

# Nationally Appropriate Mitigation Actions in the Refrigeration and Air Conditioning Sectors

## RAC NAMA

Prepared by GIZ Proklima

October 2012

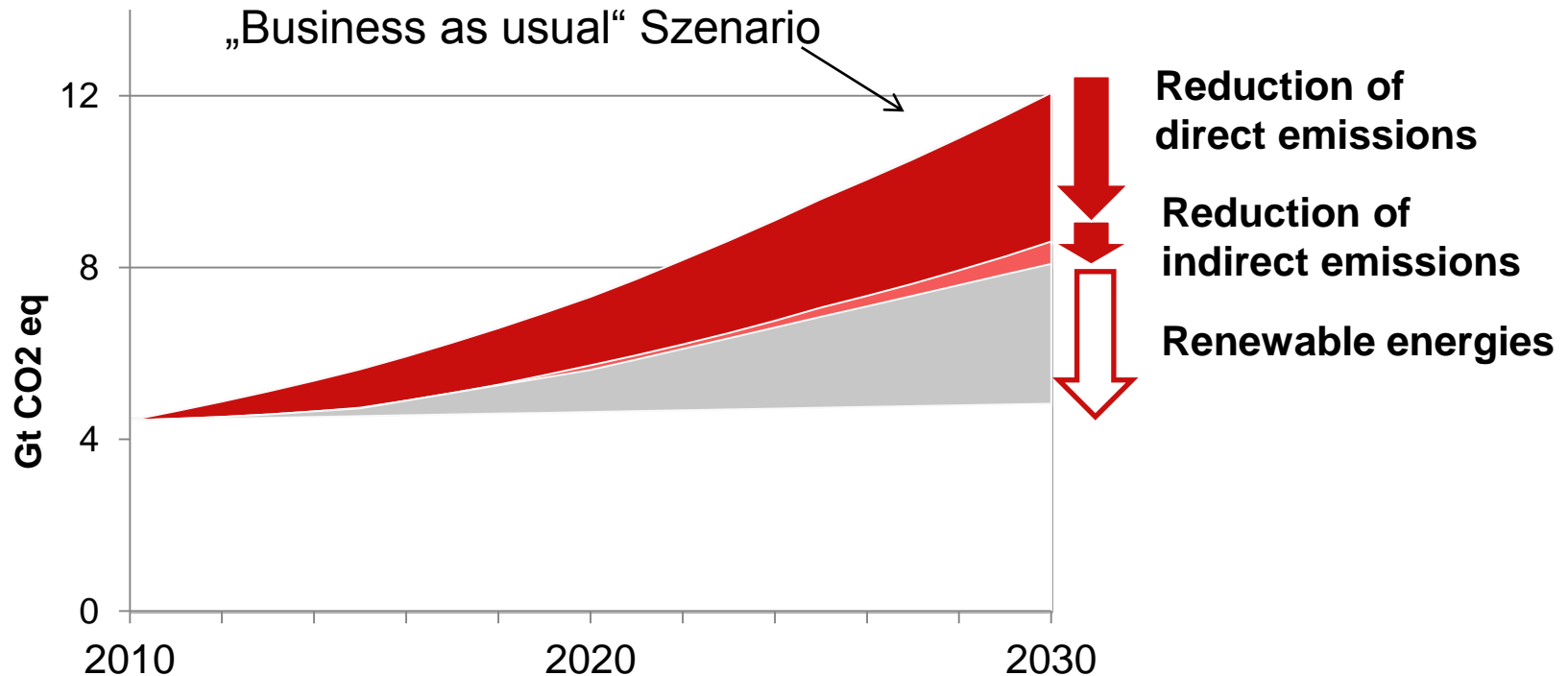
## Agenda – **RAC NAMA OVERVIEW**

**Background I – RAC – Contributing (strongly) to GHG emissions growth**

**Background II – Alternatives are available**

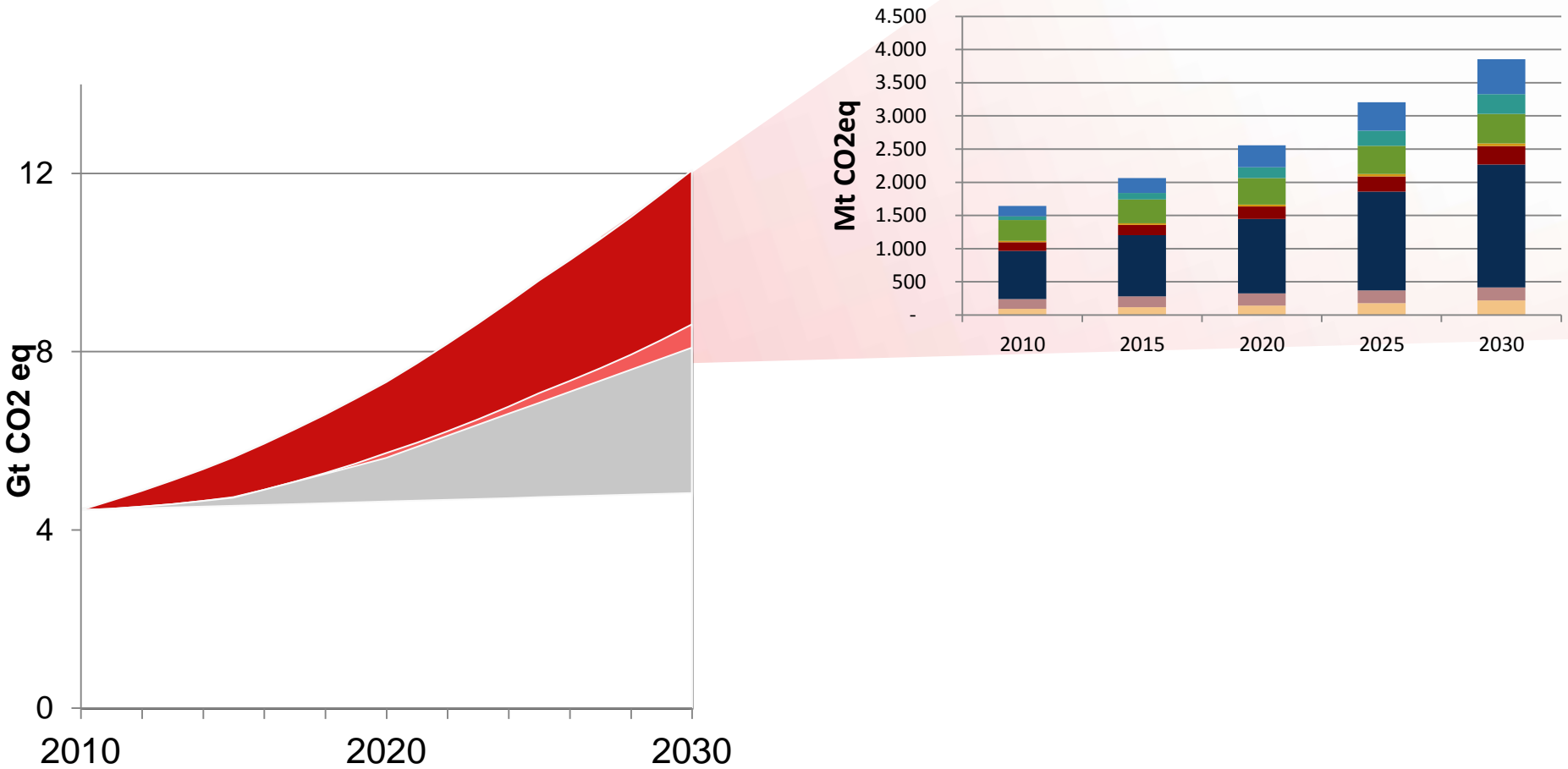
**NAMA – Elements of a NAMA and how Thailand and the industry can benefit**

## Global significance – BAU and Target

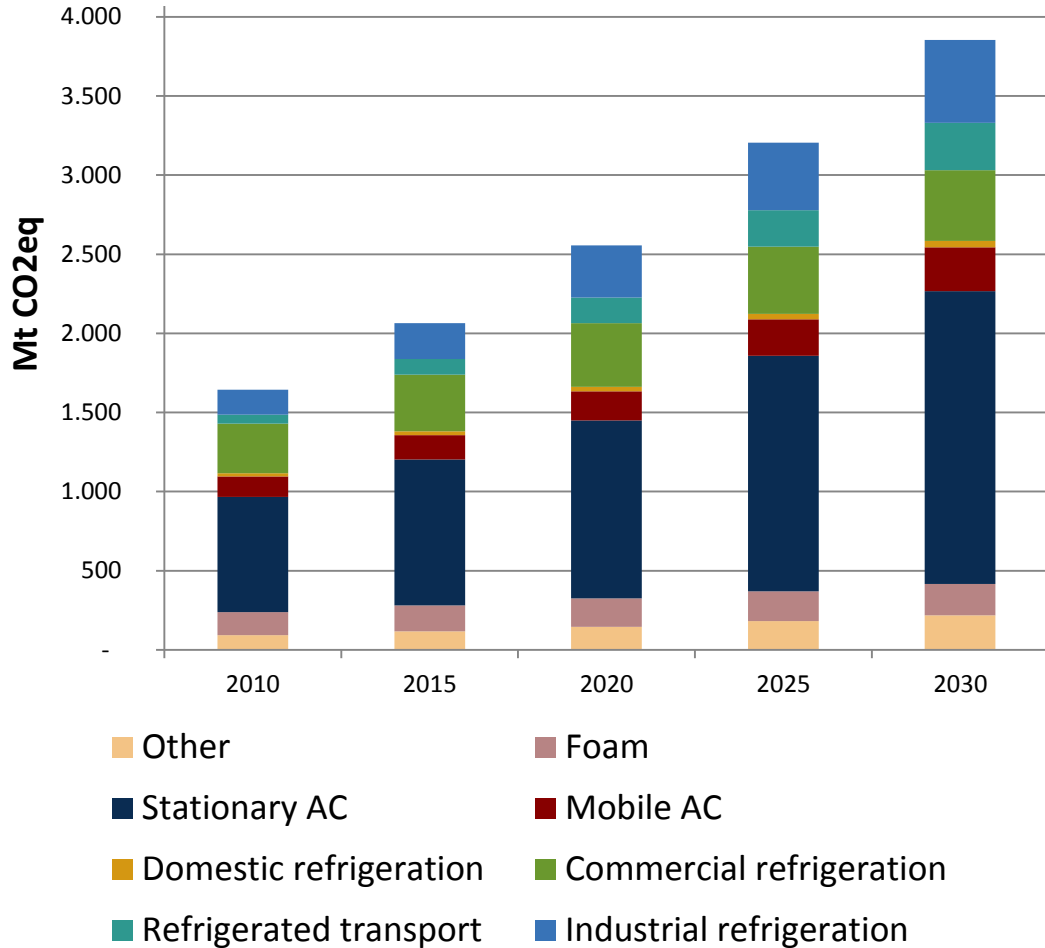


- To meet 2C target emissions: we need to freeze instead of triple
- Potential to eliminate direct emissions
- 20% reductions through additional energy efficiency
- Remainder: replacement of fossile fuels with renewable energies

