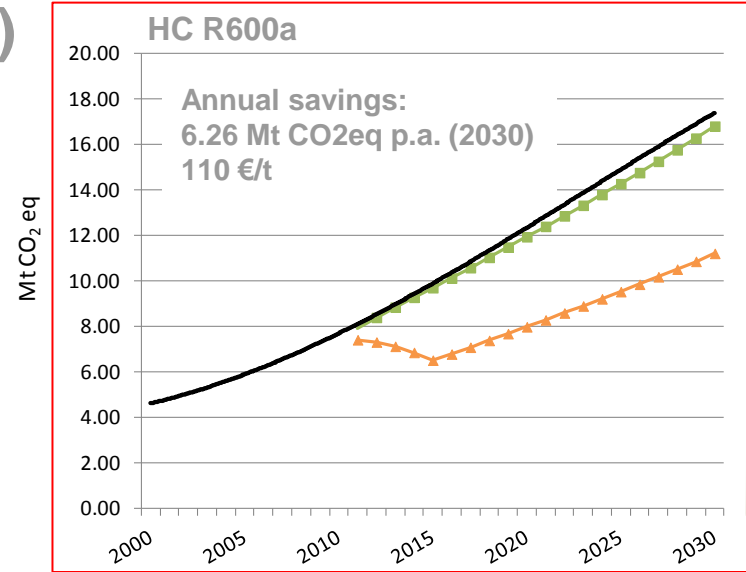


■ DER  
▲ DERE  
— BAU

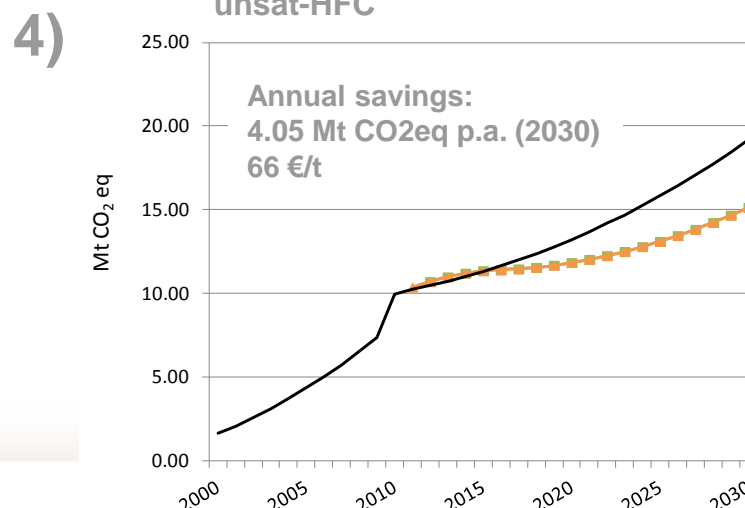
