

## **Importance of RAC sector focusing on ozone depletion and climate change**

**GIZ Proklima**

**Bangkok, 31st July 2012**

## Agenda

**Rational for NAMAs in the Refrigeration, Air Conditioning & Foam Blowing sector**

**NAMA Example: Refrigeration and Air Conditioning (RAC)**

**Towards a NAMA in the RAC&FB sector in Thailand**

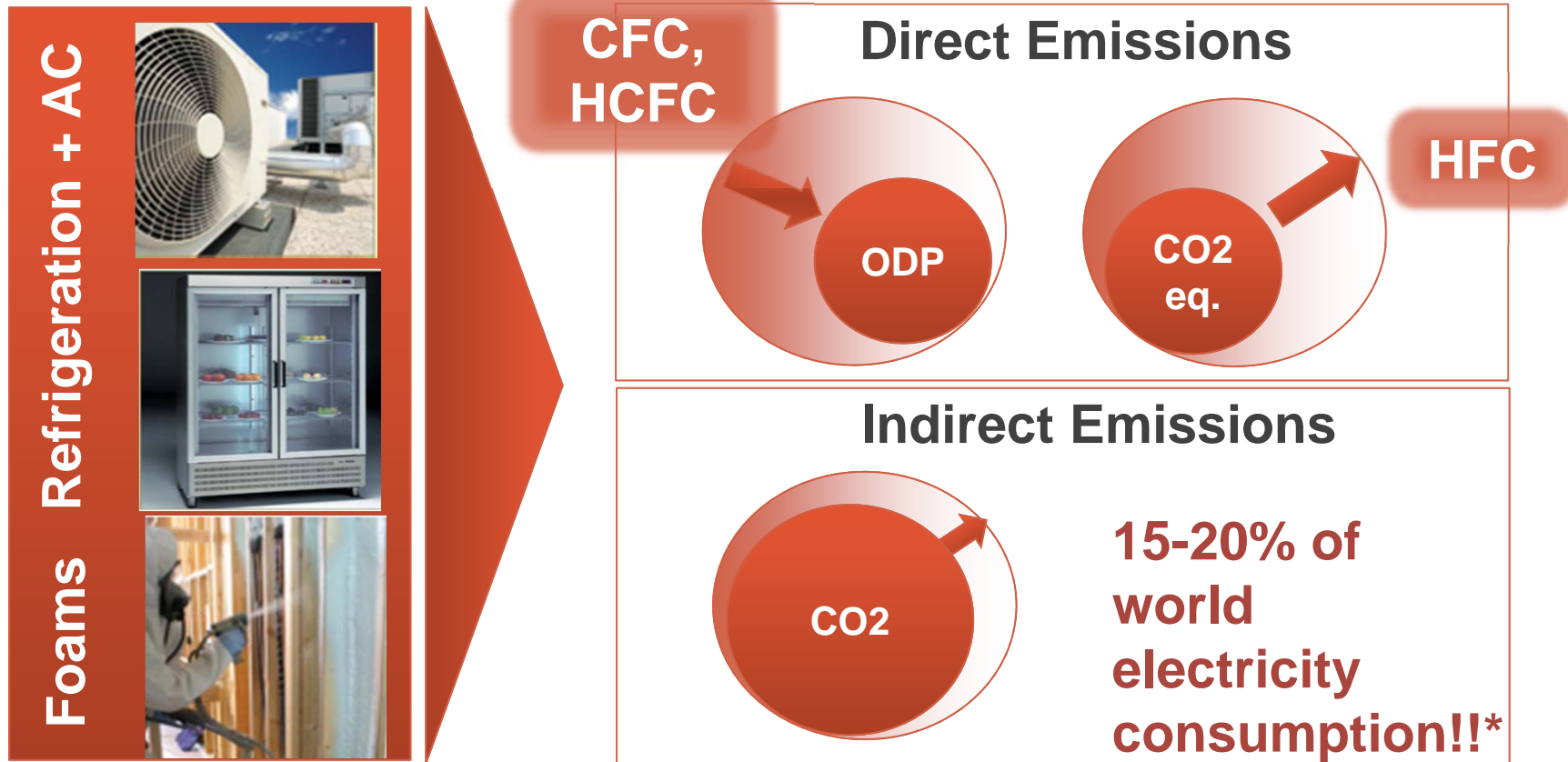
## Agenda

**Rational for NAMAs in the Refrigeration, Air Conditioning & Foam Blowing sector**

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## Background – Climate Impact Refrigeration and Air Conditioning

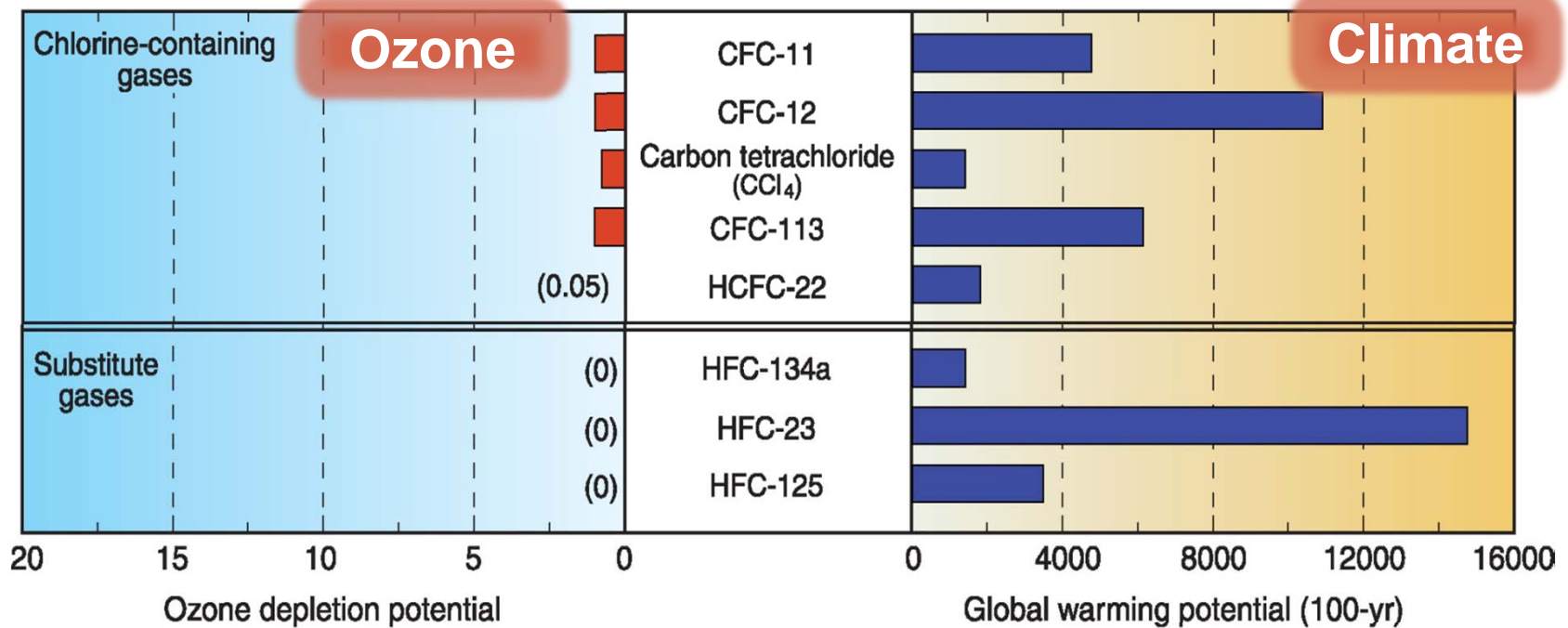


\*IIR, 2002

## Background – From CFC, HCFC to HFC

CFC-11 – 1

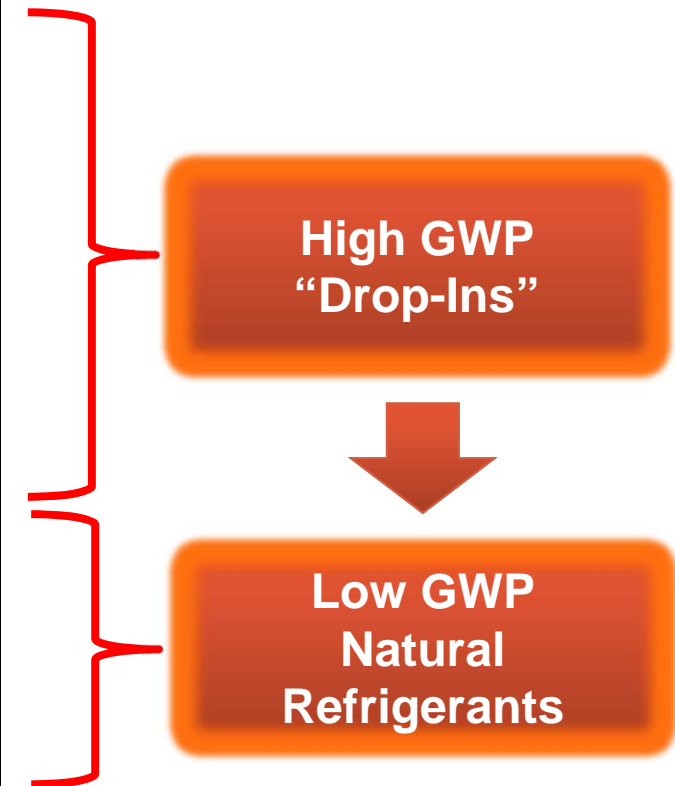
CO<sub>2</sub> = 1



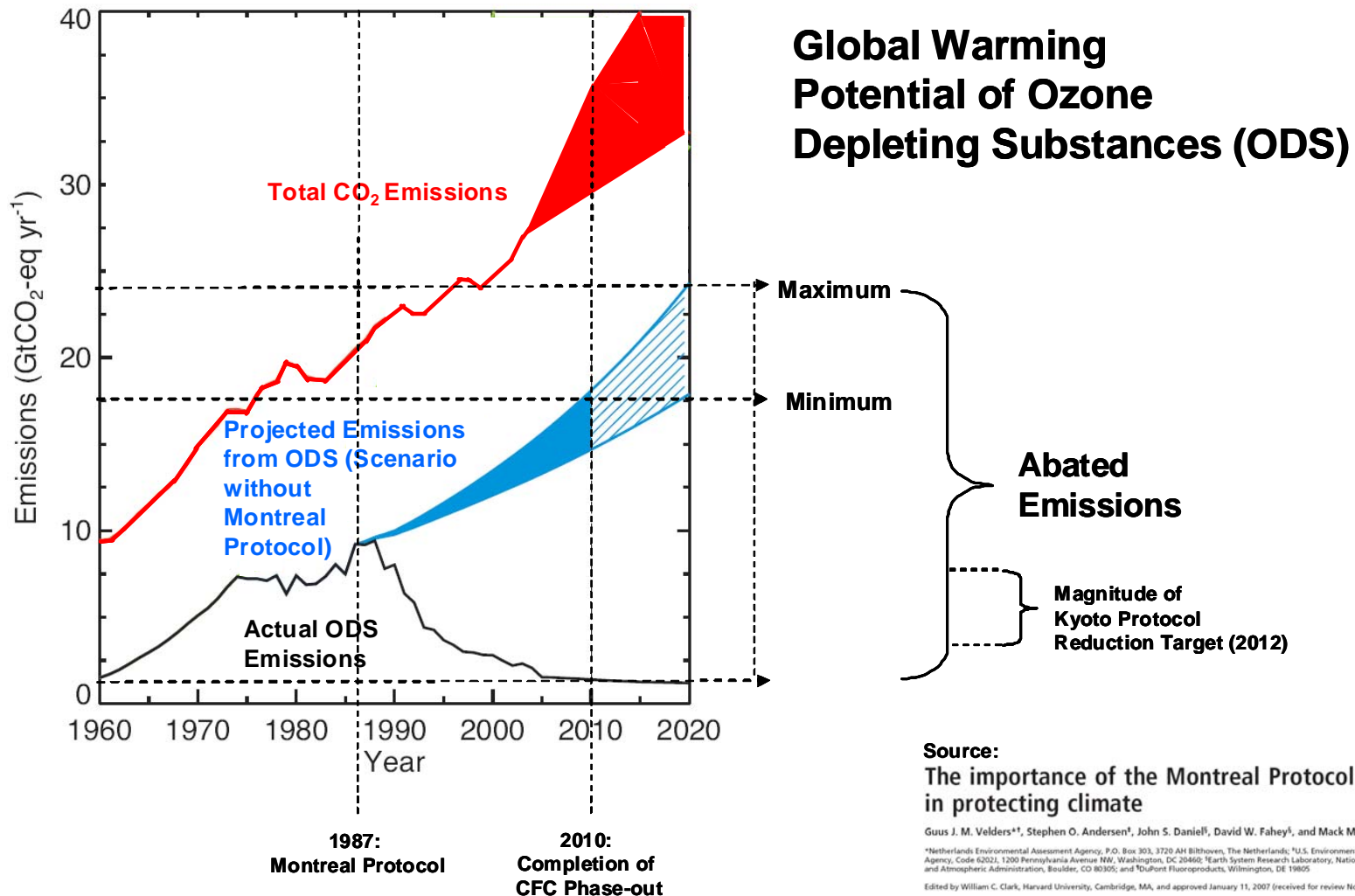
**HFCs have no effect on the ozone layer, but are potent greenhouse gases.**