## Direct emissions have a significant contribution

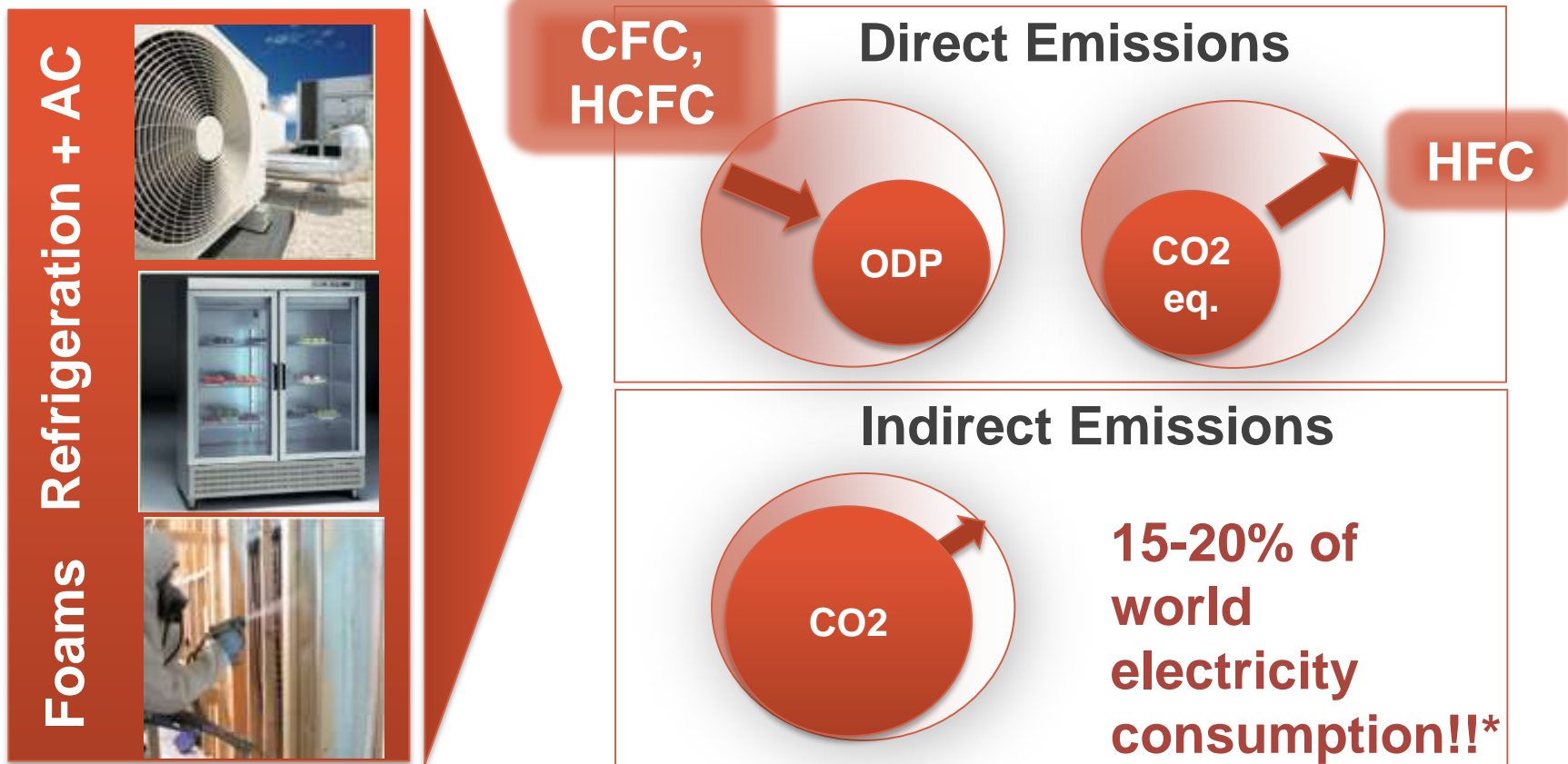


## Global appliance demand will drive direct emissions



- 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.

## Climate Impact of RAC & Foam sectors



\*IIR, 2002

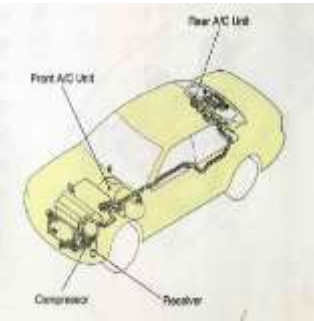
## Agenda – RAC NAMA OVERVIEW

**Background I – RAC – Contributing (strongly) to GHG emissions growth**

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**NAMA – Elements of a NAMA and how Thailand and the industry can benefit**

**There are alternatives available for nearly all applications!**



**Mobile AC**

**Domestic Refrigeration**

**Commercial Refrigeration**

**Industrial Refrigeration**

**AC**

**Foams**



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

**HC**

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

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

**HC**

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



## Agenda – RAC NAMA OVERVIEW

**Background I – RAC – Contributing (strongly) to GHG emissions growth**

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**NAMA – Elements of a NAMA and how Thailand and the industry can benefit**

## Key elements of a NAMA

### Strategy

- Comprehensive plan of measures
- Market and regulatory strategy
- Removal of barriers

### Policy

- Government led programme
- Intended to be included in legislation

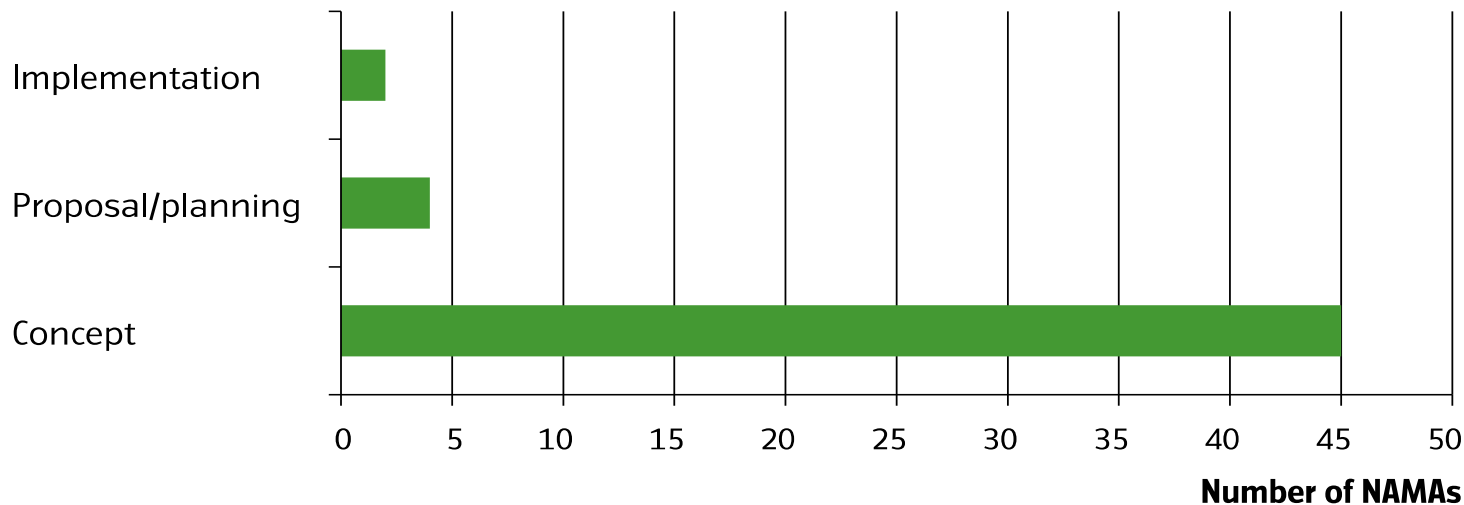
### Action

- Policies, programmes and projects leading to emission reductions
- Target 2020 against Baseline and/or Business as Usual
- Evidence of reductions through MRV