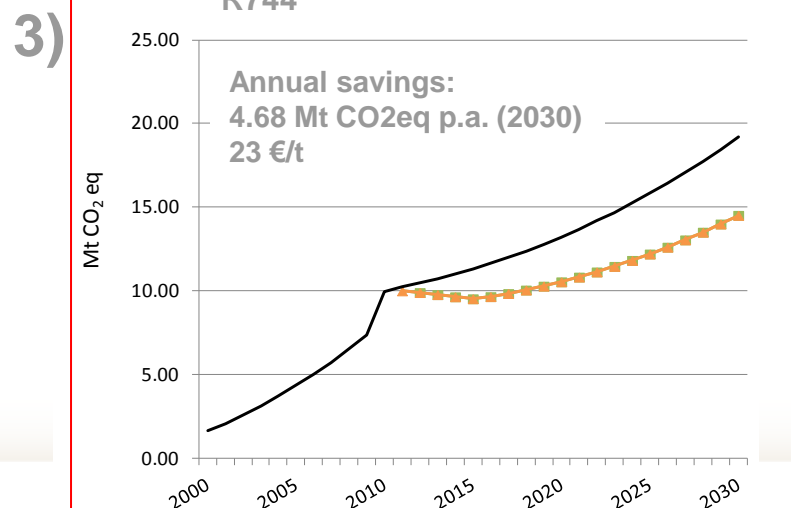
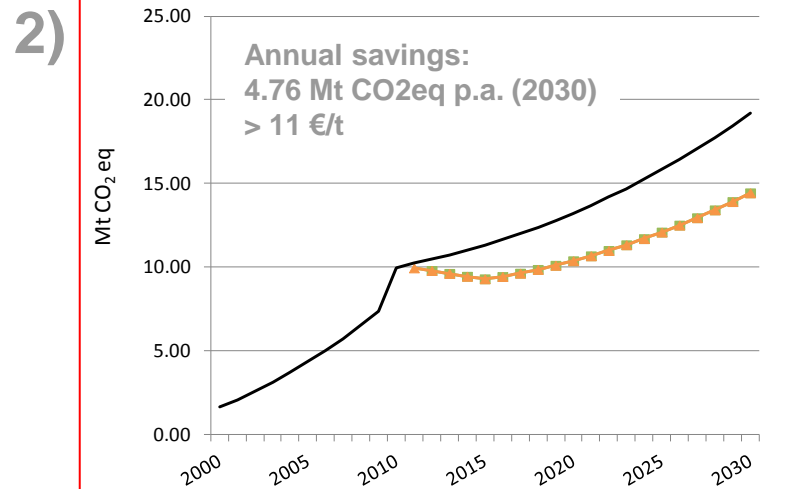
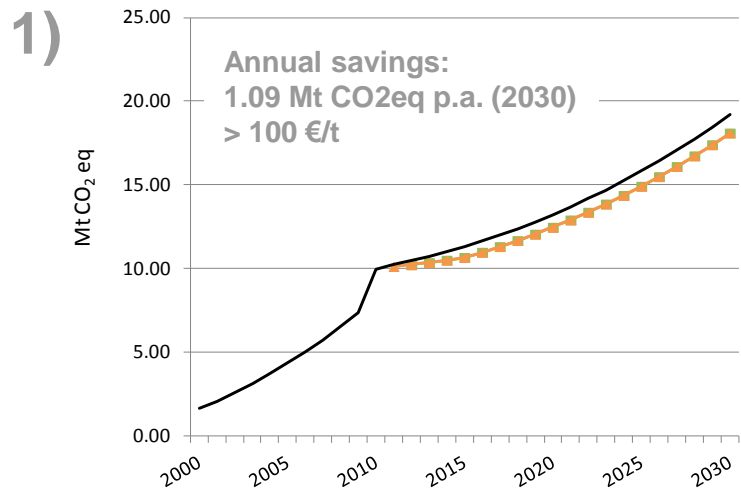
3)