## There are climate-friendly alternatives!

Refrigerant	Group	Atmospheric life	ODP	GWP
R11	CFC	130	1	4000
R12	CFC	130	1	8500
R22	HCFC	15	.05	1500
R134a	HFC	16	0	1300
R404a	HFC	16	0	3260
R410a	HFC	16	0	1720
R507	HFC	130	1	3300
R717	NH <sub>3</sub>	-	0	0
R744	CO <sub>2</sub>	-	0	1
R290	HC	< 1	0	8
R600a	HC	< 1	0	8



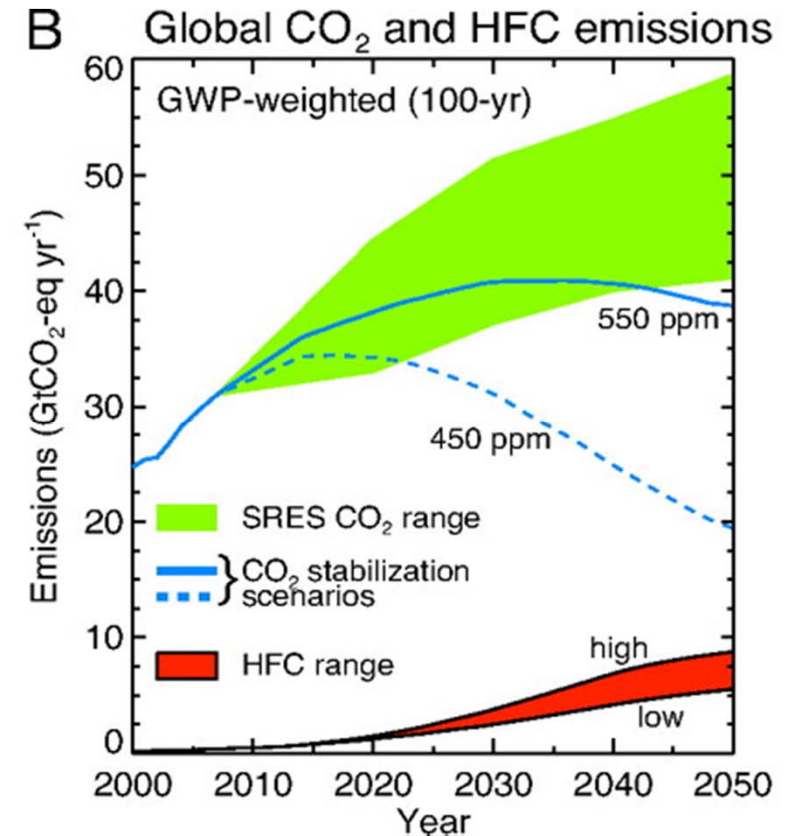
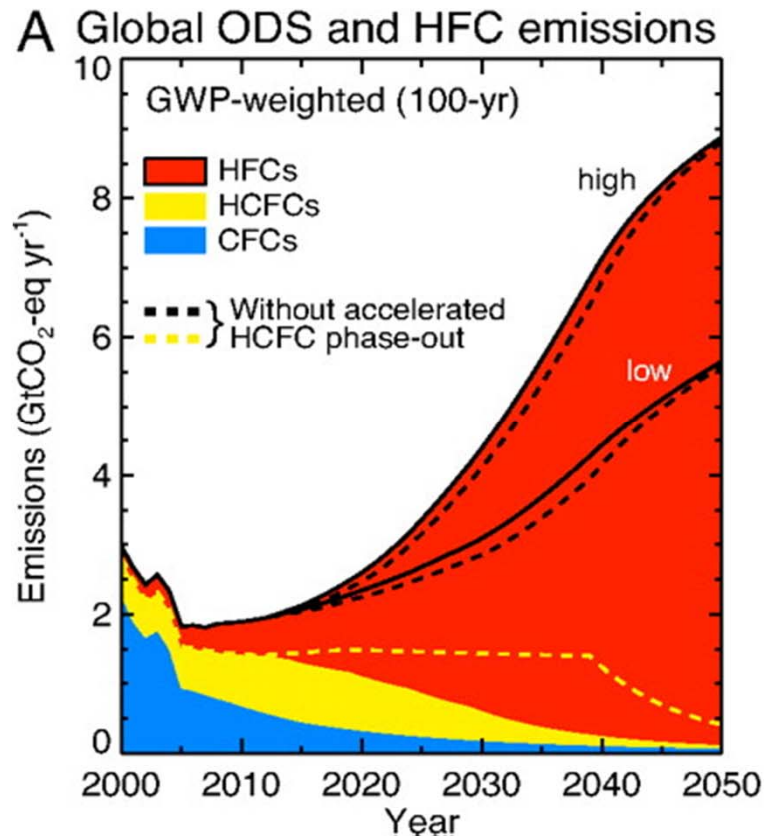
## GWP-weighted emission reductions through the Montreal Protocol



## Estimated HFC emissions till 2050

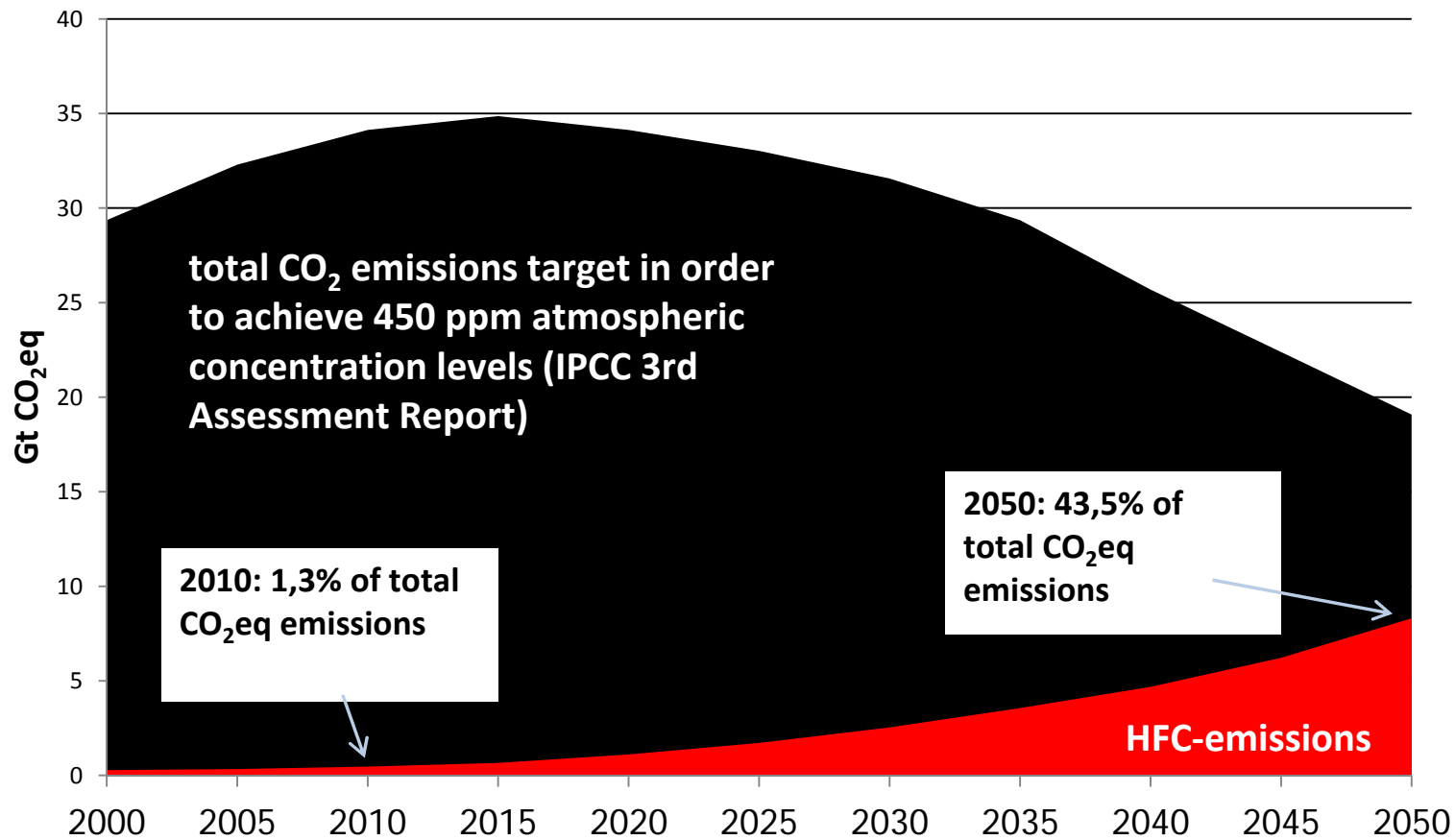
Fig A: Predicted Growth of HFCs without constraint

Fig B: HFC share of global GHG-emissions (compare HFC high vs. 450 ppm stabilization szenario → blue dotted line) Source: Velders, Guus J.M. et.al., 2009

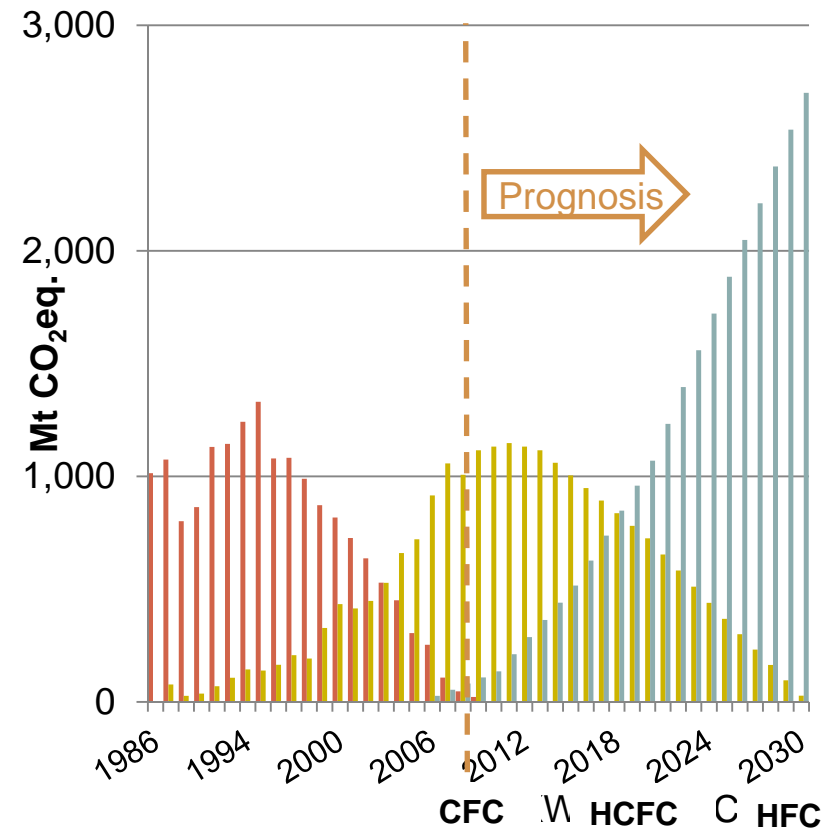
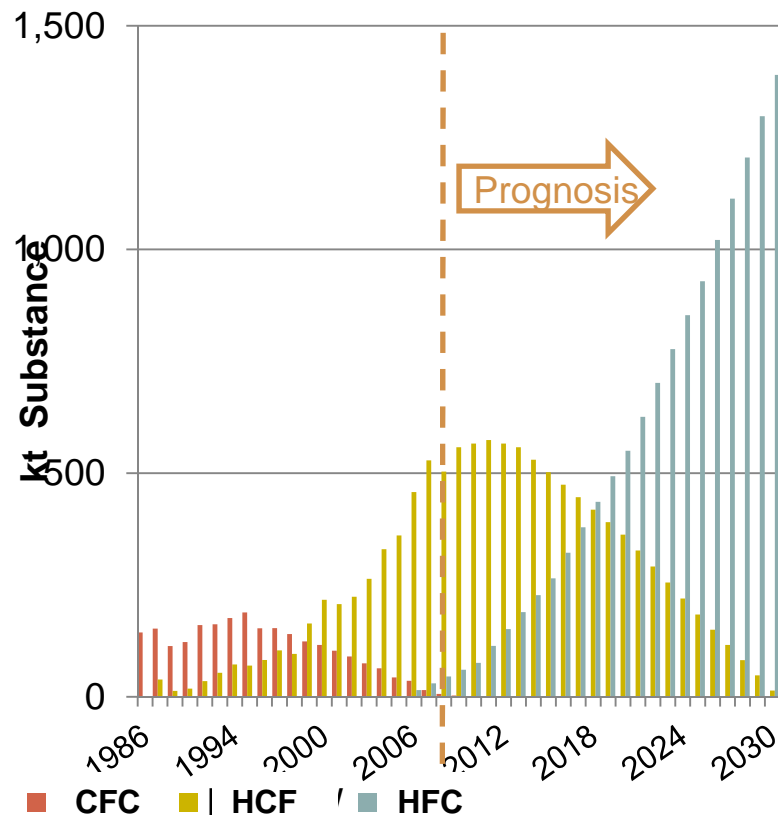




