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SUSTAINABLE DEVELOPMENT GOALS

Preparing project Proposal

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Based on a presentation by Omar Abdelaziz

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SUSTAINABLE DEVELOPMENT GOALS

Agenda

- Background
- Technology Improvement
- Available Funding
- Reporting

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Background & General Info

Operational Framework

Additional capital costs (C_t)

- Product design for energy efficiency
- Changes in the manufacturing facilities mainly relating to energy performance testing and upgrades related to the use of more efficient components (e.g., new welding jigs for gaskets)
- Training
- Third-party product testing and certifications

Additional component costs (C_e)

- Energy efficient compressors (e.g., invertor-based compressors)
- Energy efficient heat exchangers
- Controls.

Key Information

- Refrigeration equipment eligible:
  - Converted lines with low-GWP refrigerants or HFC conversion projects to low-GWP refrigerants
  - RAC: conversion to a refrigerant providing a path towards compliance with the Kigali Amendment (servicing demand!)
- Project duration: 36 months; money will be returned if it takes longer!
- Target EE is evaluated on equipment produced 1-year after project completion.
- Enterprises commit to meet target EE and strive to improve further at their own expense after the project ends.
- Monitoring will last two years after project completion by the NOU and the agency.
- The government will regularly update MEPS regulations, labelling, and outreach to promote efficient equipment.
- Within three years of project completion, regulations will ensure manufacturing, import, and sales meet target EE levels.

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Project monitoring & evaluation

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Reporting

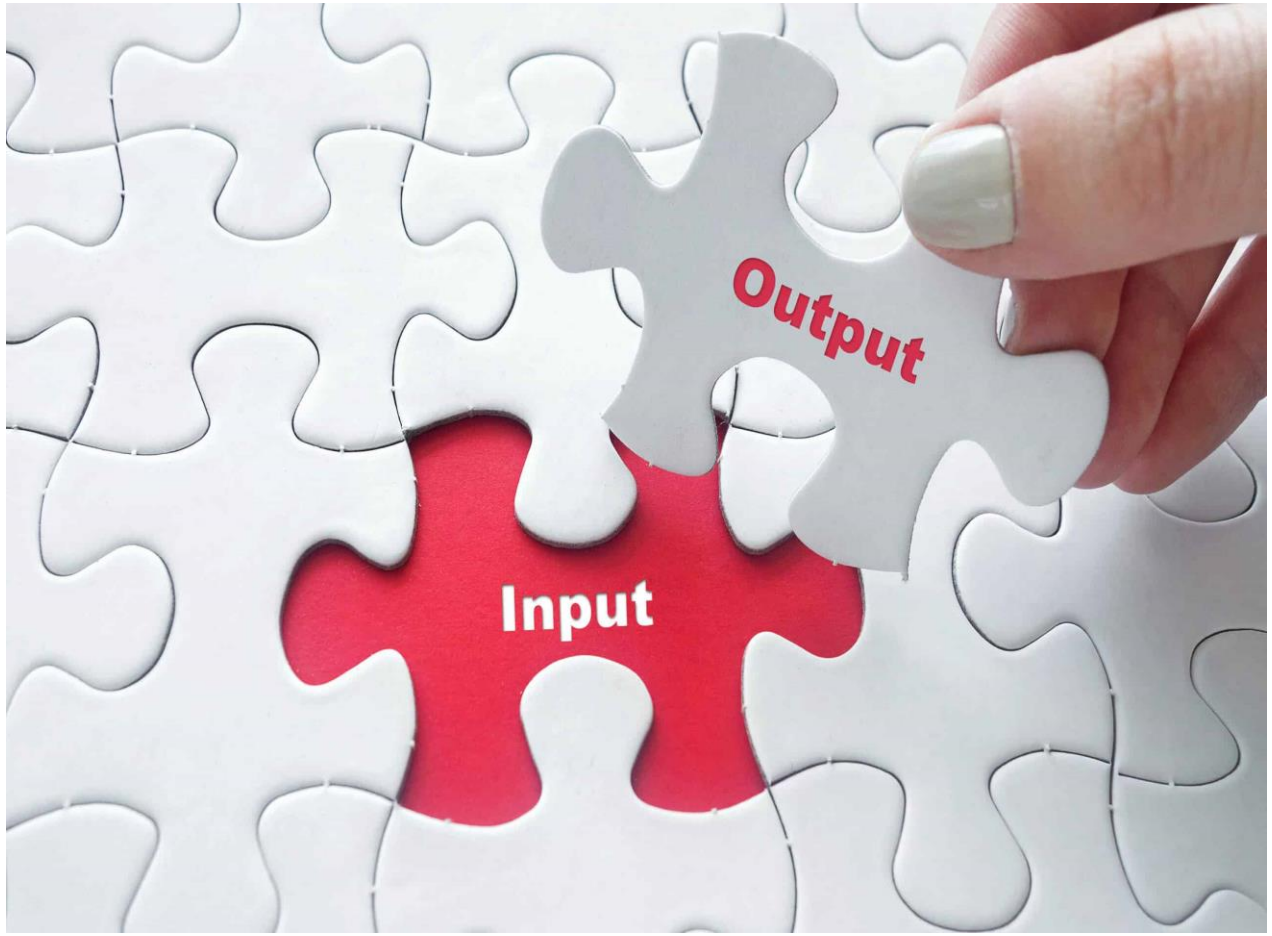
- Assess baseline energy performance based on manufacturing and sales;
- Set target performance upon project completion;
- Report on MEPS implementation, current vs. baseline levels, refrigerant GWP inclusion in standards, and measures promoting low-GWP energy-efficient technologies.