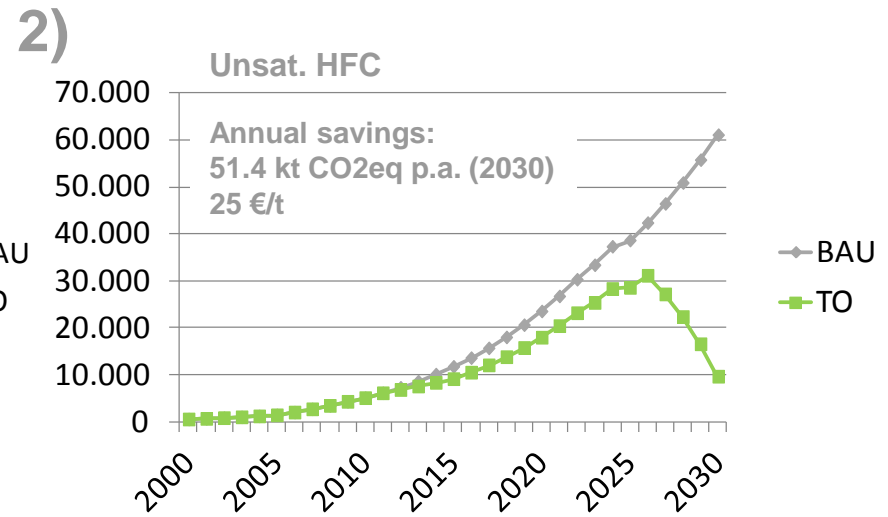
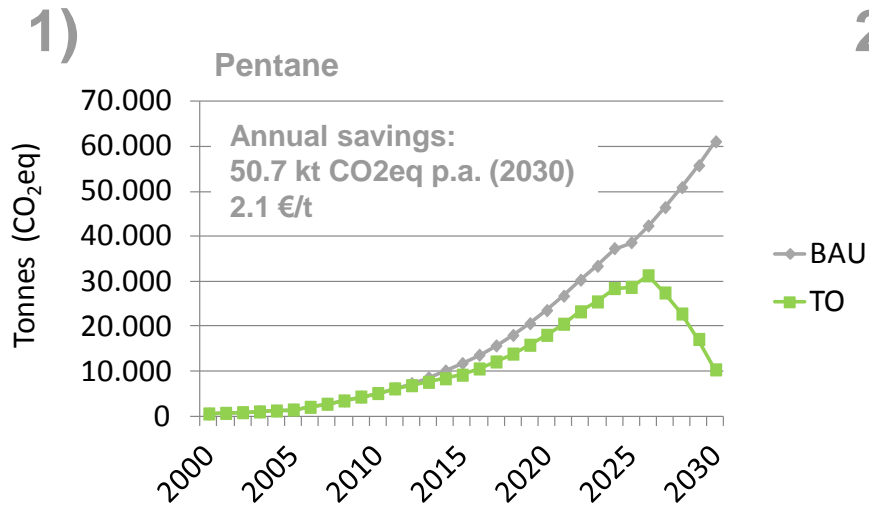
4)



# Mobile air conditioning cars – The effect of technical options



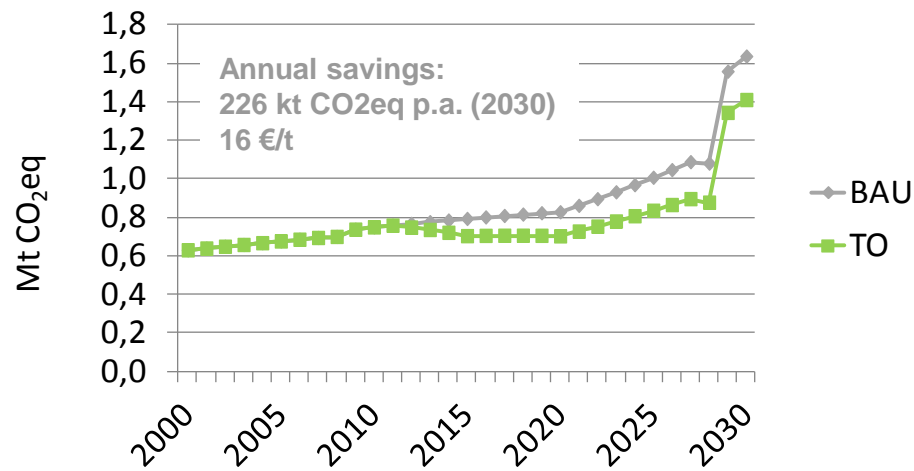
# Foam: Refrigerated trucks – The effect of technical options



# Foam: Domestic refrigeration – The effect of technical options

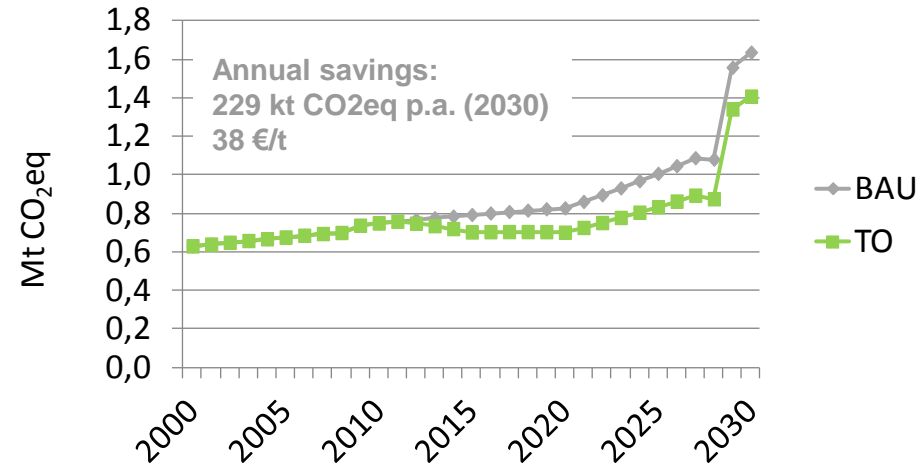
1)