## Worldwide HFC-emissions projection till 2050

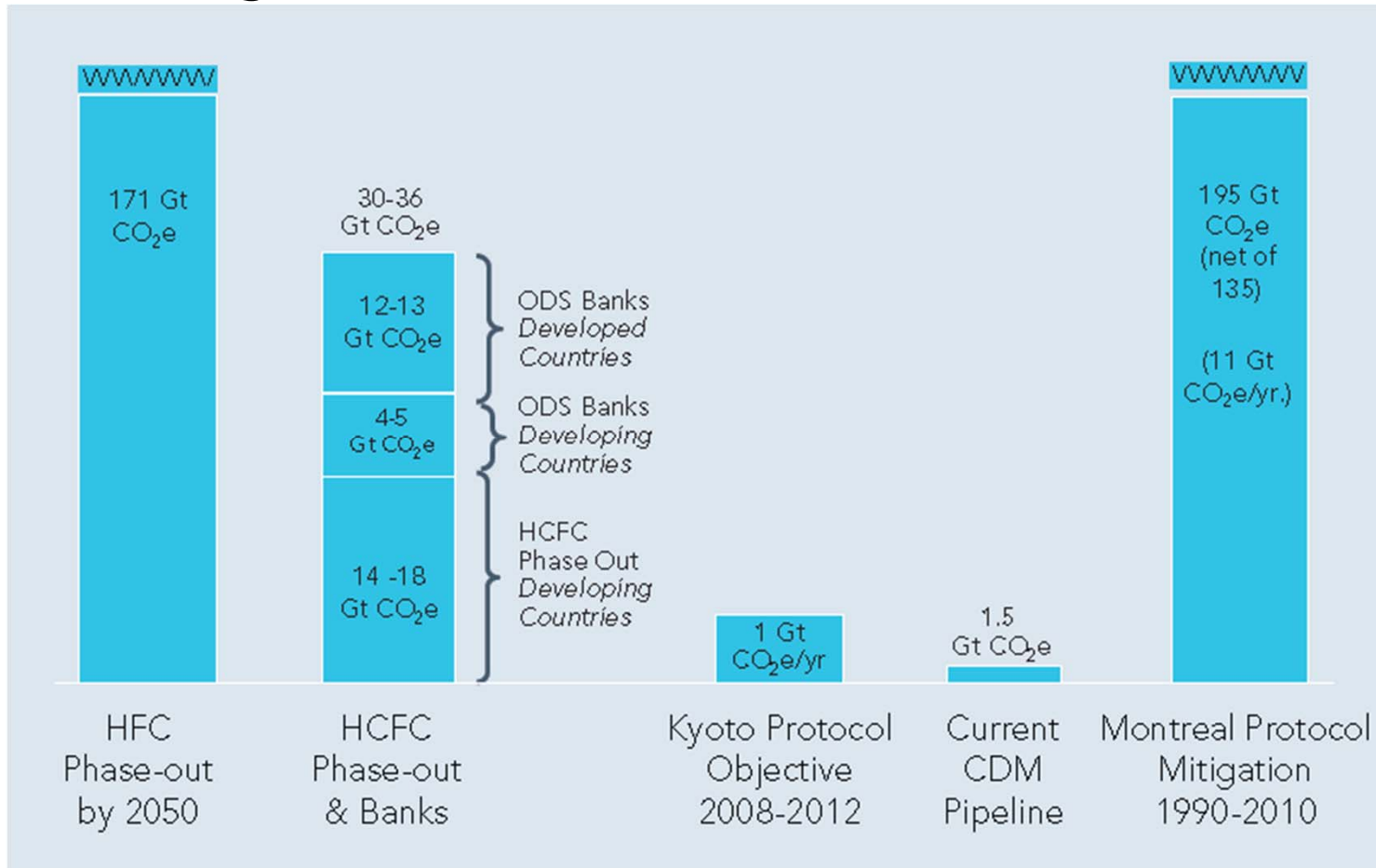


## CFC-, HCFC- and HFC-consumption in developing countries: Business as Usual



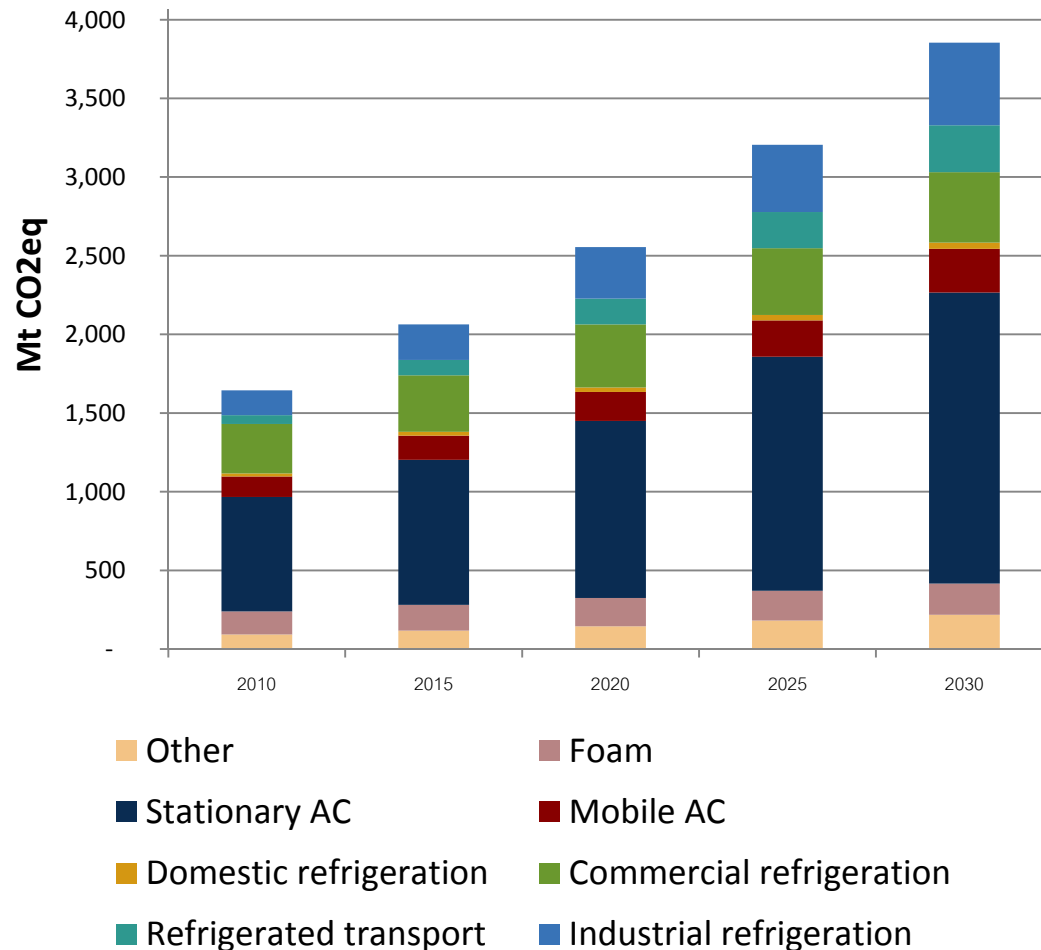
Source: UNEP and own projections

## Total emission reduction potential including banks



Source: UN Dept. of Public Information, 2009

## Global demand (mainly for AC) will drive demand for refrigerants (unabated)



- AC demand
  - more people
  - moving in cities
  - warm and humid climates
  - warmer world
  - more wealth
  - more ACs,.....
  
- Similar drivers for
  - commercial refrigeration
  - industrial refrigeration
  - mobile AC and refrig.