## Status Quo: Importance and significance

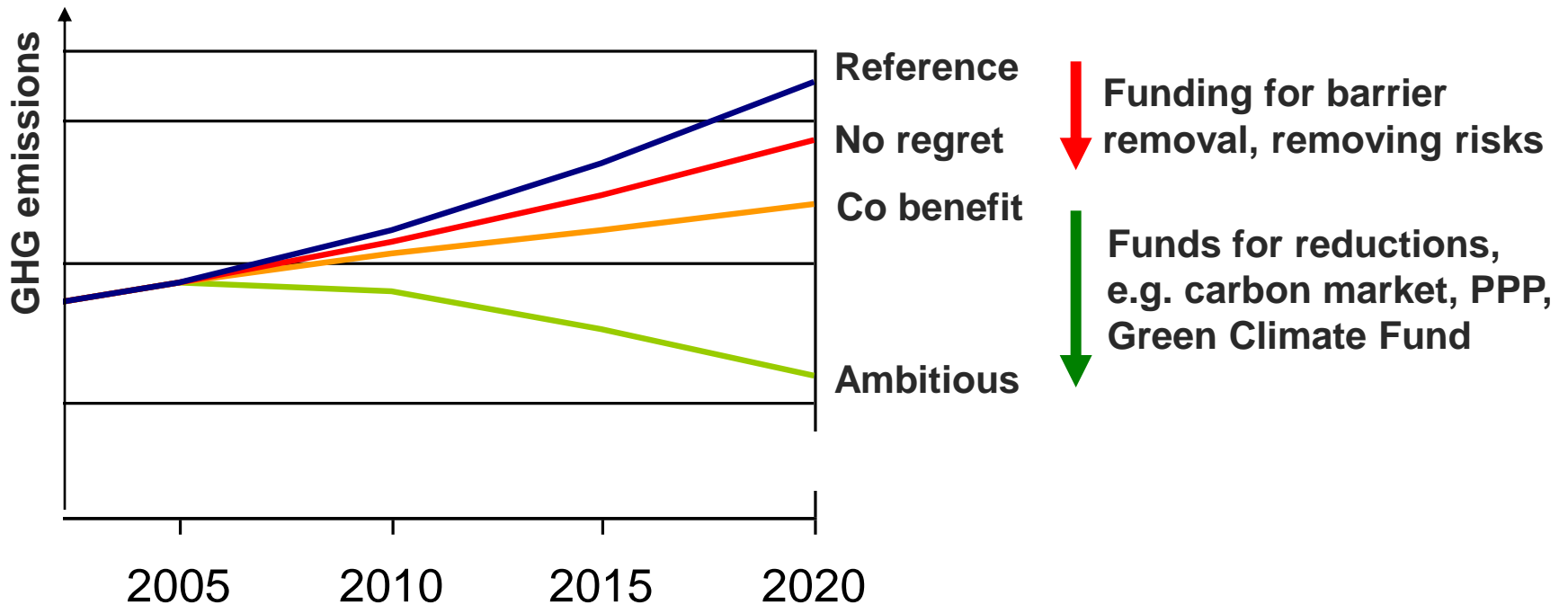
- 50 countries have submitted NAMAs to UNFCCC
- 52 NAMAs from 24 countries are under development
- Nearly all NAMAs with focus on „preparation“: concept, proposal/ planning

### Stage



Source: Nama Database 2012, [www.nama-database.org](http://www.nama-database.org).

## Ambitious targets qualify for supported NAMA



## GHG reduction targets on submitted NAMAs (examples)

Name	Country name	GHG reductions in 2020 (MtCO <sub>2</sub> e/yr)
Incentivize energy efficiency in copper mining	Chile	4,7
Morocco solar plan	Morocco	3,7
Supporting up-scaled mitigation in the cement sector	Vietnam	3,5
Incentivize electricity generation with geothermal energy	Chile	3,0
Financing upgraded energy specifications of new low-income housing	South Africa	3,0
Renewable energy programme	Chile	2,0
Improving the efficiency of electric motors used in industry and mining	Chile	1,2
Electric vehicles NAMA	Colombia	0,9
City wide mitigation programme of Greater Amman Municipality	Jordan	0,6
NAMAs in the Costa Rican coffee sector	Costa Rica	0,5
Process improvement in the cement industry	Chile	0,2
E-mobility readiness plan	Chile	0,2
Demand-side energy efficiency programme for water pumping stations	Jordan	0,1

Figure 7: Potential GHG impacts of selected NAMAs

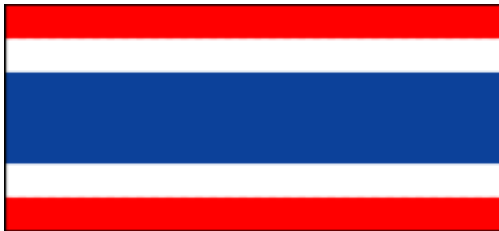
## NAMA intervention levels

NAMA category	Goal	Effect on emissions
<b>Strategy development</b>	Enabling environment	Indirect / long-term
<b>Policies and measures</b>	Support immediate reductions	Direct / short-term
<b>Specific action or project</b>		

## BENEFITS for Thailand and its industry

**Taking action to reduce emissions in a significant sector  
with national benefits and international recognition**

### Thailand



- Comprehensive, transparent understanding of inventory, emissions
- Practical approach for emission reductions
- Co-Benefits (jobs environment)

### Industry



- Green competitiveness (nationally and internationally)
- Access to advanced technologies
- Early adaptors will profit the most (growth) and take leadership

### International



**United Nations**  
Framework Convention on  
Climate Change

- Proper National Communication (including HFCs)
- Demonstrate action on emission reduction in important sector
- Gain recognition (with Best Practice approach)