Pentane



2)

Unsat. HFC





# Agenda

**Inventory – the basis for emissions scenarios**

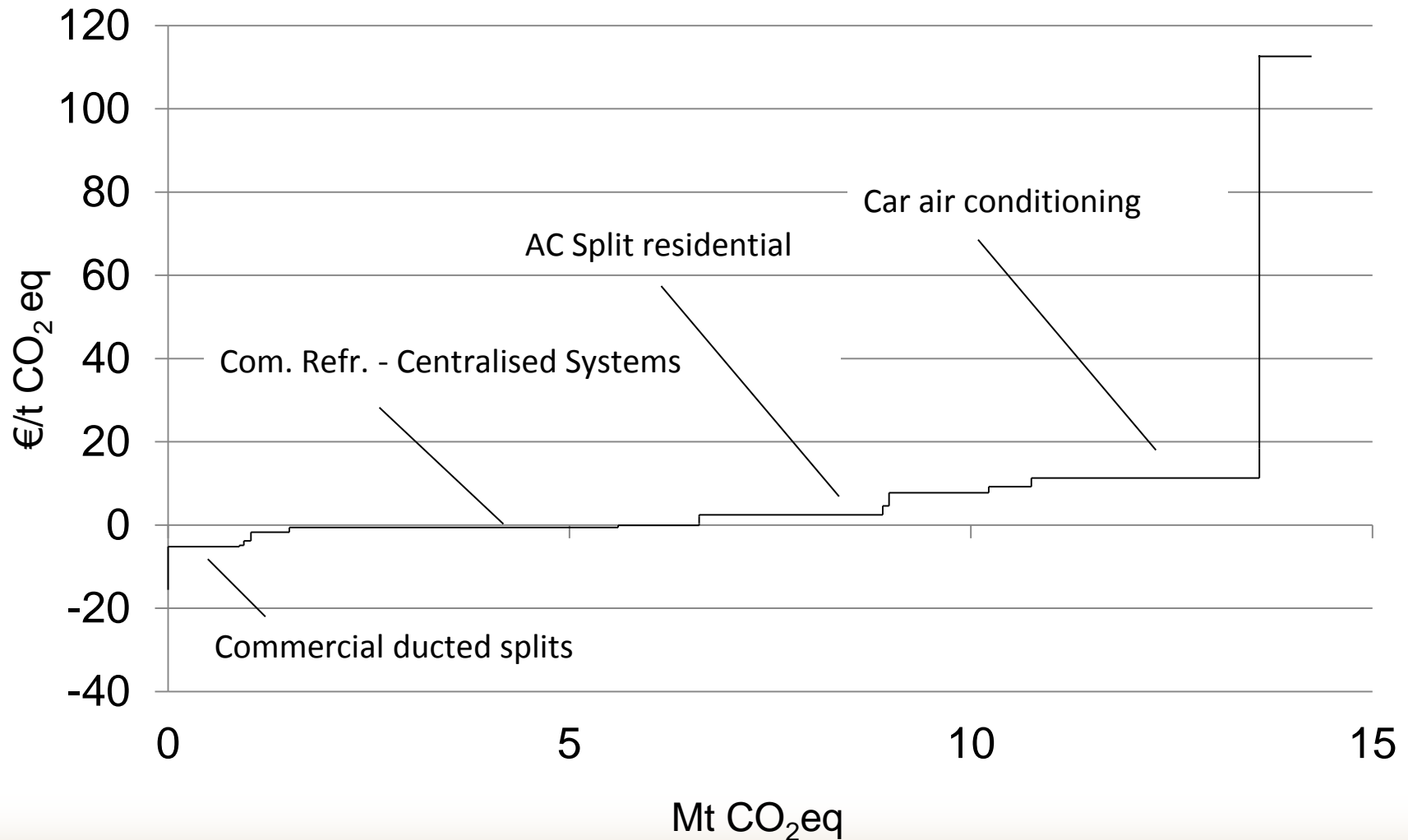
**The NAMA baseline: more than HFC emissions**