## There are alternatives for (nearly) all applications!



**Mobile AC**

**Domestic  
Ref.**

**Comm.  
Ref.**

**Industr.  
Ref.**

**AC**

**Foams**



**CO<sub>2</sub>,  
HC**

**HC**

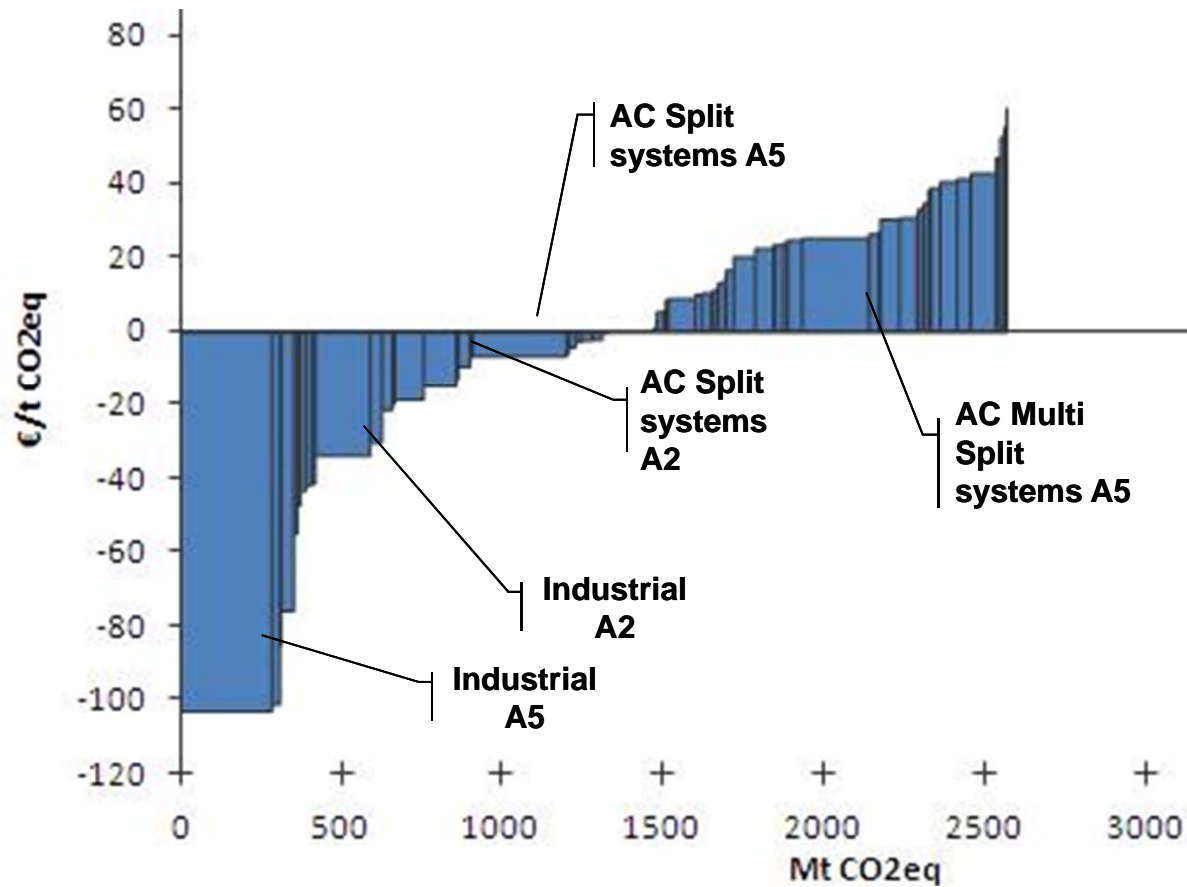
**CO<sub>2</sub>**

**NH<sub>3</sub>**

**HC**

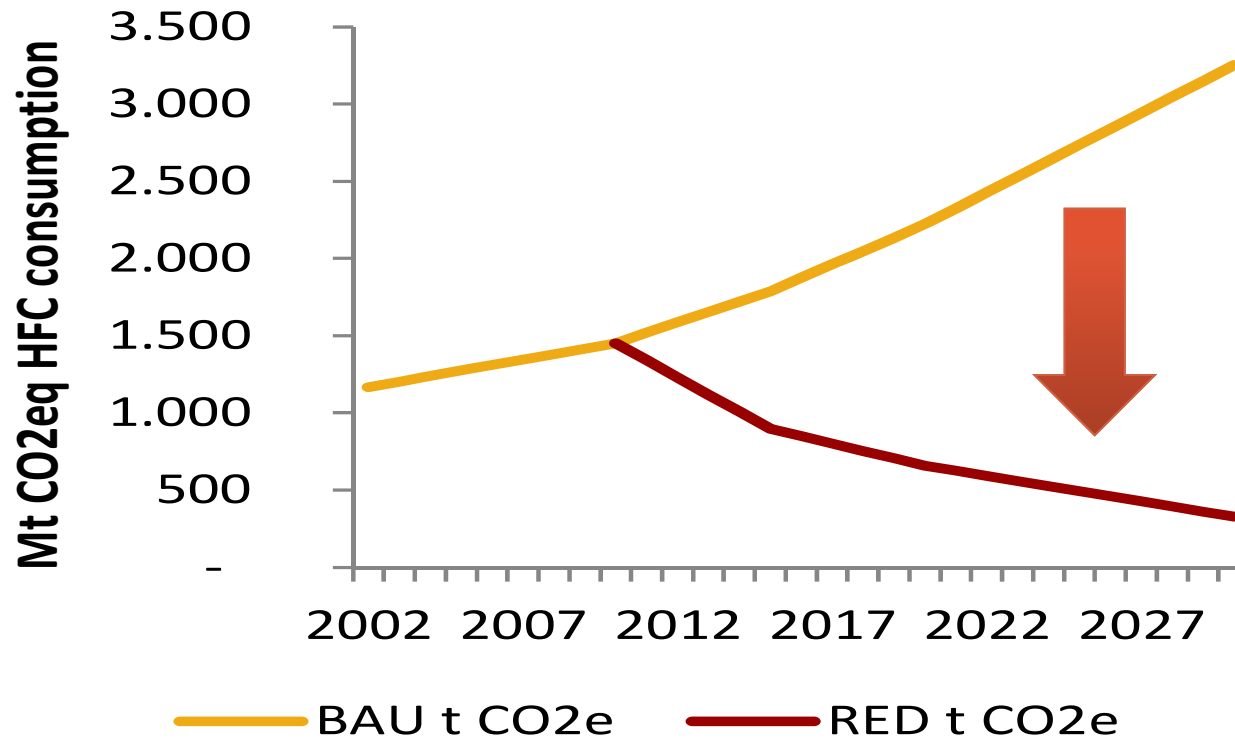
**CO<sub>2</sub>/  
HC**

... and often they make better economics!

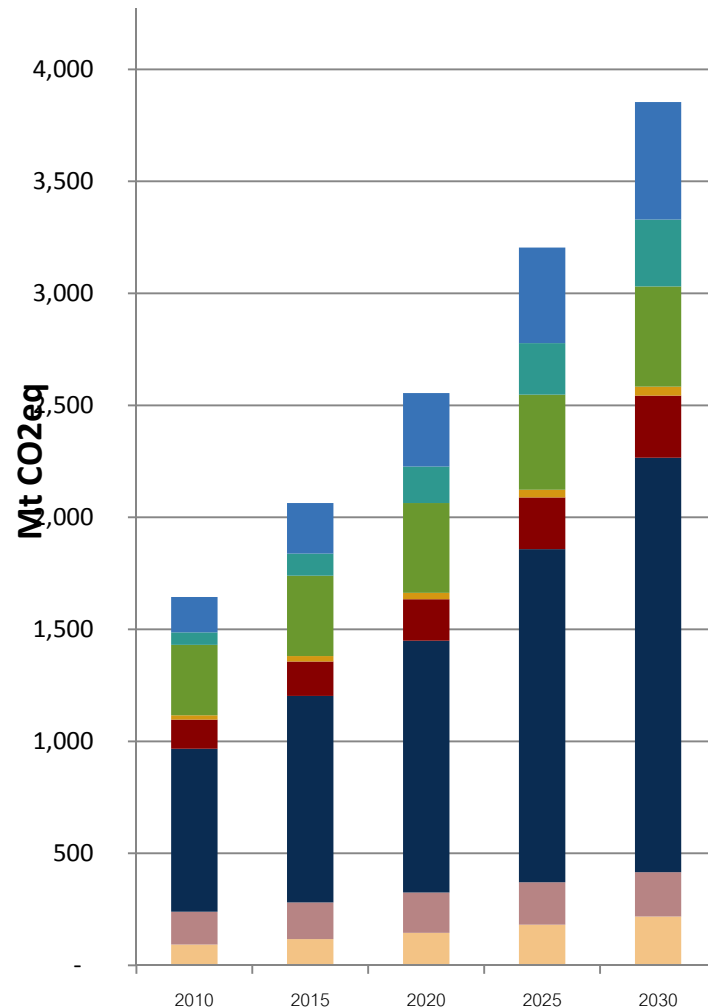


World 2020 Scenario

## Strong reduction possible ... to a large extent without additional costs to the society



## ... addressing alternative solutions in key countries and subsectors ..



• Domestic Refrigeration – Swaziland (HC)

• Commercial Refrigeration – SA (NH3, CO2)

• Mobile AC – South Africa - trans. Refrigeration (CO2)

• Room AC China/ India (HC R290)  
• Central Chiller Mauritius (NH3)

HPMP XPS Foam Sector Plan China (HC, CO2)



## Agenda

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**NAMA Example: Refrigeration and Air Conditioning (RAC)**

**Towards a NAMA in the RAC&FB sector in Thailand**

## Abatement options – supermarkets

### Conventional technology

Centralised pack concept, HCFC-22

High leakage rate, large refrigerant charge



### Abatement Option

### Expected result

Reduction of leakages

Reduction of direct emissions

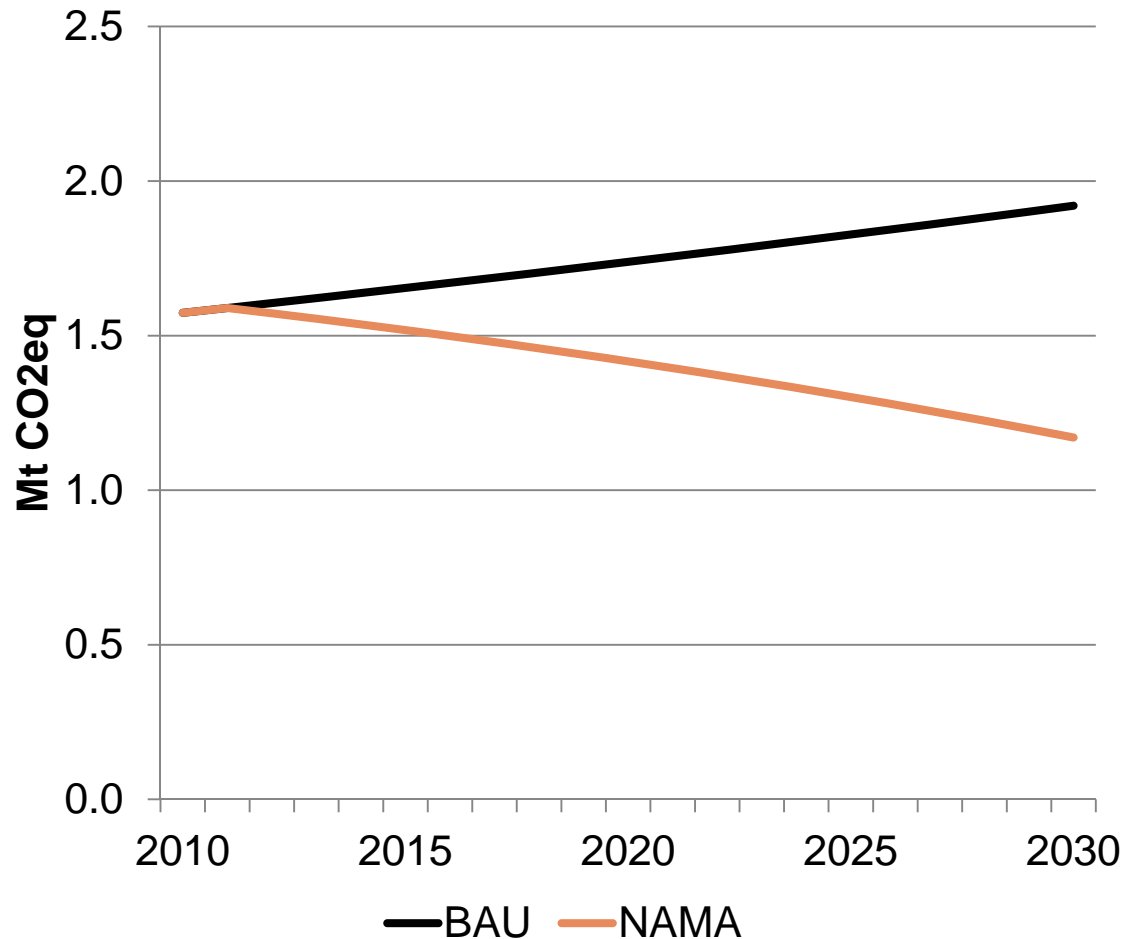
Introduce Low-GWP refrigerant

Reduction of direct emissions

Improvement of energy efficiency

Reduction of indirect emissions

## Sample NAMA mitigation scenario



- **BAU with direct and indirect emissions**
- **1% growth of stores p.a.**
- **5% of stores are converted annually (app. 55 p.a.)**
- **20% efficiency improvement compared to conv.**
- **100% direct emissions avoided**