## Agenda – Ranking subsectors

### Ranking criteria + approach

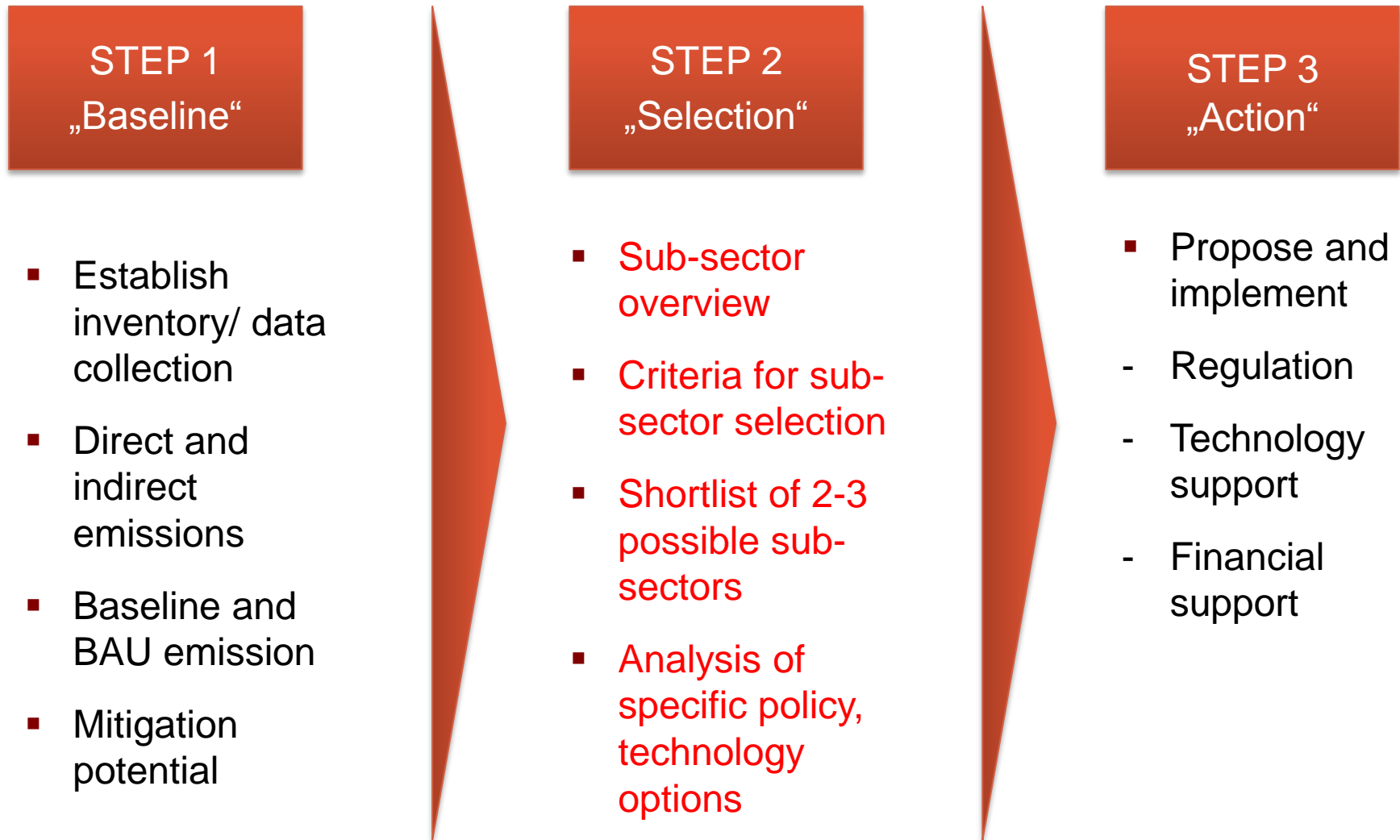
#### I. Quantitative analysis

#### II. Workshop session on technical and economic feasibility, political acceptance








#### III. Synthesis



## Step 2: Subsector selection



## Subsectors and ranking criteria

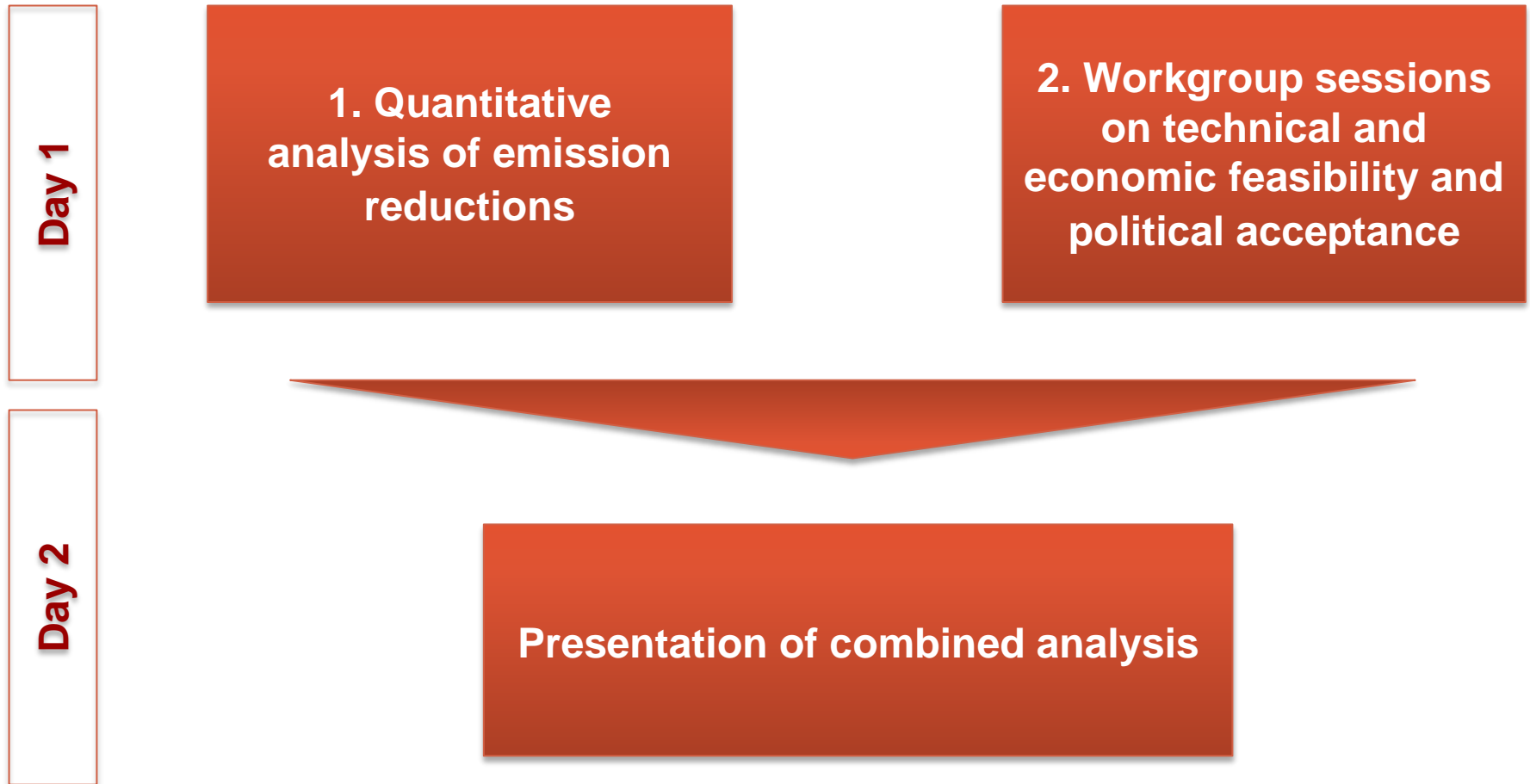
Domestic	
Commercial	
Industrial	
Transport	
Stationary	
Mobile	
Heat Pumps	



## Ranking criteria

- Emission reduction potential
  - total/ direct/ indirect
- Technical feasibility
- Economic feasibility
- Political acceptance

## 2 Step ranking approach



## Agenda – Ranking subsectors

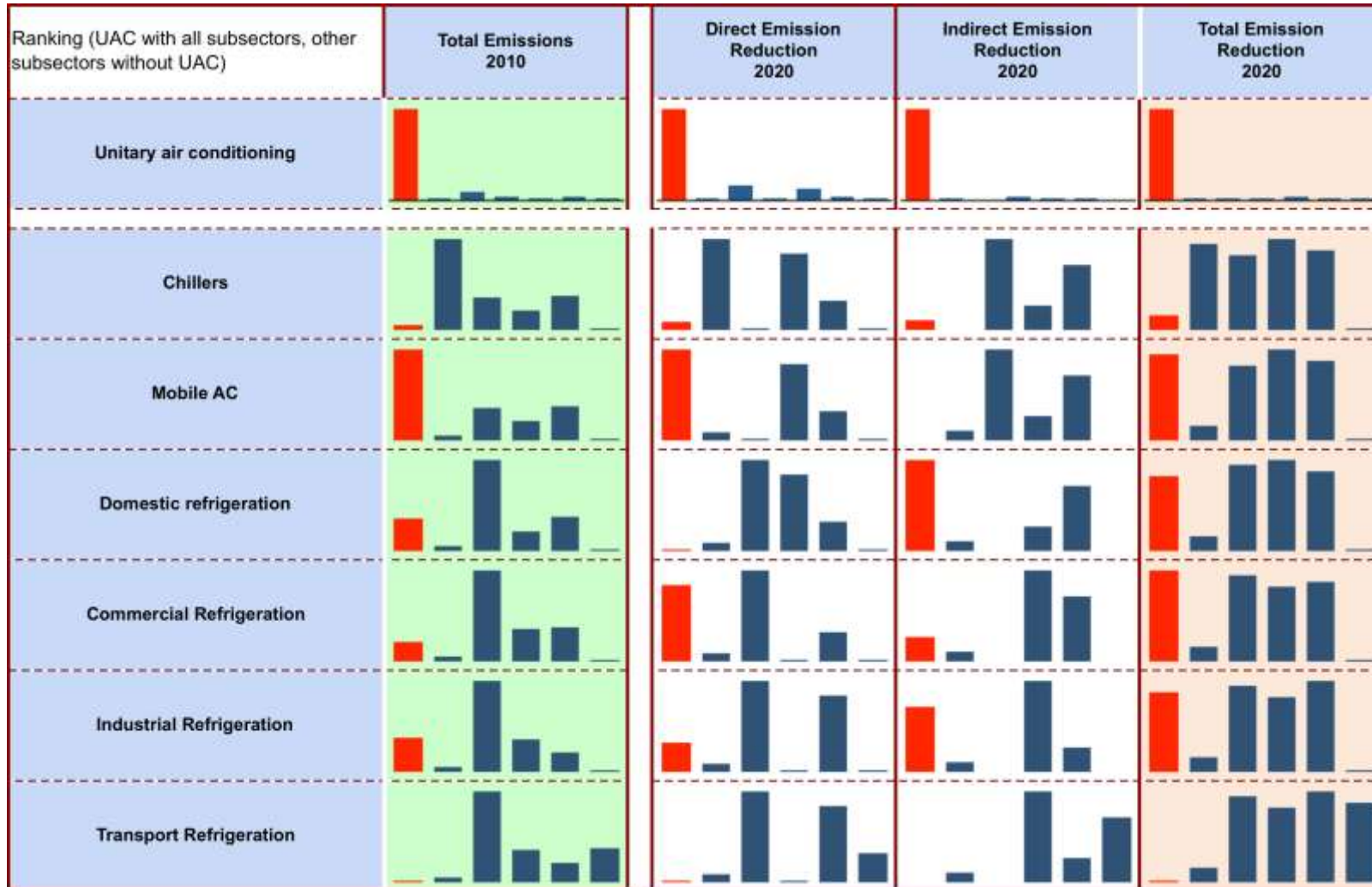
**Ranking criteria + approach**

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## Ranking approach I: Quantitative analysis



## Agenda – Ranking subsectors

**Ranking Criteria + Approach**

**I. Quantitative Analysis**

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## Work session approach

Split in 3 Expert Groups

Political  
Technical  
Economical

Define Evaluation Table

Add/ Remove  
Criteria  
Set Weight for Each  
Criteria  
Allocate 7 points  
among subsectors  
for each criteria)

Document Discussion

For each criteria  
Major consideration  
for each subsector

## Ranking approach II: Political Expert Group

Political Feasibility (Distribute 7 points for each criteria among subsectors)						
	Potential to "tax" high GWP solutions and "Refund" low GWP solutions	Restricted use of High GWP Refrigerants	Conflicts Montreal Protocol/ no Additionality	Mandatory Labelling/ Minimum Energy Efficiency	....	Overall Ranking
Unitary air conditioning						
Chillers						
Mobile AC						
Domestic refrigeration						
Commercial Refrigeration						
Industrial Refrigeration						
Transport Refrigeration						



## Ranking approach II: Technical Expert Group

Technical Feasibility (Distribute 7 points for each criteria among subsectors)						
	Potential for Repacement with low GWP Refrigerants	Potential for Leakage Reduction	Availability for low GWP technologies	Potential to Improve Energy Efficiency	....	Overall Ranking
Unitary air conditioning						
Chillers						
Mobile AC						
Domestic refrigeration						
Commercial Refrigeration						
Industrial Refrigeration						
Transport Refrigeration						

## Ranking Approach II: Economic Expert Group

Economic Feasibility (Distribute 7 points for each criteria among subsectors)							
	Upfront costs of low GWP systems	Operating costs of low GWP systems	Costs / t CO <sub>2</sub> eq abated (MACCs) Direct Emission	Costs / t CO <sub>2</sub> eq abated (MACCs) Total Emission	Potential to Improve Energy Efficiency	...	Overall Ranking
Unitary air conditioning			-1	-286			
Chillers			0	-209			
Mobile AC			-26	-26			
Domestic refrigeration			62,5	-354			
Commercial Refrigeration			6	-94			
Industrial Refrigeration			4	-153			
Transport Refrigeration			-8	-8			