**Significance of the RAC&F sectors**

**Important sectors – potential NAMAs**

**Economic impact**

# Marginal abatement cost curve 2020 - Direct emissions (DER)



# Thank you for your kind attention!

Contact:

[jonathan.heubes@proklima.net](mailto:jonathan.heubes@proklima.net)

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



$$\text{€/tCO}_2\text{eq reduced} = \frac{\text{Cost}_{TO} - \text{Cost}_{BAU}}{E_{BAU} - E_{TO}}$$

where

$\text{Cost}_{TO}$  = Costs of an appliance system with a particular technical option

$\text{Cost}_{BAU}$  = Costs of an appliance system with business-as-usual technology

$E_{TO}$  = Emissions of an appliance system over lifetime with a particular technical option

$E_{BAU}$  = Emissions of a business-as-usual appliance system over lifetime

# RAC categories

Sector	Sub-sector	Appliance systems
Air conditioning	Unitary air conditioning	Self-contained air conditioners
		Split residential air conditioners
		Split commercial air conditioners
		Duct split residential air conditioners
		Commercial ducted splits
		Rooftop ducted
		Multi-splits
Air conditioning/ Refrigeration	Chillers	Air conditioning chillers
		Process chillers
Air conditioning	Mobile AC	Car air conditioning
		Large vehicle air conditioning
Refrigeration	Domestic refrigeration	Domestic refrigeration
Refrigeration	Commercial Refrigeration	Stand-alone equipment
		Condensing units
		Centralised systems for supermarkets
Refrigeration	Industrial Refrigeration	Stand-alone equipment
		Condensing units
		Centralised systems
Refrigeration	Transport Refrigeration	Refrigerated trucks/trailers

(UNEP RTOC, 2010, modified)

## Foam categories

Cell type	Sub-application
Open cell type	Integral foam
Closed cell type	Refrigerated trucks
Closed cell type	Spray foam
Closed cell type	Commercial refrigeration
Closed cell type	Discontinuous panel
Closed cell type	Domestic refrigeration
Closed cell type	Continuous sandwich metal panel
Closed cell type	Continuous sandwich flexible facing panel
Closed cell type	Extruded Polystyrene