## Agenda

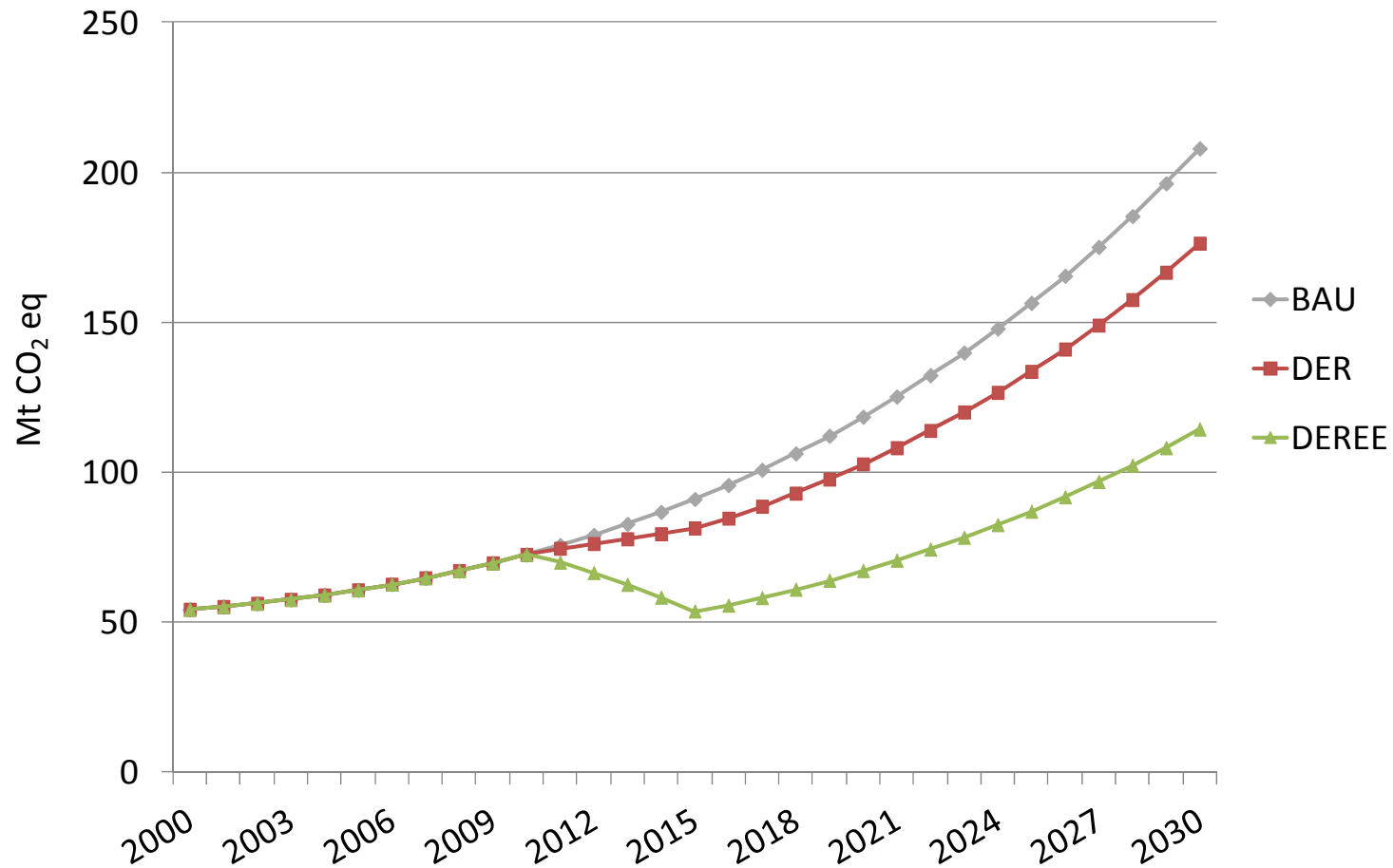
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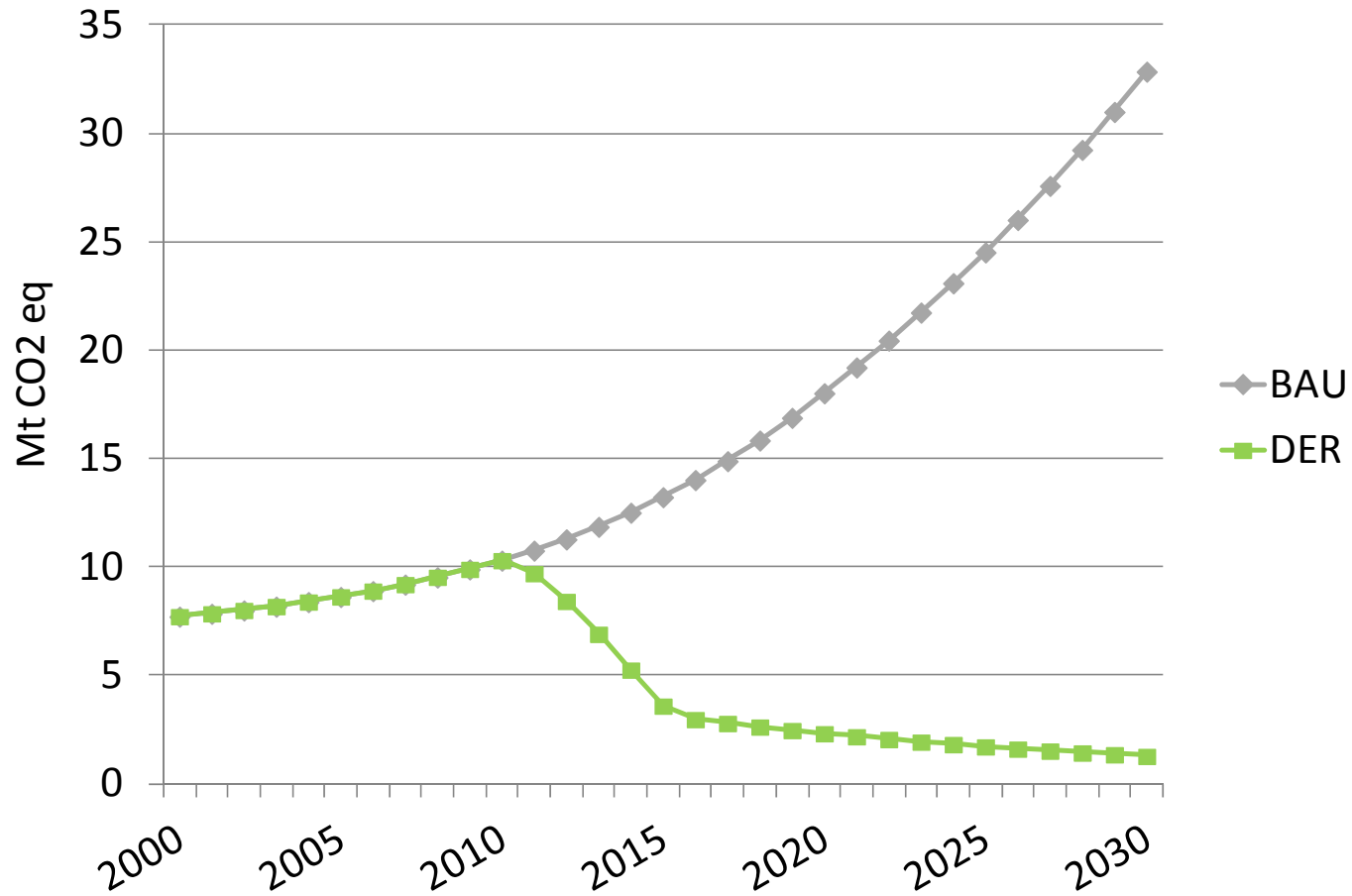
## RAC Emission pathways for Thailand (preliminary results!)

Total emissions and Reduction potential



## RAC Emission pathways for Thailand (preliminary results!)

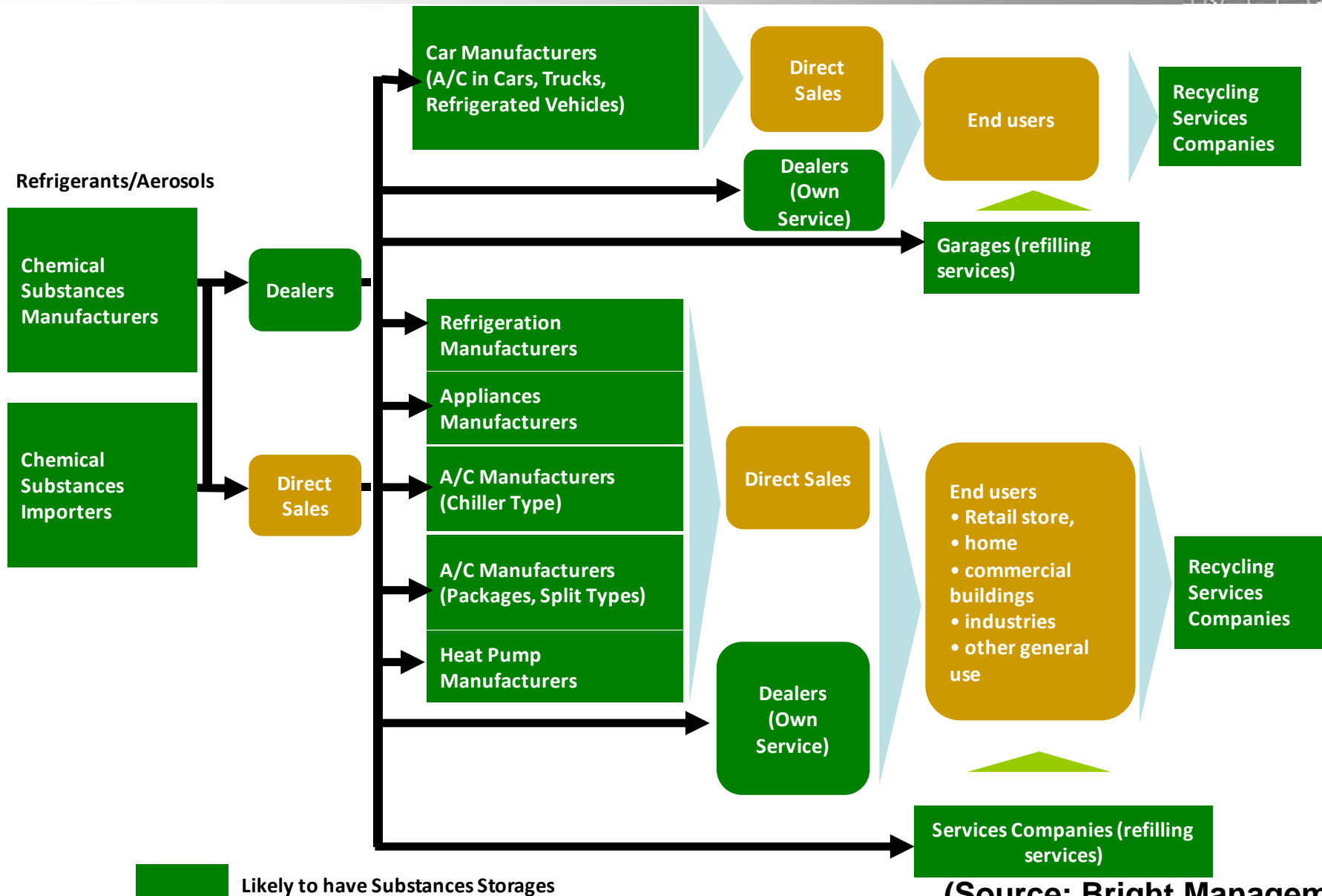
Total Direct Emissions



## Working Plan: RAC&FB NAMA in Thailand

Part I: Inventory/ Stakeholder Engagement	Step 1	Stakeholder (Industry) Engagement	Institutional development and stakeholder engagement
	Step 2	Establishment of Inventory	
Part II: Preparing NAMA Description Document (NAMA-DD)	Step 3	Defining Sector BAU and Mitigation Scenarios	
	Step 4	Identification of Subsectors for Mitigation Action	
	Step 5	Alternative Technologies + Barrier Removal	
	Step 6	Policy and Financing	
	Step 7	Roadmap	
	Step 8	Upload NAMA – DD for Registration	
Part III: NAMA Implementation	Step 9	Enabling implementation of measures	
	Step 10	NAMA support framework	
	Step 11	NAMA Progress and verification of emission reductions	

# RAC NAMA



(Source: Bright Management)



## RAC categories

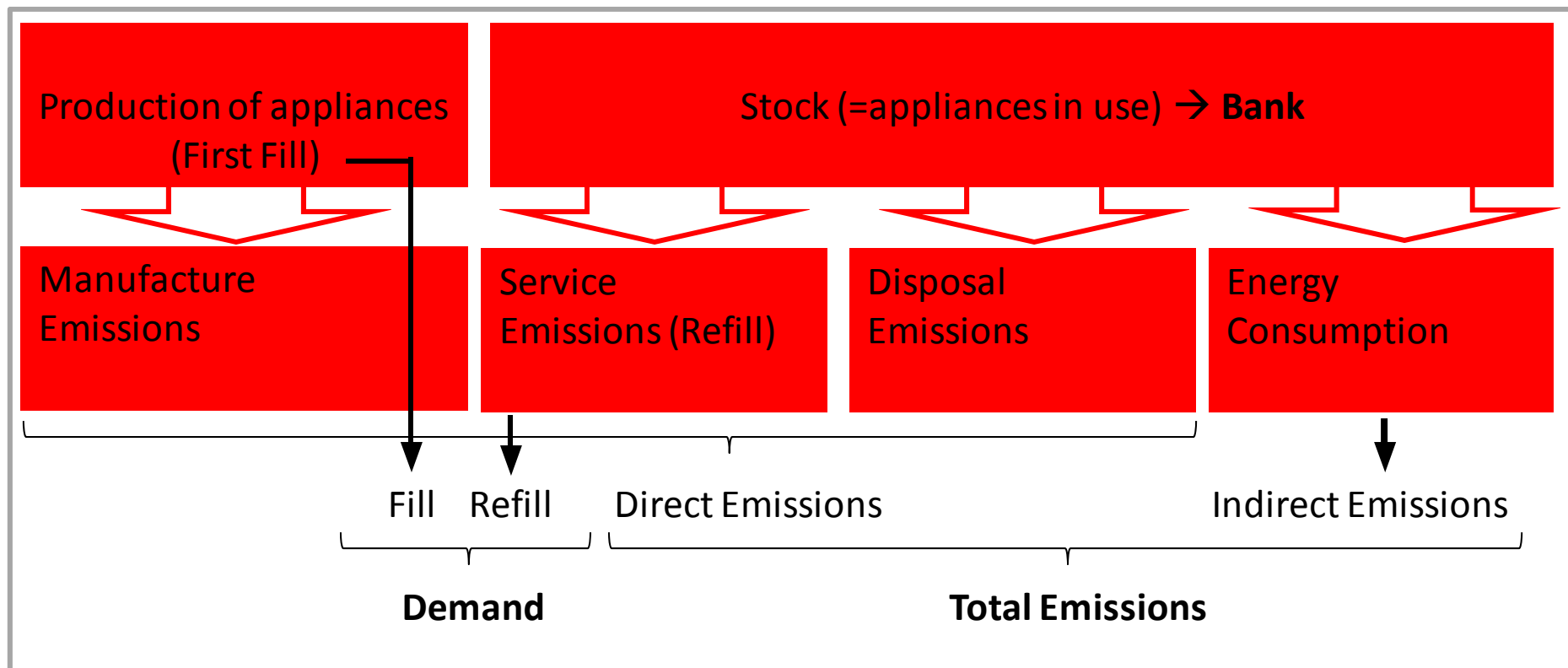
Sector	Subsector
Unitary air conditioning	Self-contained air conditioners
	Split residential air conditioners
	Split commercial air conditioners
	Duct split residential air conditioners
	Commercial ducted splits
	Rooftop ducted
	Multi-splits
Chillers	Air conditioning chillers
	Process chillers
Mobile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

(UNEP RTOC, 2010, modified)