## Agenda – Ranking subsectors








**Ranking criteria + approach**

**I. Quantitative analysis**

**II. Workshop session on technical and economic feasibility, political acceptance**

**III. Synthesis**

## Ranking approach III: Combined

Ranking (UAC with all subsectors, other subsectors without UAC)	Emission Reduction Potential	Economic Feasibility	Technical Feasibility	Political Acceptance	Overall Ranking
Unitary air conditioning					
Chillers					
Mobile AC					
Domestic refrigeration					
Commercial Refrigeration					
Industrial Refrigeration					
Transport Refrigeration					

## Setting enabling environments

Results of Ranking (previous day analysis)

**Barriers & Enabling Environments I: Political system**

**Barriers & Enabling Environments II: Technical system**

**Barriers & Enabling Environments III: Economic system and financing**

## Ranking approach III: Combined

Ranking (UAC with all subsectors, other subsectors without UAC)	Emission Reduction Potential	Economic Feasibility	Technical Feasibility	Political Acceptance	Overall Ranking
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Industrial Refrigeration					
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## Setting enabling environments

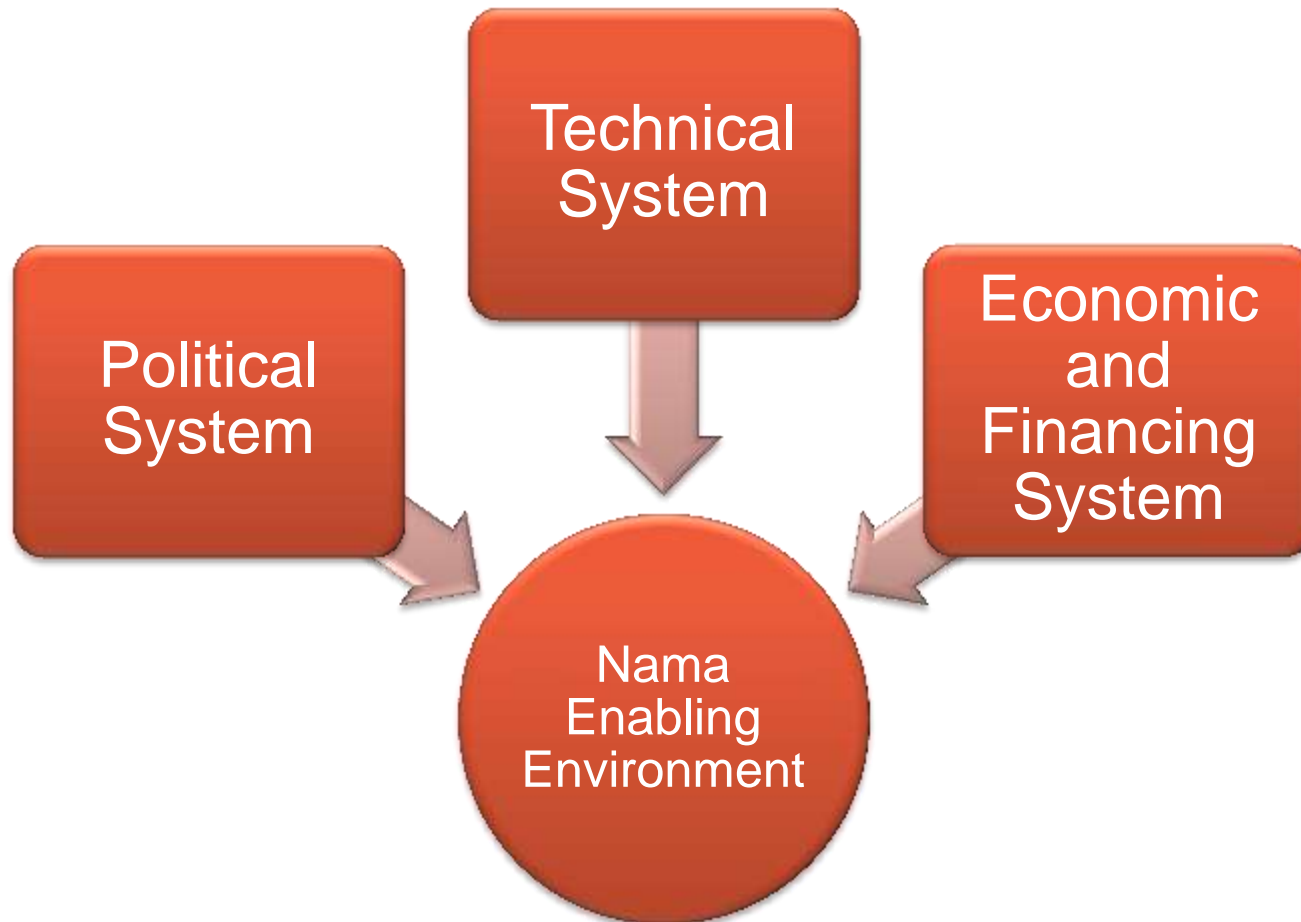
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## Enabling environments





## Enabling environments: Political system

### Institutional Setup

- **Institutional/ political roles** → Government Steering Committee
- **Technical support roles** → Technical Steering Committee
- **Support roles** → national, international (GIZ Proklima recommended)

### Defining NAMA Type

- **Supported:** ambitious (baseline), international MRV process, seeking international financial support
- **Unilateral:** Reduce against BAU
- **Registered:** for recognition, seeking support
- **Enabling/ Policy based:** setting the political framework
- **Target based:** Emission reduction 2020, 2030
- **Project/ Programme based: scale:** How many projects, units changed etc.

### National Communication (BURs)

- **Biennial update reports:** including NAMAs and their scale
- **Name and description:** i.e. “RAC NAMA in subsector... “
- **Objectives and steps taken**
- **Information on progress, MRV process**



Countries have committed to  
submit BURs and subject them  
to ICA

## Enabling environments: Political system

Direct Emissions

Indirect Emissions

	Measures which target direct emissions, HFC emissions	Measures which target indirect emissions (CO <sub>2</sub> emissions through energy consumption)
Bans	+	(+) e.g. ban of light bulbs
Quota systems	+	
Norms and standards	+	+
Licensing	+	+
Labelling	+	+
Capacity Building/Awareness	+	+
Intensity Benchmarks	(+) GWP limit	+
Measures to improve Containment and recovery	+	
Taxation and financial incentives	+	
Measures related to record Keeping and logbook	+	
Voluntary measures	+	+

## Enabling environments: Political system

	Barriers	Solutions
<p><b>Regulations &amp; Standards - direct emissions</b></p>	<ul style="list-style-type: none"> <li>Standards/ regulation favor the use of high GWP refrigerants</li> </ul>	<ul style="list-style-type: none"> <li>Tax high GWP refrigerants and rebate low GWP refrigerants</li> <li>Eventual phase out of high GWP refrigerants</li> <li>Adopt standards to allow low GWP refrigerant systems</li> </ul>
<p><b>Regulations &amp; Standards - indirect emissions</b></p>	<ul style="list-style-type: none"> <li>Most energy efficient equipment not valued enough by consumers and end users</li> </ul>	<ul style="list-style-type: none"> <li>Mandatory minimum energy standards</li> <li>Top runner programme</li> <li>Periodic phase out of less efficient equipment</li> </ul>