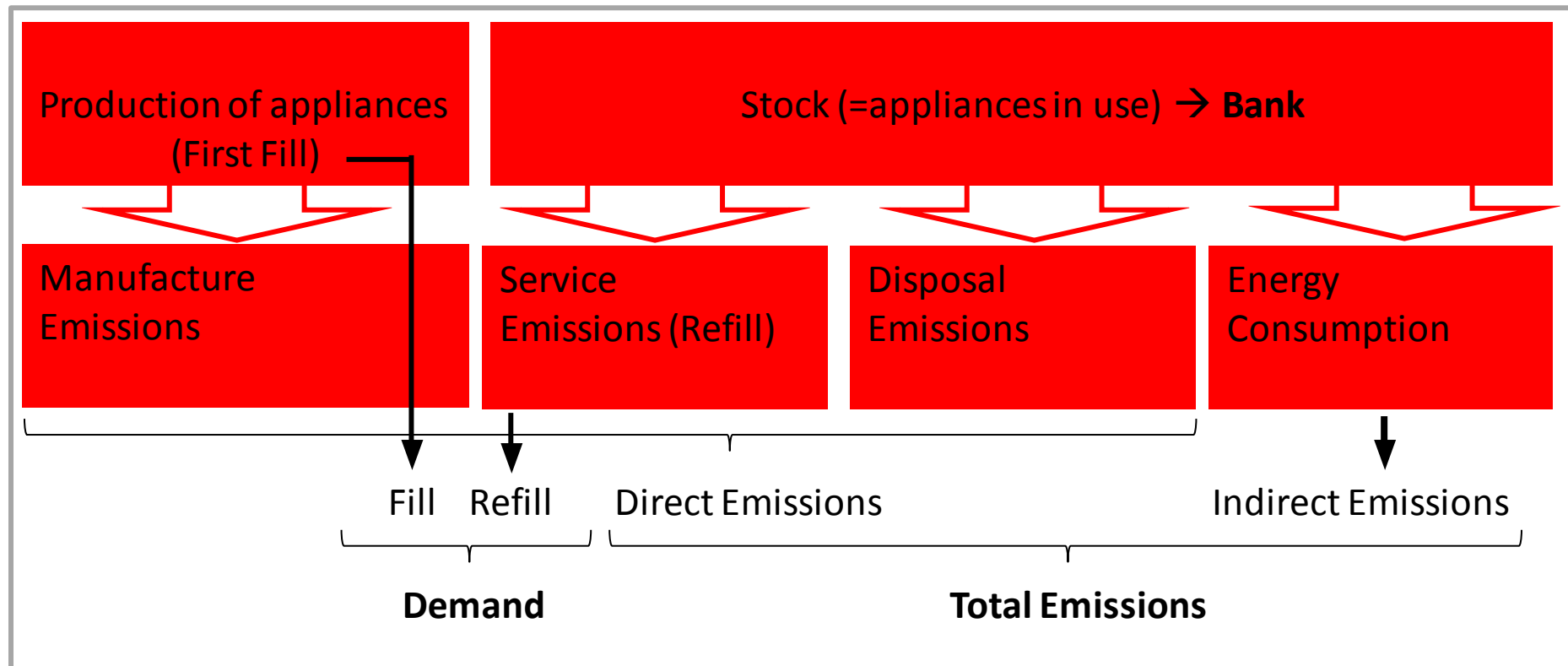
# Technical Options in the foam sector

- The replacement of the blowing agent

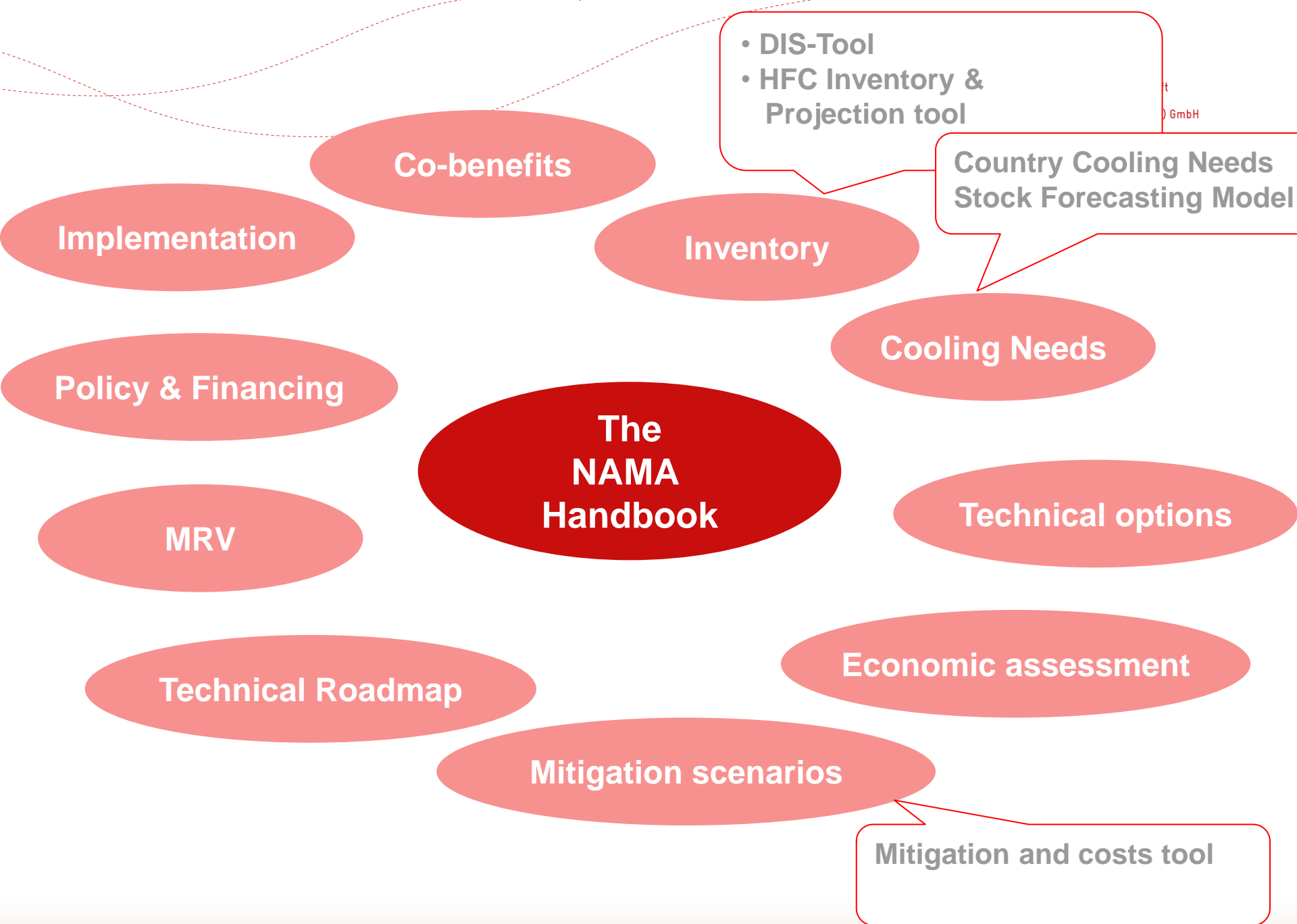
<b>Polyurethane (PU)</b>	<b>Extruded polystyrene (XPS)</b>
Hydrocarbons	Hydrocarbons
Unsaturated-HFCs	HFC 152a
Methylformate and Methylal	CO <sub>2</sub> and CO <sub>2</sub> blends
Waterblown	...
...	