## Foam categories

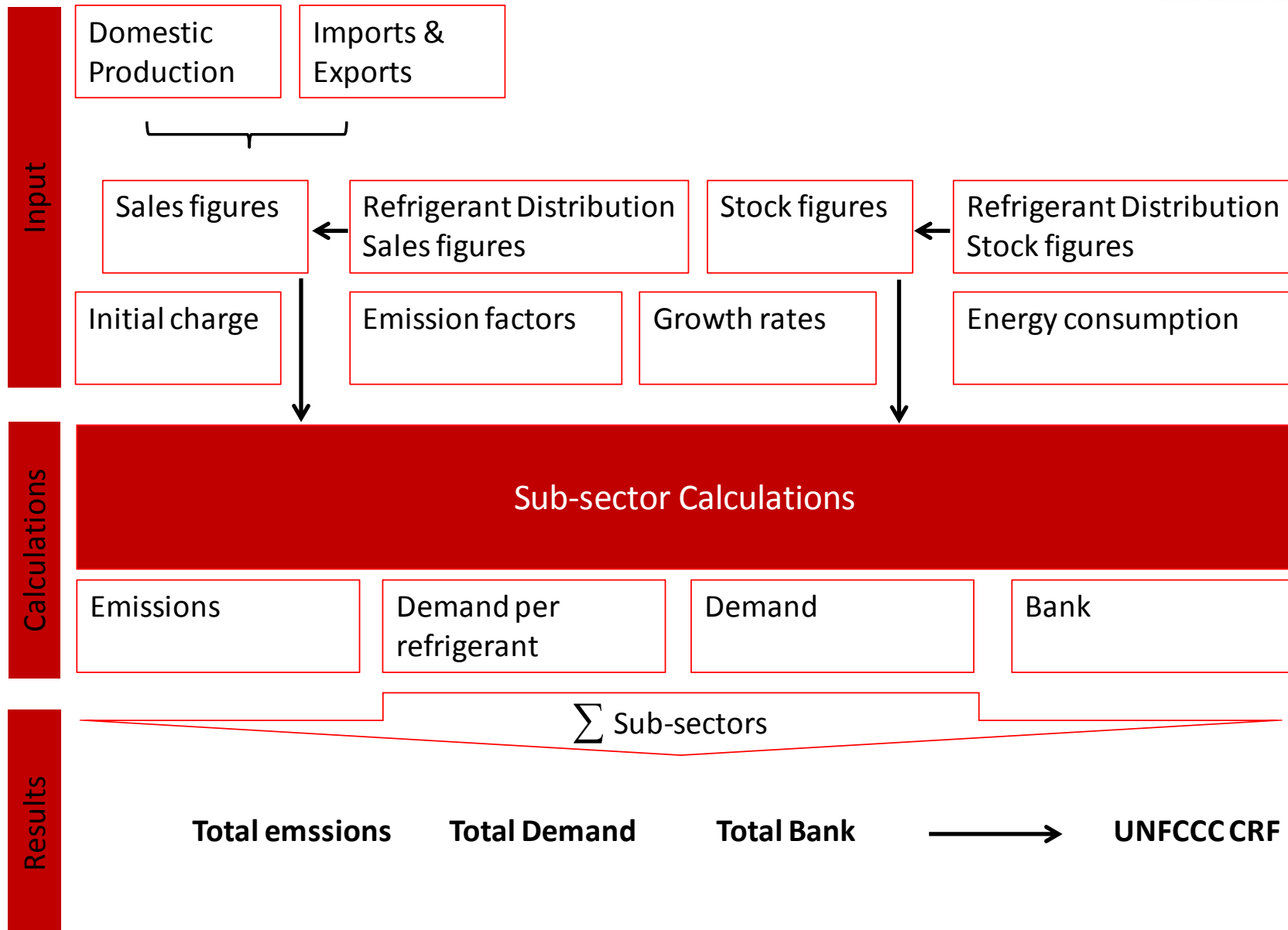
Cell type	Sub-application
Open cell type	PU Flexible Foam Continuous
	PU Flexible Foam Discontinuous
	PU Flexible Moulded Foam
	PU Integral Skin Foam
Closed cell type	PU Continuous Panel
	PU Continuous Flexible panel
	PU Discontinuous Panel
	PU Appliance Foam
	PU Continuous Block
	PU Discontinuous Block
	PU Spray Foam
	PU Pipe-in-Pipe
	PU OCF (bottle foam)
	PU Rigid foam all other applications
XPS Extruded Polystyrene boards	

## Inventory: Appliance numbers (equipment) in Thailand → Estimate of Bank, Demand and Emissions

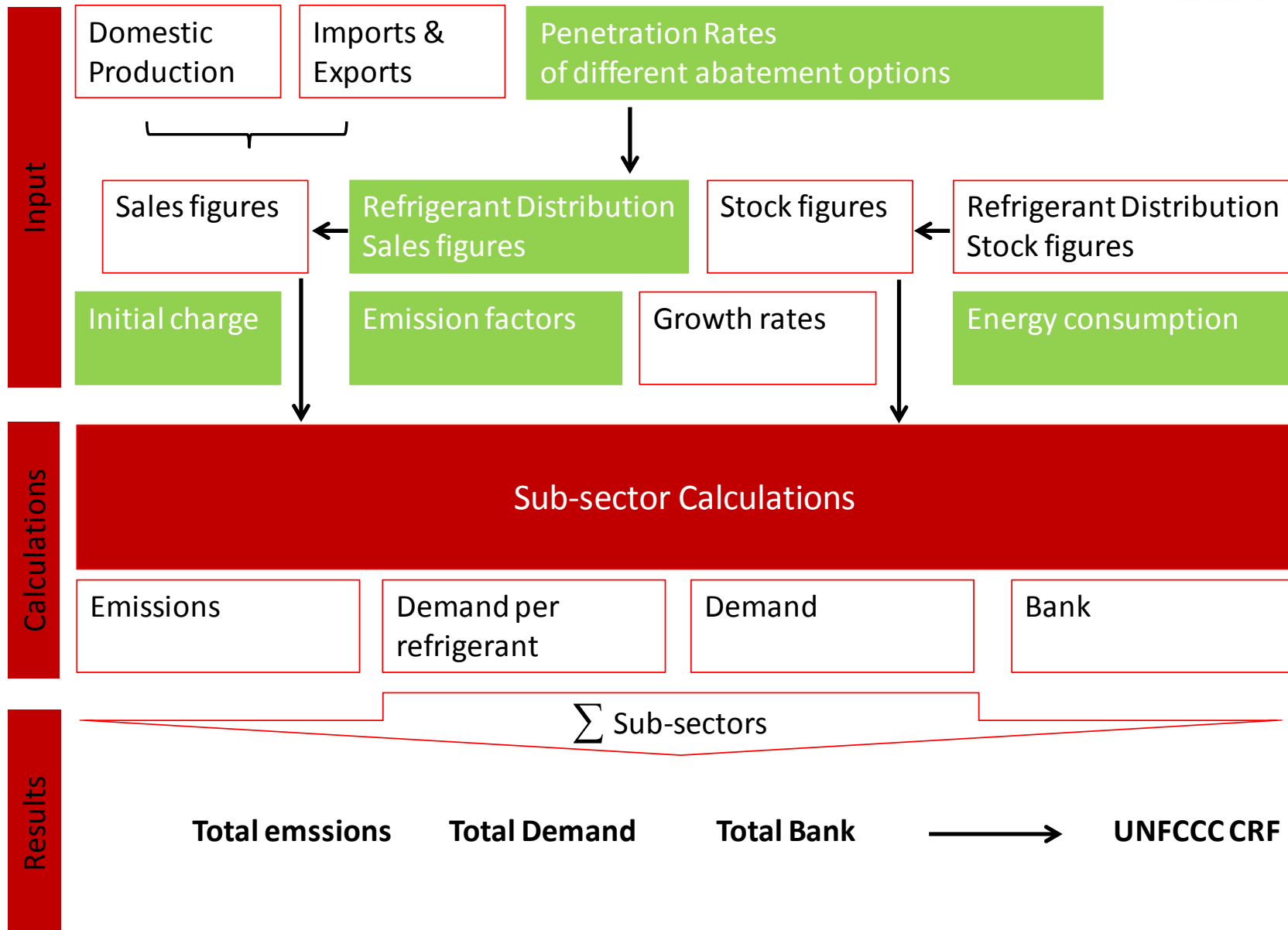


**Following the Tier 2a emission-factor approach (IPCC, 2006)**

# RAC NAMA



# RAC NAMA



## Feed vintage bottom-up model with inventory data from Thailand

How many units are produced in your country?		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Sector	Sub-sector											
Unitary air conditioning	Self-contained air conditioners											
Unitary air conditioning	Split residential air conditioners											
Unitary air conditioning	Split commercial air conditioners											
Unitary air conditioning	Duct split residential air conditioners											
Unitary air conditioning	Commercial ducted splits											
Unitary air conditioning	Rooftop ducted											
Unitary air conditioning	Multi-split											
Chillers	Air conditioning in your country?											
Chillers	Process chillers											
Mobile AC	Car air conditioning											
Mobile AC	Large vehicle air conditioning											
Domestic refrigeration	Domestic Unitary air conditioning											
Commercial Refrigeration	Stand-alone Unitary air conditioning											
Commercial Refrigeration	Condensing units											
Commercial Refrigeration	Centralised systems for supermarkets											
Industrial Refrigeration	Integral Unitary air conditioning											
Industrial Refrigeration	Condensing units											
Industrial Refrigeration	Centralised systems											
Transport Refrigeration	Refrigerated trucks/trailers											
Mobile AC	Mobile AC											
Domestic refrigeration	Domestic refrigeration											
Commercial Refrigeration	Stand-alone equipment											
Commercial Refrigeration	Condensing units											
Commercial Refrigeration	Centralised systems for supermarkets											
Industrial Refrigeration	Integral											
Industrial Refrigeration	Condensing units											
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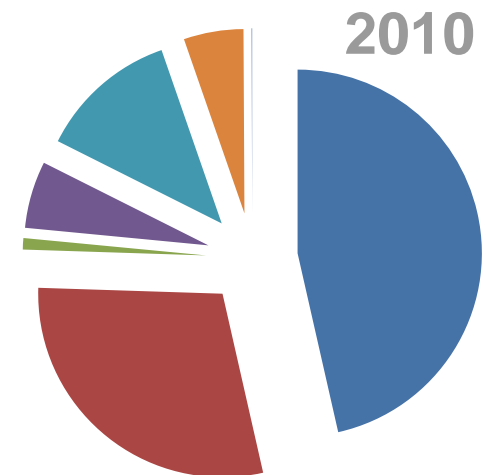
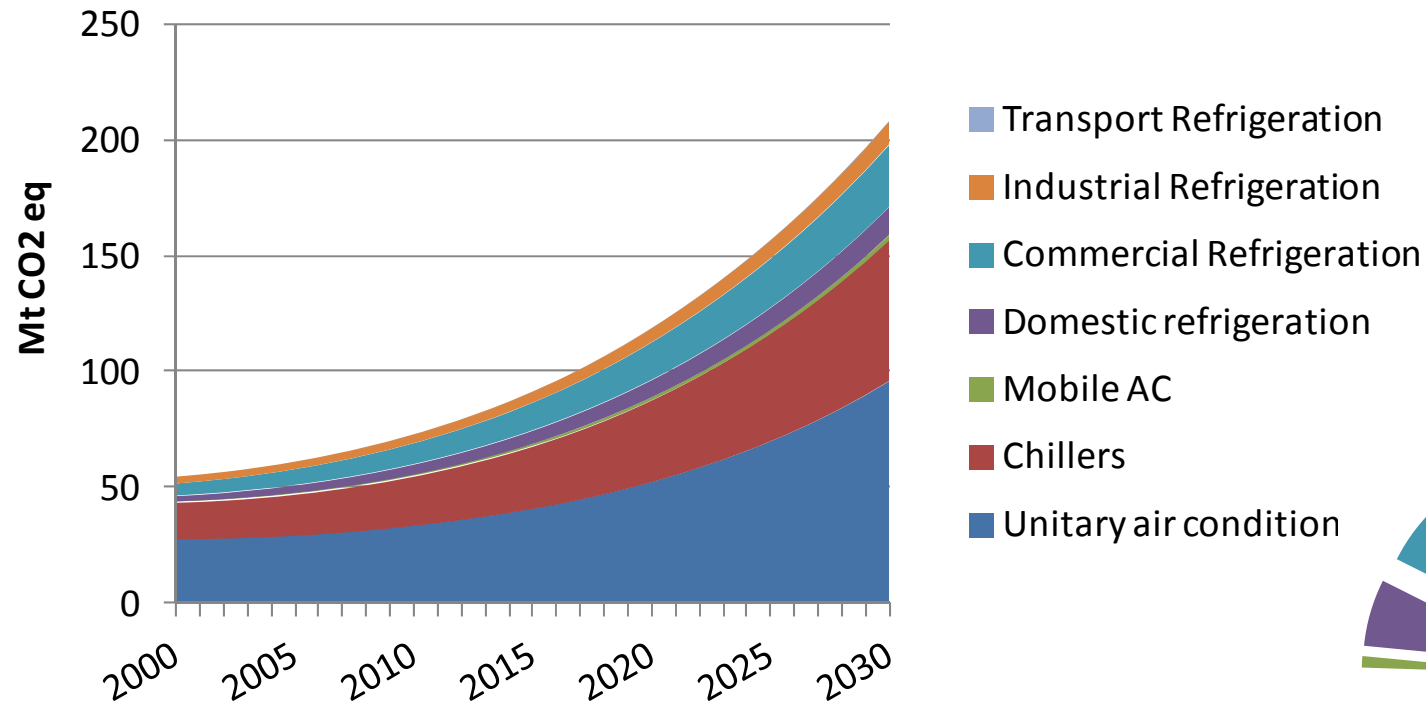
## Technical parameters needed