## Setting enabling environments

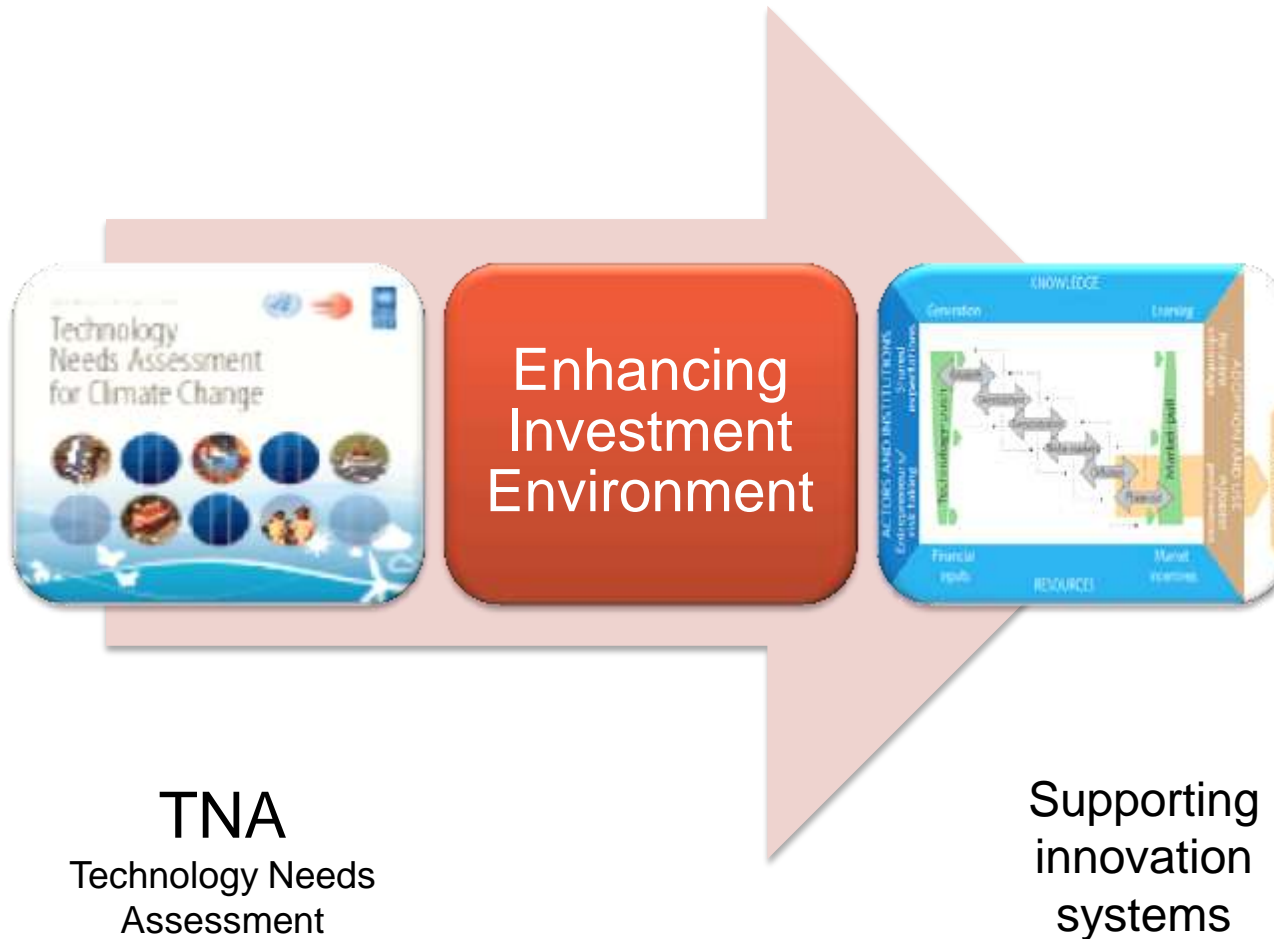
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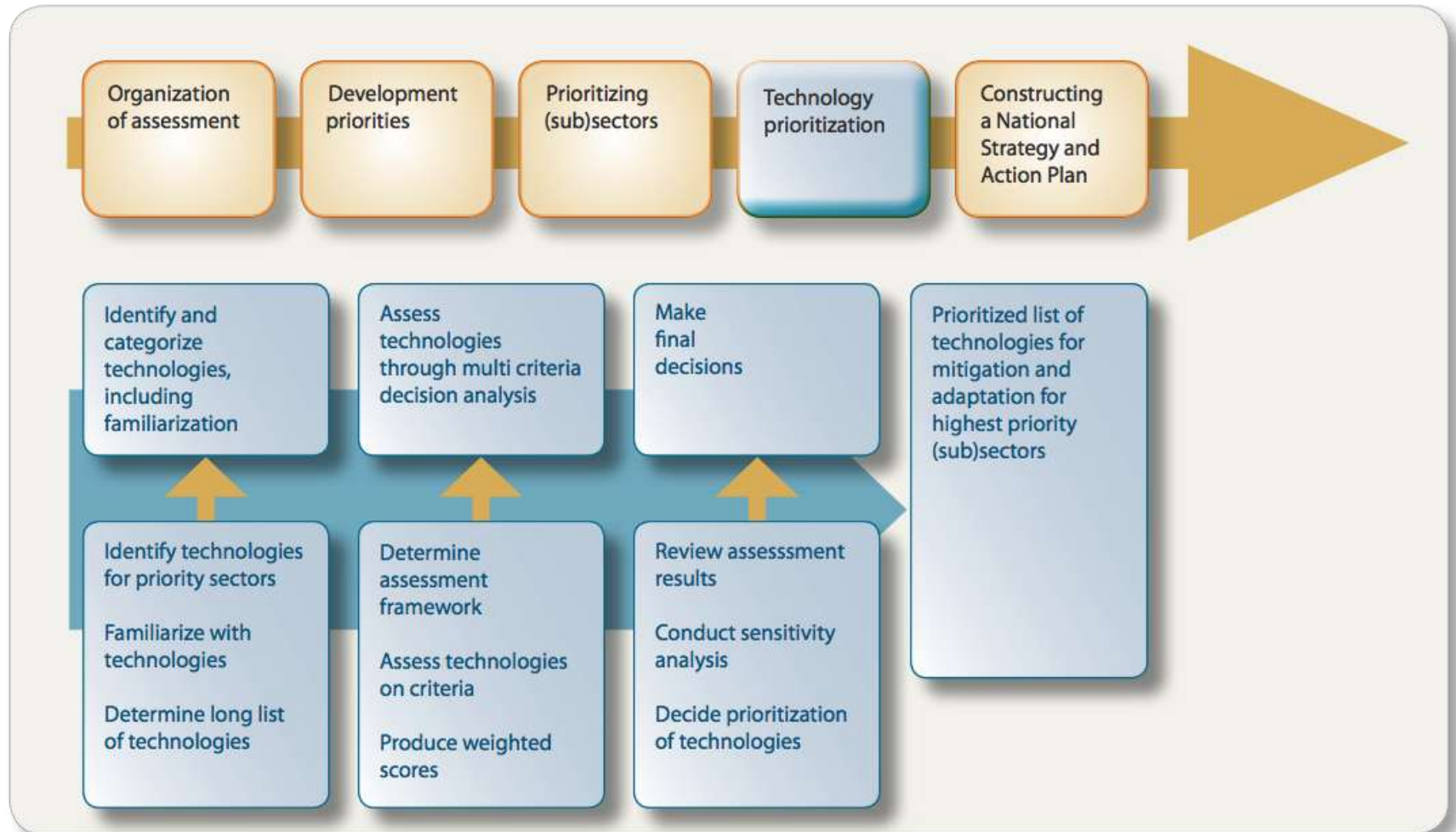
Barriers & Enabling Environments II: Technical system

Barriers & Enabling Environments III: Economic system and financing

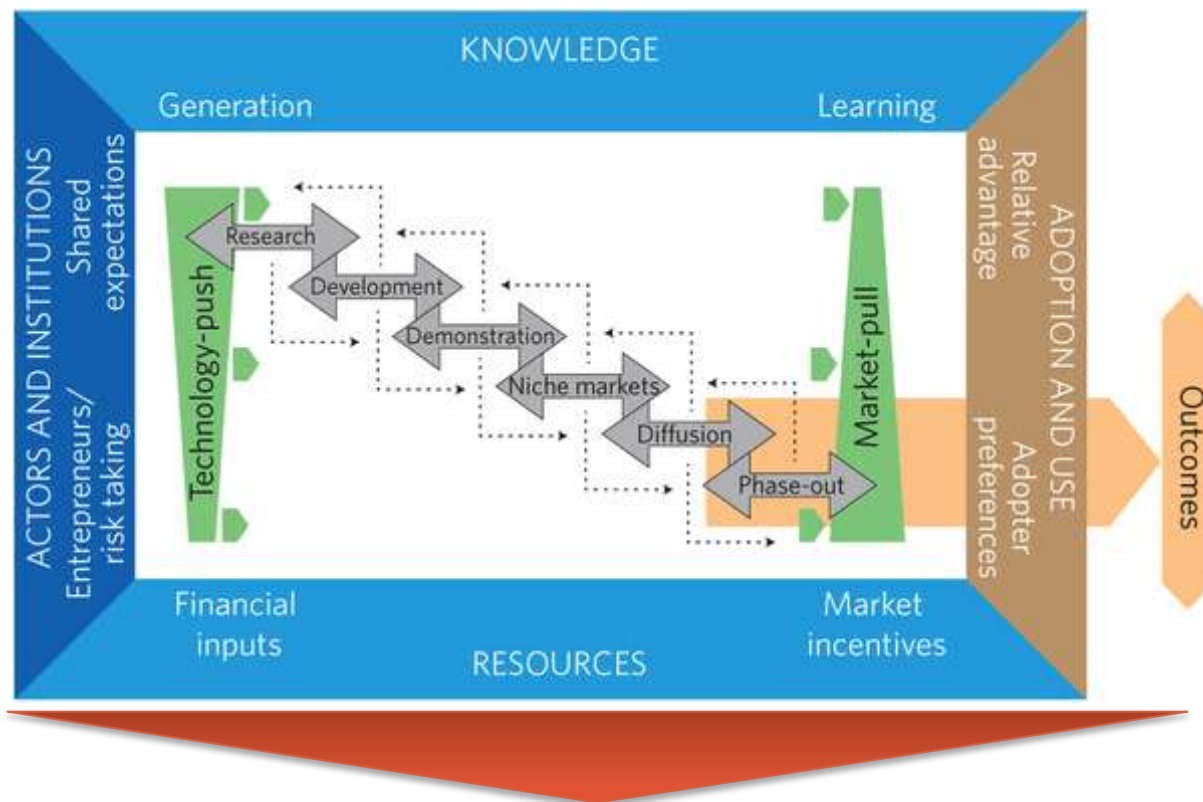
## Technology system: Promote alternative low emission technologies



## Enabling environments: Technology prioritisation



## Setting technology innovation framework



Subsector	R&D	Pilot	Penetration	Phase Out
Technology 1	***	*	*	*
Technology 2	***	***	***	***

## Enabling environments: Technical framework

	Barriers	Solutions
<b>Alternative Technology availability</b>	<ul style="list-style-type: none"> <li>Limited access to best practice technologies</li> </ul>	<ul style="list-style-type: none"> <li>Technology cooperations</li> <li>R&amp;D cooperations</li> <li>Establish networks</li> </ul>
<b>Component availability</b>	<ul style="list-style-type: none"> <li>Limited availability of components for low GWP systems</li> </ul>	<ul style="list-style-type: none"> <li>Limited availability of components for low GWP systems</li> </ul>
<b>Technical competence</b>	<ul style="list-style-type: none"> <li>Limited skills available to handle low GWP refrigerants (flammability)</li> </ul>	<ul style="list-style-type: none"> <li>Information sources/ Tech WIKI</li> <li>Workshop/ Expert lectures</li> <li>Training</li> <li>Demonstration projects</li> </ul>



## Setting enabling environments

Results of Ranking (previous day analysis)