- Recycling of foam products with recovery of the blowing agent

# Terminology



HFC units → National Communications; HCFC and HFC units → NAMA

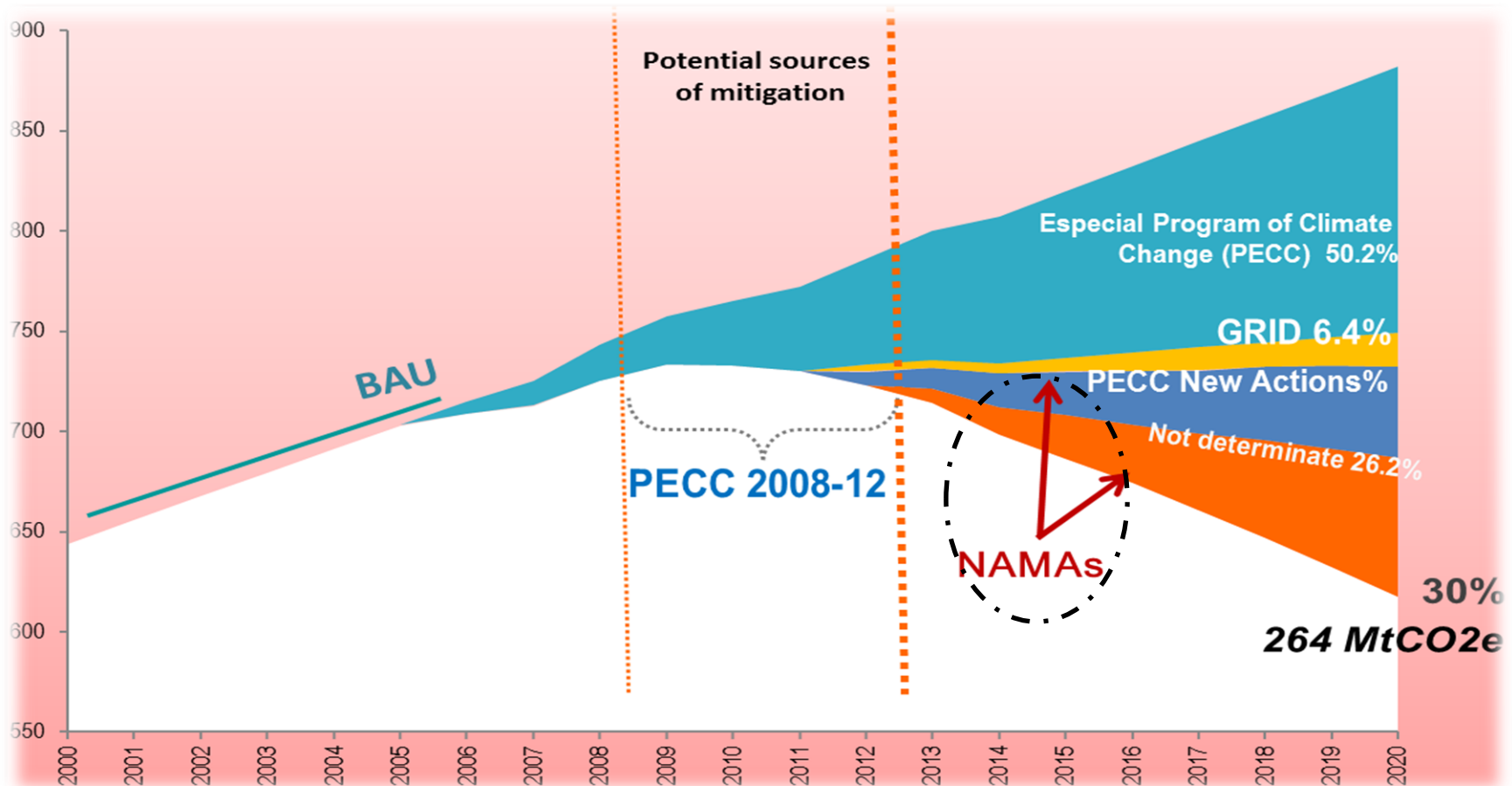


- DIS-Tool
- HFC Inventory & Projection tool

Country Cooling Needs Stock Forecasting Model

Mitigation and costs tool

# Mexico Commitment: 30% reduction from BAU on 2020



## Expected future annual growth rates

Self-contained air conditioners	8,5%
Split residential air conditioners	8,5%
Split commercial air conditioners	8,5%
Duct split residential air conditioners	8,5%
Commercial ducted splits	8,5%
Rooftop ducted	8,5%
Multi-splits	8,5%
Air conditioning chillers	8,5%
Process chillers	8,5%
Car air conditioning	4,3%
Large vehicle air conditioning	7,8%
Domestic refrigeration	3,0%
Stand-alone equipment	13,4%
Condensing units	11,7%
Centralised systems for supermarkets	8,4%
Integral	
Condensing units	
Centralised systems	
Refrigerated trucks/trailers	8,5%



BAU - 2020 and BAU- 2030	HCFC-22	HCFC-123	HCFC-141b	HCFC-142b	HFC-32	HFC-125	HFC-134a	HFC-152a	HFC-143a	HFC-227ea	HFC-365mfc	HFC-407C	HFC-404A	HFC-410A	HC-600a	HC-290	R-717	R-744	low GWP	unsat HFC
Self-contained air conditioners												50%		50%						
Split residential air conditioners												50%		50%						
Split commercial air conditioners												50%		50%						
Duct split residential air conditioners												50%		50%						
Commercial ducted splits												50%		50%						
Rooftop ducted												50%		50%						
Multi-splits												50%		50%						
Air conditioning chillers							100%													
Process chillers																				
Car air conditioning							100%													
Large vehicle air conditioning							100%													
Domestic refrigeration							90%								10%					
Stand-alone equipment							100%													
Condensing units													100%							
Centralised systems for supermarkets													100%							
Integral																	100%			
Condensing units																	100%			
Centralised systems																	100%			
Refrigerated trucks/trailers							50%						50%							

### HFC emissions: domestic refrigeration