Payment

- Upfront capital cost provided to beneficiary.
- Incentives paid in two parts: 50% after project completion upon meeting energy targets, and 50% one year later after verifying production at target efficiency levels.

Outputs

- EE improvements,
- MEPS revisions and implementation,
- Increased market share of energy-efficient, low-GWP equipment;
- Energy savings for consumers and end users;
- Emissions reductions



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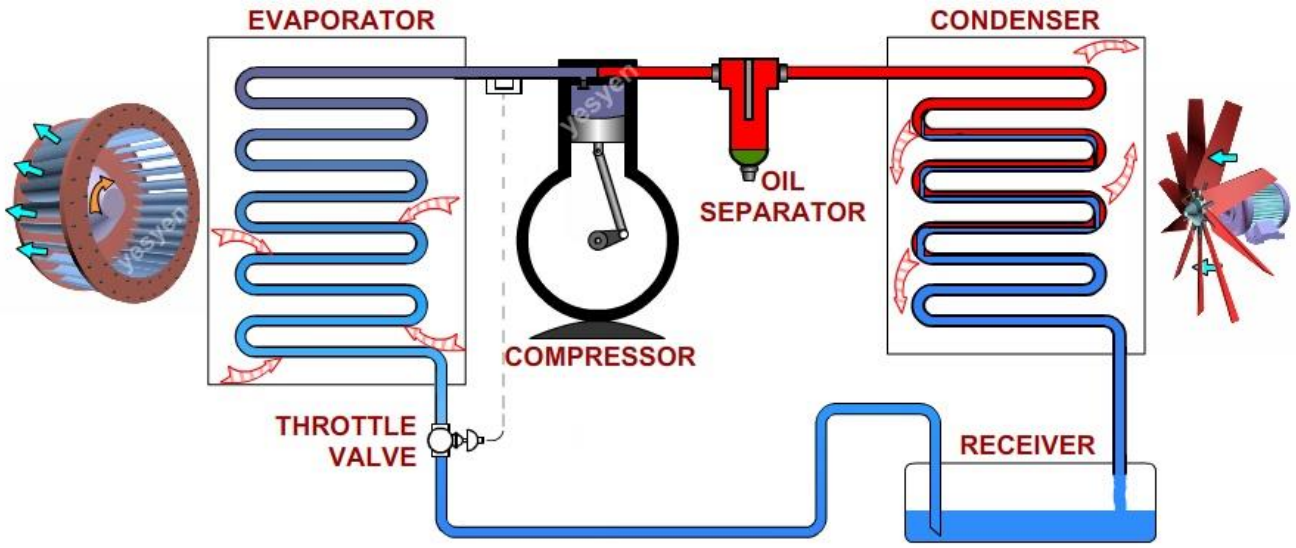
Technology Improvement