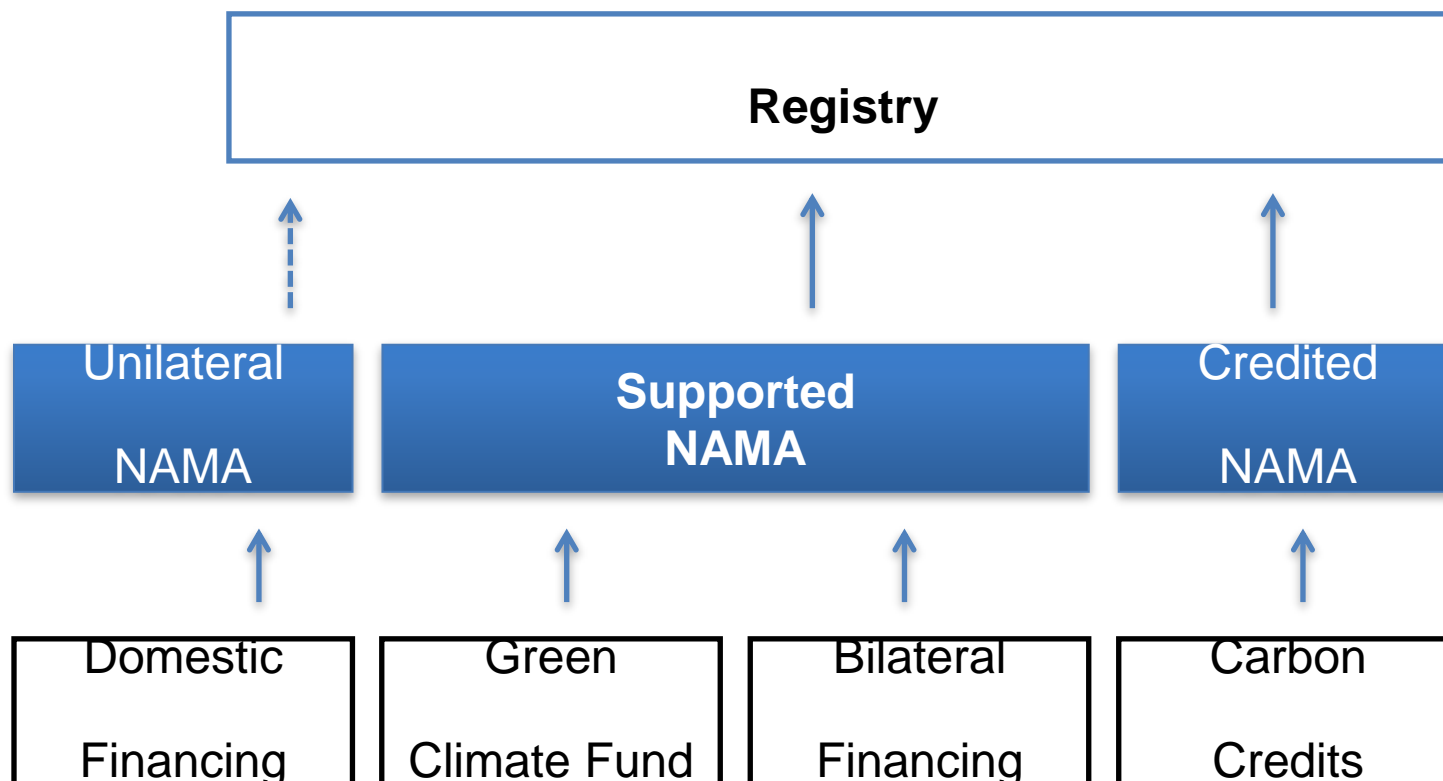
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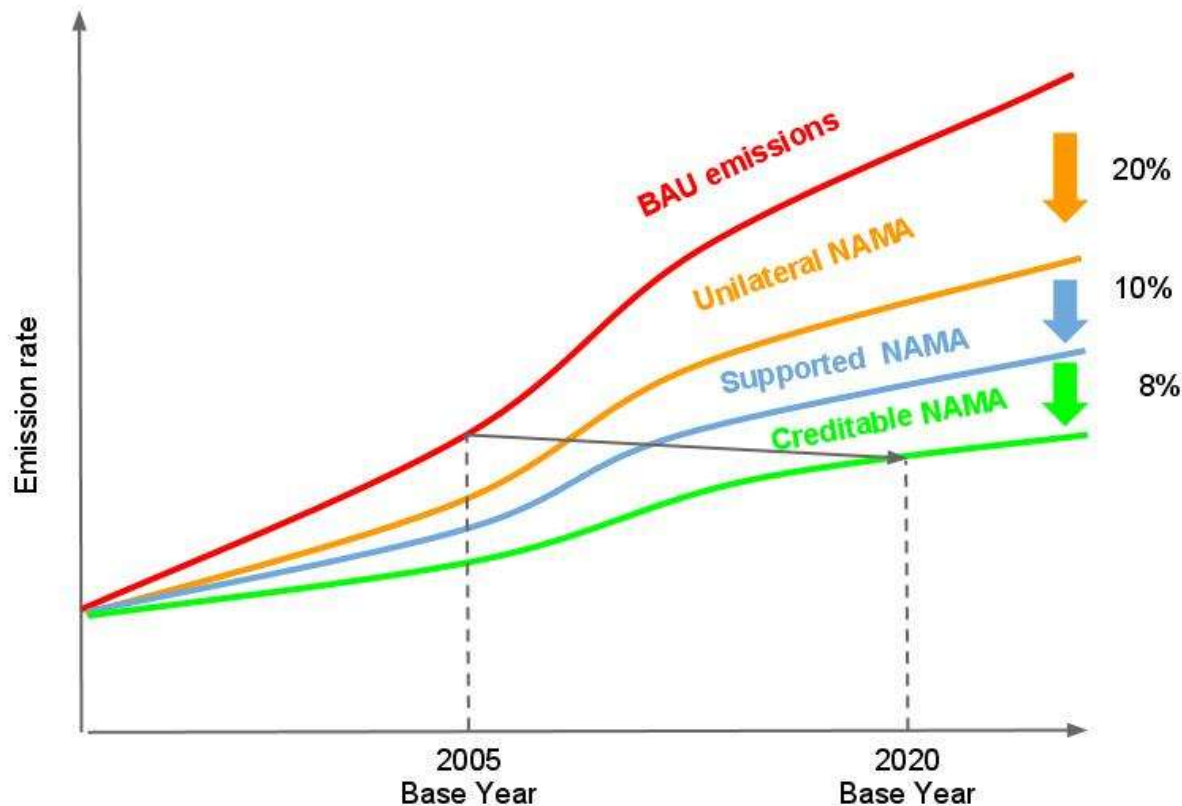
Barriers & Enabling Environments III: Economic system and financing

Roundup: Defining the NAMA Roadmap

## Overview: NAMA FUNDING & Financing



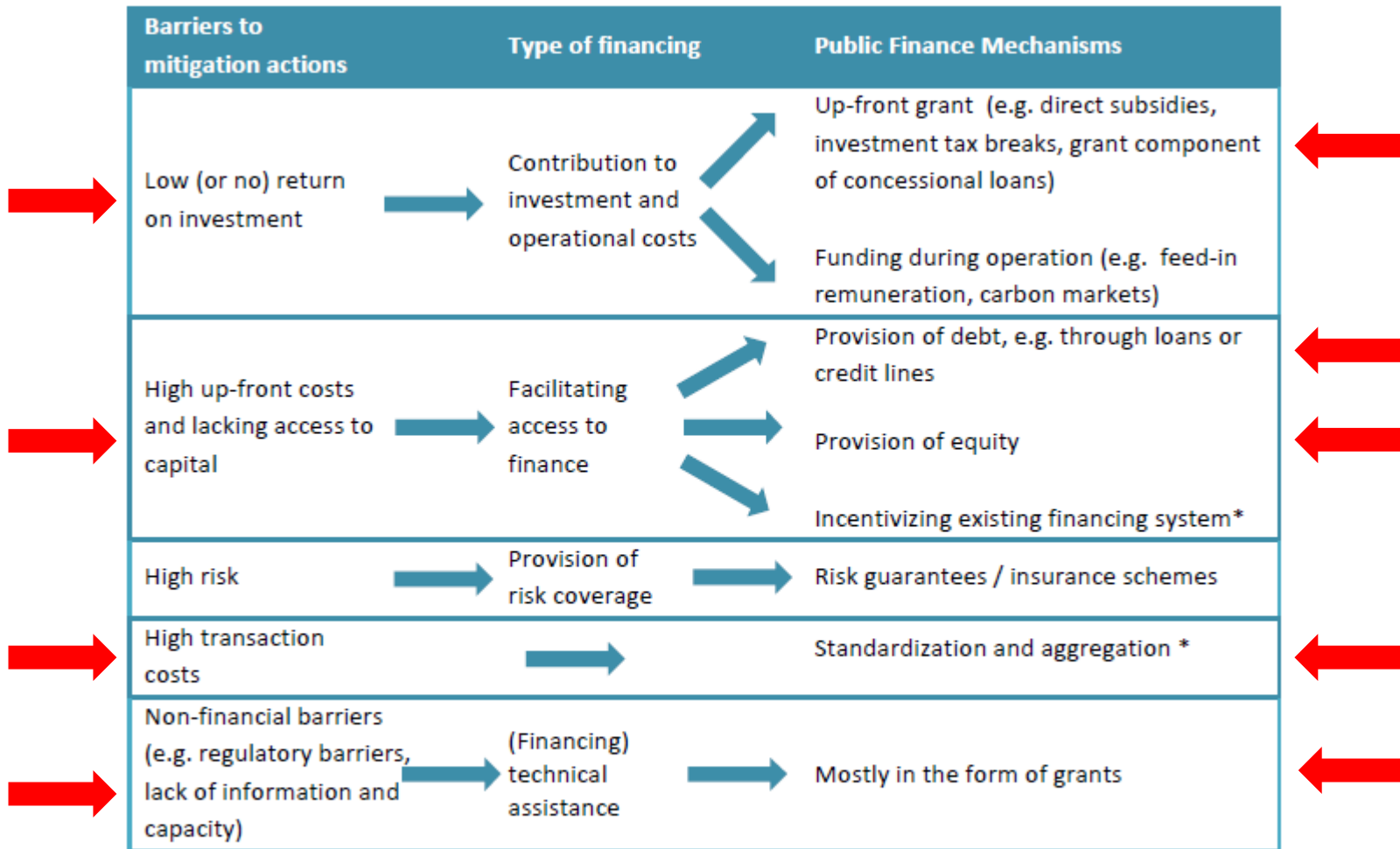
## Supported NAMA funding: ideally „near“ baseline emissions