Refrigeration and air conditioning				Initial charge						
Initial Charge in New units [kg]				2000	2005	2010	2015	2020	2025	2030
Sector	Sub-sector	Please choose the dominant refrigerant from the drop-down list (Therefore click on the cell below)								
Unitary air conditioning	Self-contained air conditioners									
Unitary air conditioning	Split residential air c									
Unitary air conditioning	Manufacture Emission Factors (%)	<b>Manufacture Emission Factors</b>								
Unitary air conditioning	Initial Charge)									
Unitary air conditioning	Sub-sector	Refrigerant								
Unitary air conditioning	Self-contained air conditioners		0							
Unitary air conditioning	Split residential air conditioners		0							
Unitary air conditioning	Split commercial air conditioners									
Chillers	Unitary air conditioning	Service Emission Factors (%) of Initial Charge)	<b>Servicing Emission Factors</b>							
Mobile AC	Unitary air conditioning	Commercial Refrigeration								
Mobile AC	Unitary air conditioning	Rooftop								
Domestic refrigeration	Unitary air conditioning	Multi-split								
Commercial Refrigeration	Chillers	Air conditioning								
Commercial Refrigeration	Chillers	Process chillers								
Commercial Refrigeration	Mobile AC	Car air conditioning								
Industrial Refrigeration	Mobile AC	Large vehicle air conditioning								
Industrial Refrigeration	Domestic refrigeration	Domestic refrigeration								
Industrial Refrigeration	Commercial Refrigeration	Stand-alone equipment								
Transport Refrigeration	Commercial Refrigeration	Condensing units								
Commercial Refrigeration	Chillers	Air conditioning chillers								
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etc.

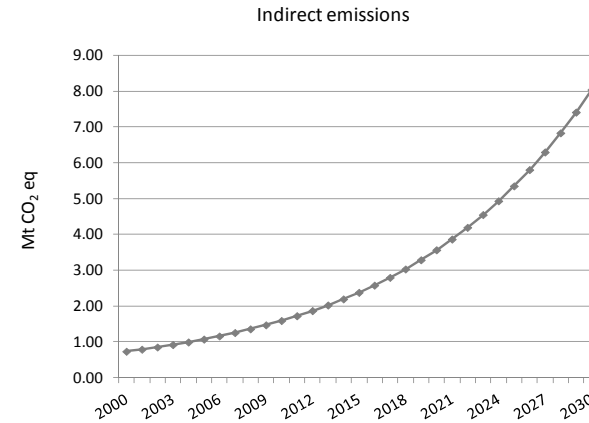
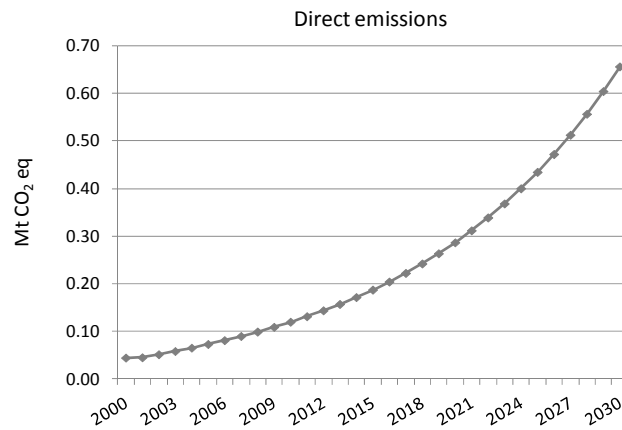
## Business as usual (BAU) simulations for Thailand (preliminary results!)

**Total Emissions (Direct + Indirect)**

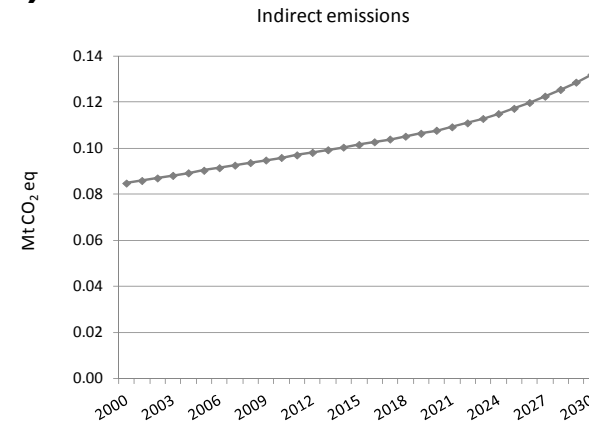
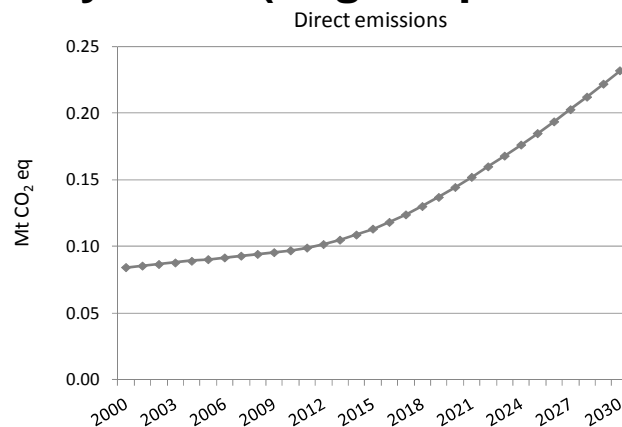


## BAU Direct and Indirect Emissions: Commercial Refrigeration

### Stand alone units (e.g. bottle cooler and ice cream freezers)



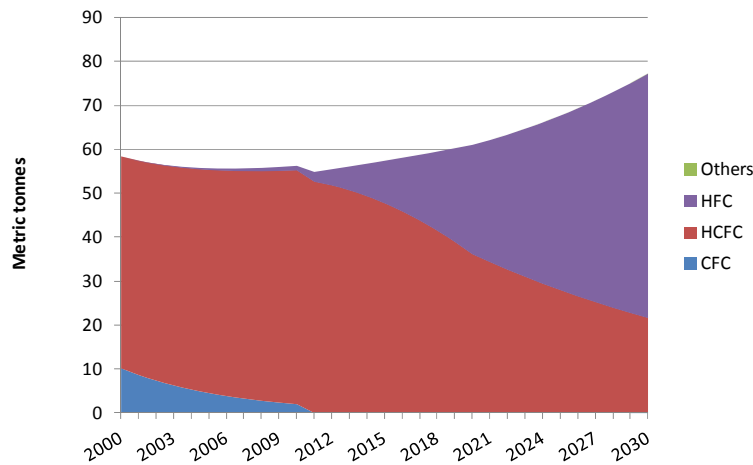
### Centralized systems (large supermarket)