## Supported NAMA funding: understanding incremental costs → detailed cost analysis of technology options

TO	Cost groups														
	Market introduction	Refrigerant price	Product parts (system)	Product parts (ancillary)	Technician tools/equipment	Technician training	Engineer training	Techn assess, cert and registration	Regulations	Standards (restrictions)	Awareness raising	Research and development	Production line	Installation time	Installation materials
Leak reduction (design/const)			X				X				X	X	X	X	X
Leak reduction (maintenance)					X	X		X			X				
Charge size reduction			X				X				X	X			
Recovery and recycling					X	X		X			X				
HC R-600a				X	X	X	X	X	X		X		X	X	X
HC-290/ HC-1270	X	X	X	X	X	X	X	X	X	X	X		X	X	X
R-717	X				X	X	X	X	X	X	X		X	X	X
R-744	X	X	X	X	X	X	X	X	X		X	X	X	X	X
unsat-HFC	X	X	X	X	X	X	X	X	X		X	X		X	X
unsat-HFC blends	X	X	X		X	X	X		X						
Low-GWP + liquid secondary	X	X	X								X			X	X
Low-GWP + evap secondary	X	X	X				X	X			X	X		X	X
Low-GWP + cascade	X	X	X								X			X	X
Distributed water-cooled	X	X	X				X	X			X			X	X
Low-GWP + liquid sec (discrete)	X	X	X				X				X	X		X	X
District heating/cooling							X	X		X	X		X	X	X

## Supported financing: tailored to sector needs



\*Note that these mechanisms are not Public Finance Mechanisms but included for the sake of completeness  
 Adapted from Neuhoff et al. (2010)

## FUNDING & MRV

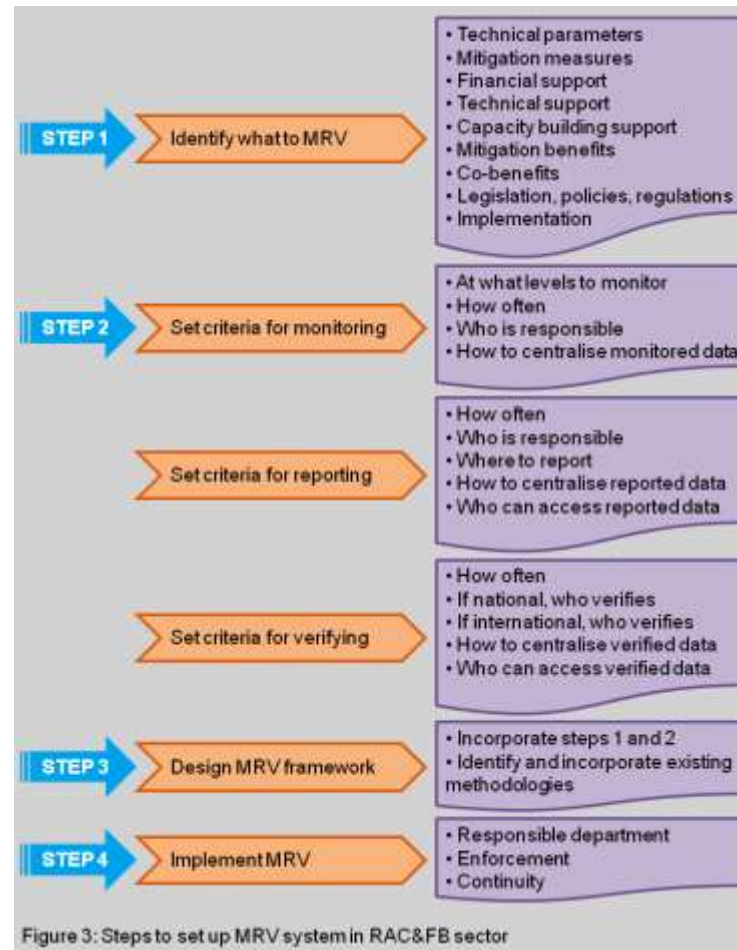


Figure 3: Steps to set up MRV system in RAC&FB sector

## FUNDING & MRV & RAC

Sub-sectors	Metrics	
	Direct emissions	Indirect emissions
<i>Refrigeration and air conditioning (RAC)</i>		
Domestic refrigeration	<ul style="list-style-type: none"> <li>No. of units sold with high- and low-GWP refrigerants</li> <li>No. of trained or certified service technicians for handling flammable refrigerants</li> </ul>	<ul style="list-style-type: none"> <li>Average energy consumption of sold units</li> <li>Energy labelling</li> </ul>
Transport refrigeration	<ul style="list-style-type: none"> <li>No. of units sold with high- and low-GWP refrigerants</li> <li>No. of trained or certified service technicians</li> </ul>	<ul style="list-style-type: none"> <li>Average energy consumption of sold units</li> <li>Energy labelling</li> </ul>
Commercial refrigeration	<ul style="list-style-type: none"> <li>Reporting of charge sizes, refill amounts, reclaimed or recycled gas</li> <li>No. of trained or certified service technicians</li> </ul>	<ul style="list-style-type: none"> <li>Monitoring of energy consumption, preferably via an online system</li> <li>Total size of display area</li> </ul>
Industrial refrigeration	<ul style="list-style-type: none"> <li>Reporting of charge sizes, refill amounts, reclaimed or recycled gas</li> <li>No. of trained or certified service technicians</li> </ul>	<ul style="list-style-type: none"> <li>Monitoring of energy consumption, preferably via an online system</li> </ul>
Mobile air conditioning	<ul style="list-style-type: none"> <li>No. of units sold with high GWP refrigerant</li> <li>No. of trained or certified service technicians</li> </ul>	<ul style="list-style-type: none"> <li>Average energy consumption of sold units</li> <li>Energy labelling</li> </ul>
Stationary air conditioning	<ul style="list-style-type: none"> <li>No. of units sold with high GWP refrigerant</li> <li>No. of trained or certified service technicians</li> </ul>	<ul style="list-style-type: none"> <li>Average energy consumption of sold units</li> <li>Energy labelling</li> </ul>

## Enabling environments: Economic, funding & financing framework

	Barriers	Solutions & Options
<b>Incremental Costs</b>	<ul style="list-style-type: none"> <li>Analyse and define incremental costs specific to subsector</li> </ul>	<ul style="list-style-type: none"> <li>Adopt robust sector specific tools on incremental financing</li> <li>Plot Marginal abatement costs curves – prioritize technical options (MAC curves)</li> </ul>
<b>Funding Gap</b>	<ul style="list-style-type: none"> <li>Lack of public and private sector financing to cover additional costs</li> </ul>	<ul style="list-style-type: none"> <li>Identify national and international financial support schemes</li> <li>Set tax and rebate schemes</li> </ul>



## Setting enabling environments

Results of Ranking (previous day analysis)

Barriers & Enabling Environments I: Political system

Barriers & Enabling Environments II: Technical system

Barriers & Enabling Environments III: Economic system and financing

Roundup: Defining the NAMA Roadmap

## Roadmap: Defining subsector action

### Political setup 1: Institutional framework

- Define NAMA type (supported, unilateral, registered)
- Government Steering Working Group

### Political setup 2: Regulatory framework

- Emission reduction targets
- Direct emissions... i.e. limits on HFC use (GWP limits, taxes, bans, phase downs or phase outs)
- Indirect emissions: .. i.e. establish minimum efficiency standards

### Technical setup

- Technical steering group
- Status of alternative technologies  
(1) R&D (2) Pilot plant (3) Incentive programmes

### Funding & financing setup

- Incremental and capacity building costs
- Seek international and/ or national funding/ financial support

## Political Expert Work Group

Questions	Subsector 1	Subsector 2
<ul style="list-style-type: none"> <li>▪ Who should participate in the government steering group?</li> <li>▪ Unilateral or supported NAMA?</li> <li>▪ Key regulatory and standard aspects to address               <ul style="list-style-type: none"> <li>– Limiting HFCs</li> <li>– Increasing EE</li> </ul> </li> <li>▪ Baseline, BAU and Emission reduction targets</li> </ul>		

## Technical Expert Work Group

Questions	Subsector 1	Subsector 2
<ul style="list-style-type: none"> <li>▪ Who should participate in the technical steering group?</li> <li>▪ Status of alternative technologies?               <ul style="list-style-type: none"> <li>– Availability: Technology, components, skills</li> <li>– Stage in the market: R&amp;D, Pilot, Deployment</li> </ul> </li> <li>▪ Key barriers to overcome               <ul style="list-style-type: none"> <li>– Safety</li> <li>– Availability...</li> </ul> </li> <li>▪ Target market penetration rates of low GWP alternatives (as part of new sold units)</li> </ul>		

## Financial Expert Work Group

Questions	Subsector 1	Subsector 2
<ul style="list-style-type: none"> <li>▪ Key costs items for building the NAMA               <ul style="list-style-type: none"> <li>– Capacity building</li> <li>– Technology costs etc.</li> </ul> </li> <li>▪ Costs / benefits of implementation</li> <li>▪ Available/ required funds to support               <ul style="list-style-type: none"> <li>– Domestically (tax, rebate, government funds..)</li> <li>– Internationally</li> </ul> </li> </ul>		