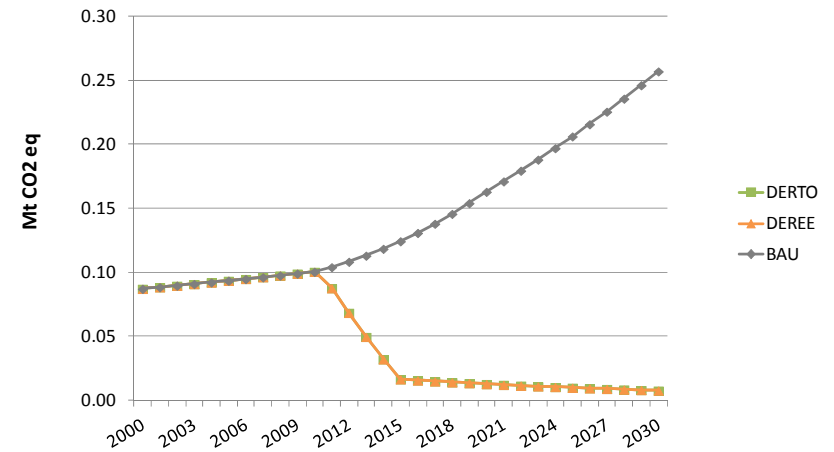


## BAU and Mitigation Scenarios – Centralized Systems

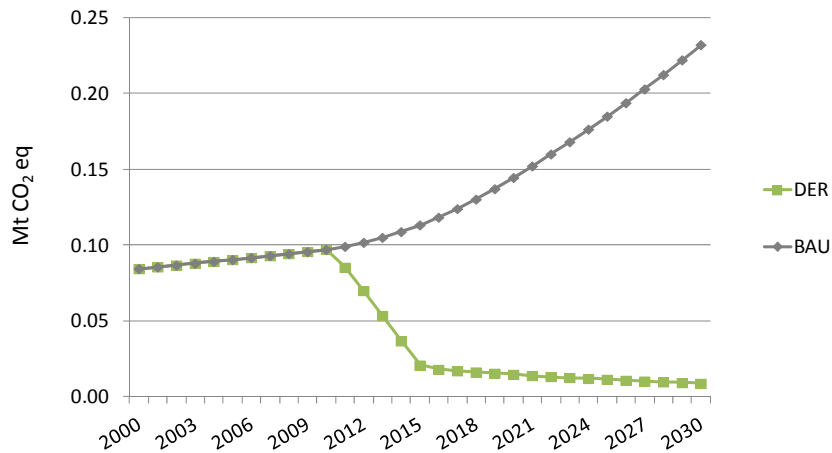
**Demand BAU**



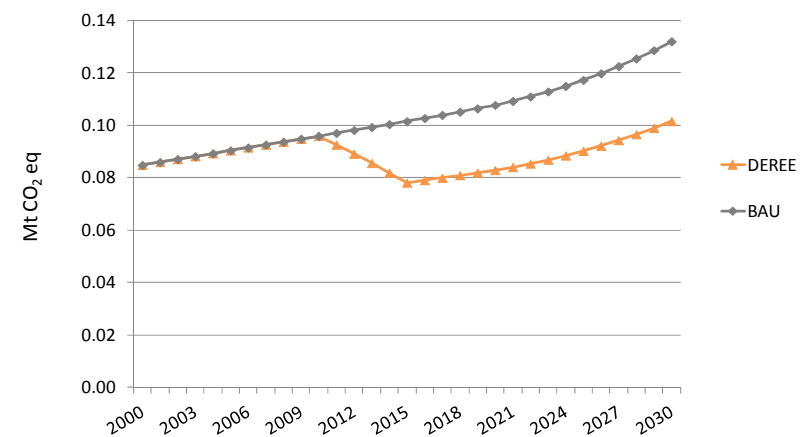
**Demand (Fill + Refill)**



**Direct emissions**

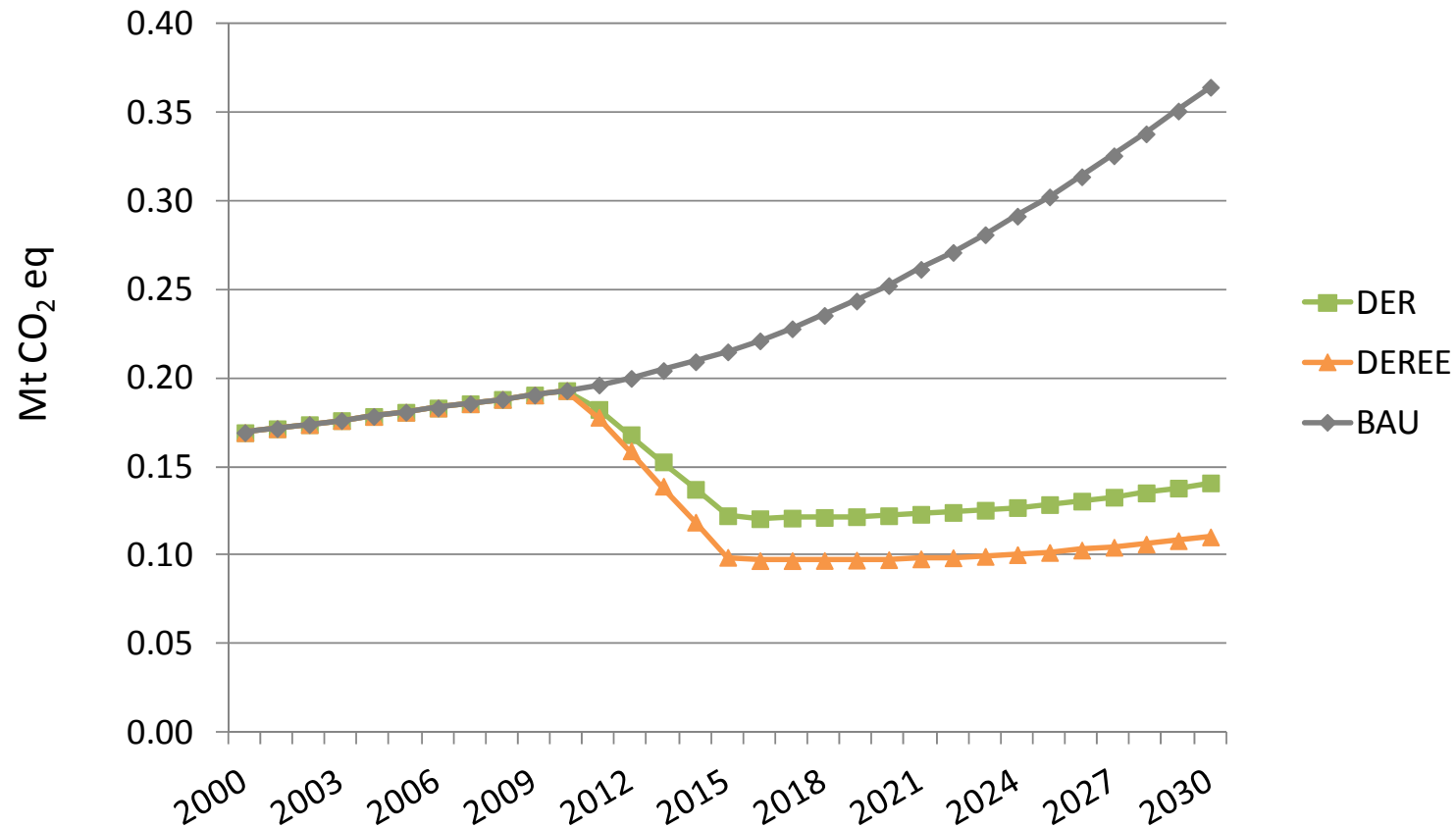


**Indirect emissions**



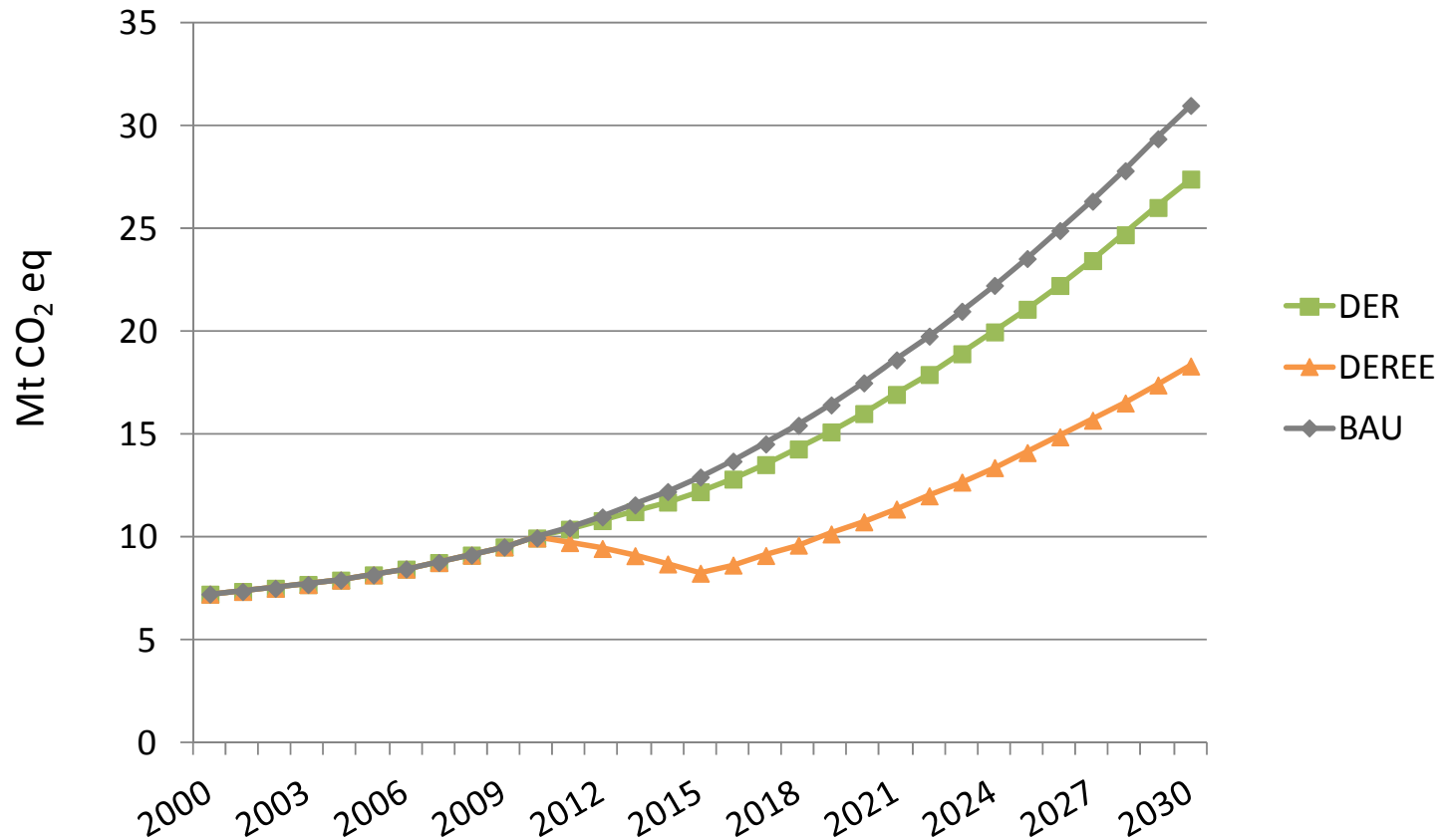
## BAU and Mitigation Scenarios – Centralized Systems

Total emissions



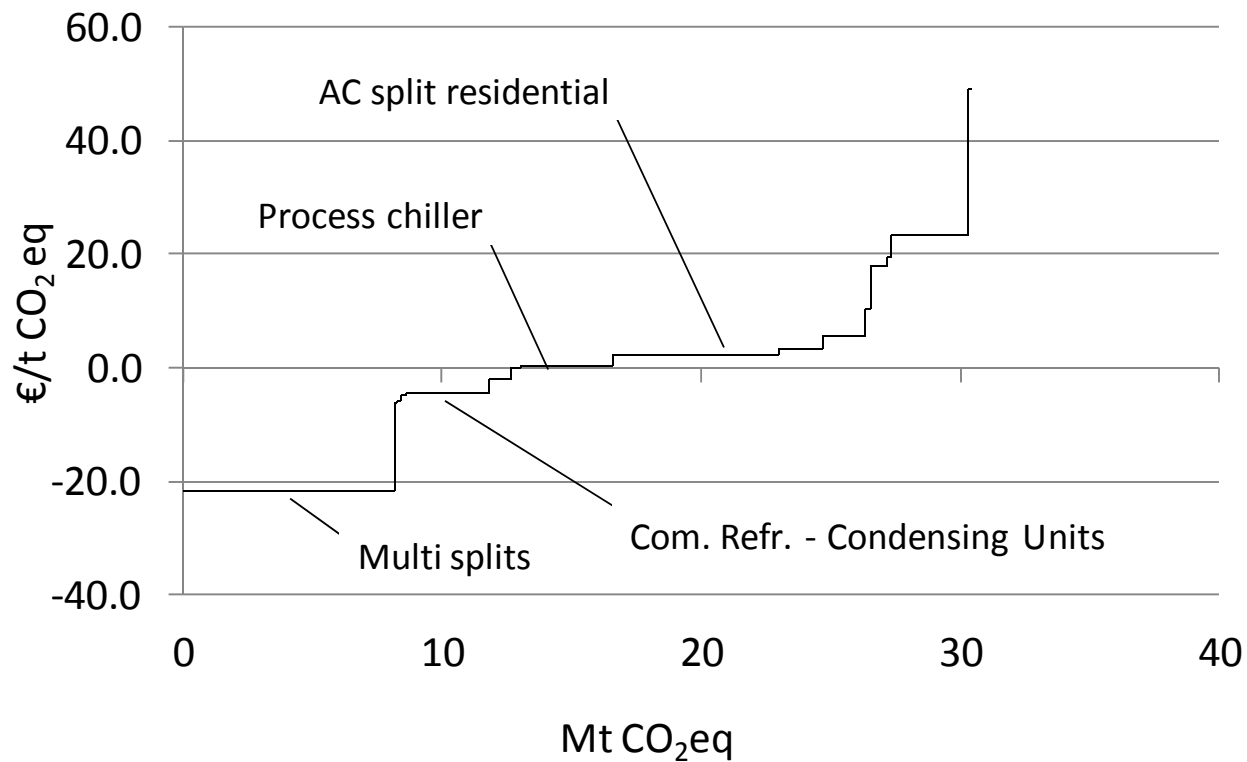
## BAU and Mitigation Scenarios – Process Chillers

Total emissions



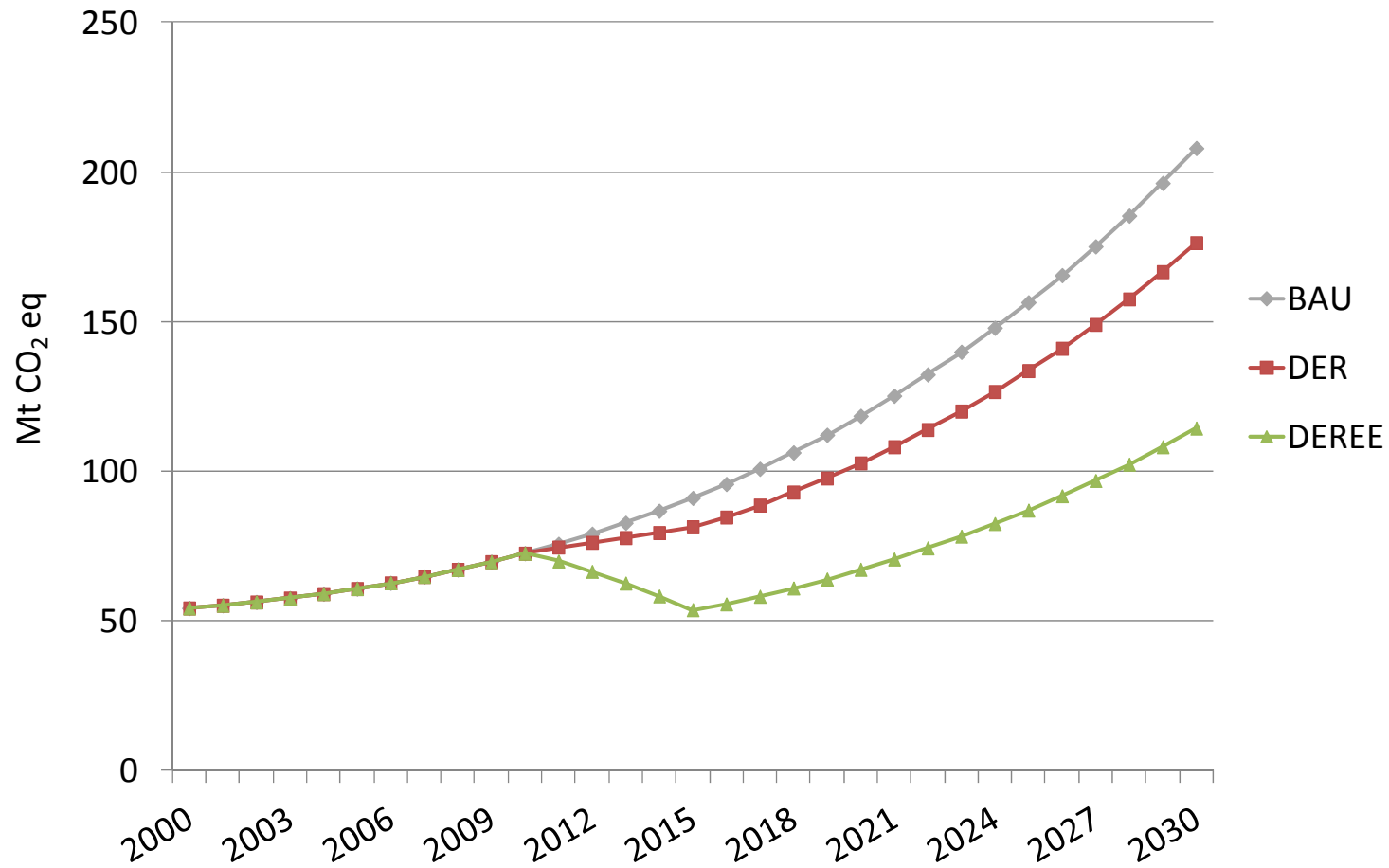
## Reduce 50% of (direct) emissions at negative costs

MACC 2030 - Direct emissions



## RAC Emission pathways for Thailand (preliminary results!)

Total emissions and Reduction potential





Federal Ministry for the  
Environment, Nature Conservation  
and Nuclear Safety

# RAC NAMA



**Thank you for your kind attention!**