EE Regulations in Türkiye

- Minimum Energy Performance Standards (MEPS) for cooling sector;
  - MEPs Residential Refrigerators – Turkish Official Gazette No 28063 (transposition of EC 643/2009)
  - MEPs Air Conditioners – Turkish Official Gazette No. 28712 (transposition of EC 206/2012)
  - Label Comparative for residential refrigerators and freezers – Turkish Official Gazette No. 28331 (transposition of EC 1060/2010)
- Additional communiqués for EE measures relevant for the cooling sector;
  - Environmentally Friendly Design Requirements for Household Cooling Appliances (SGM-2011/17) (23.09.2011 – 28063)
  - Environmentally Friendly Design Requirements for Air Conditioners and Fans (SGM-2012/13) (19.07.2013 – 28712)
  - Environmentally Friendly Design Requirements for Electric Motors (SGM-2012/2) (07.02.2012 – 28197)
  - Environmentally Friendly Design Requirements Regarding No-Load Energy Consumption and Average Active Efficiency of External Power Sources (SGM-2011/11) (27.08.2011 – 28038)
  - Energy Labelling of Household Cooling Devices (SGM-2012/4) (22.06.2012 – 28331)
  - Energy Labelling of Air Conditioners (SGM/2013-11) (24.12.2013 – 28861)
  - Energy Labelling of Space Heaters, Combined Heaters, Space Heater, Temperature Control and Solar Device Packages and Combined Heater, Temperature Control and Solar Energy Device Packages (SGM: 2018/1) (28.03.2018 – 30374)

EE Components

- Reduce load
  - For refrigeration; consider better insulation
  - For AC; consider tighter envelope
- Compressors
  - Higher EER compressors
  - Variable speed technologies
- Heat Exchangers
  - Small diameter (5 mm)
  - MCHX
  - Advanced fin designs
  - Increase size
- Fans/Blowers
  - ECM
  - Optimize blade design
  - Expansion Valves
  - Use TXV/EXV
  - Advanced Controls (IoT, FDD, etc.)



https://yesyen.com/refrigeration_cycle.php

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Summary of EE Technologies and Costs for RAC

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Component	Max. EE savings	Additional component cost	Additional capital cost	Comments
High EE compressor	10%	Up to 10%	NA	
2-stage compressor	10%	10%	NA	
VS compressor	30%	20%	Medium	Better control and better seasonal energy efficiency
MCHX	15%	NA	High	Reduce charge
5 mm FTHX	10%	NA	Medium	Reduce charge
Adiabatic condenser	30%	20 – 35%		Only applicable for HAT dry condition
ECM fans	15%	15 – 25%	Medium	Improved comfort
EXV	20%	15%	Medium	Better comfort/control
Pipe insulation	<2%	NA		
Head pressure control	2 – 3% per 1K reduction	Depends on OEM	Low	

EE measures and corresponding IOC for different technologies in commercial refrigerators

Technology	EE (%)	Incremental Operating Costs (USD/Unit)
High Performance Insulated Glazing Unit for doors	23 – 33	20 – 22
Use High Efficiency Compressor	8	-5
Increase Insulation Thickness	5	0.76 – 6
Optimize Gasket	1.5	1 – 4
MCHX	2	0 – 5
Smart Controller	5 – 12.5	6 – 22.5
Vacuum Insulating Panels VIP	4	5.33 – 35
ECM and Improved Fan Designs	4 – 26.5	2 – 33.53
Digital Controller with IOT	30	39.75 – 55
Use LED Lighting	2	3.14

How to calculate EE?

Reduced kWh/year indicates better EE
SCCR
Higher SEER reflects improved EE for RAC
In the project design phase:

- Use modeling tools to assess baseline performance and set MEPS values
- Explore design options with interventions (e.g., VSD, ECM, larger HX)
- Assess their energy efficiency impact
- Create a cost–benefit curve

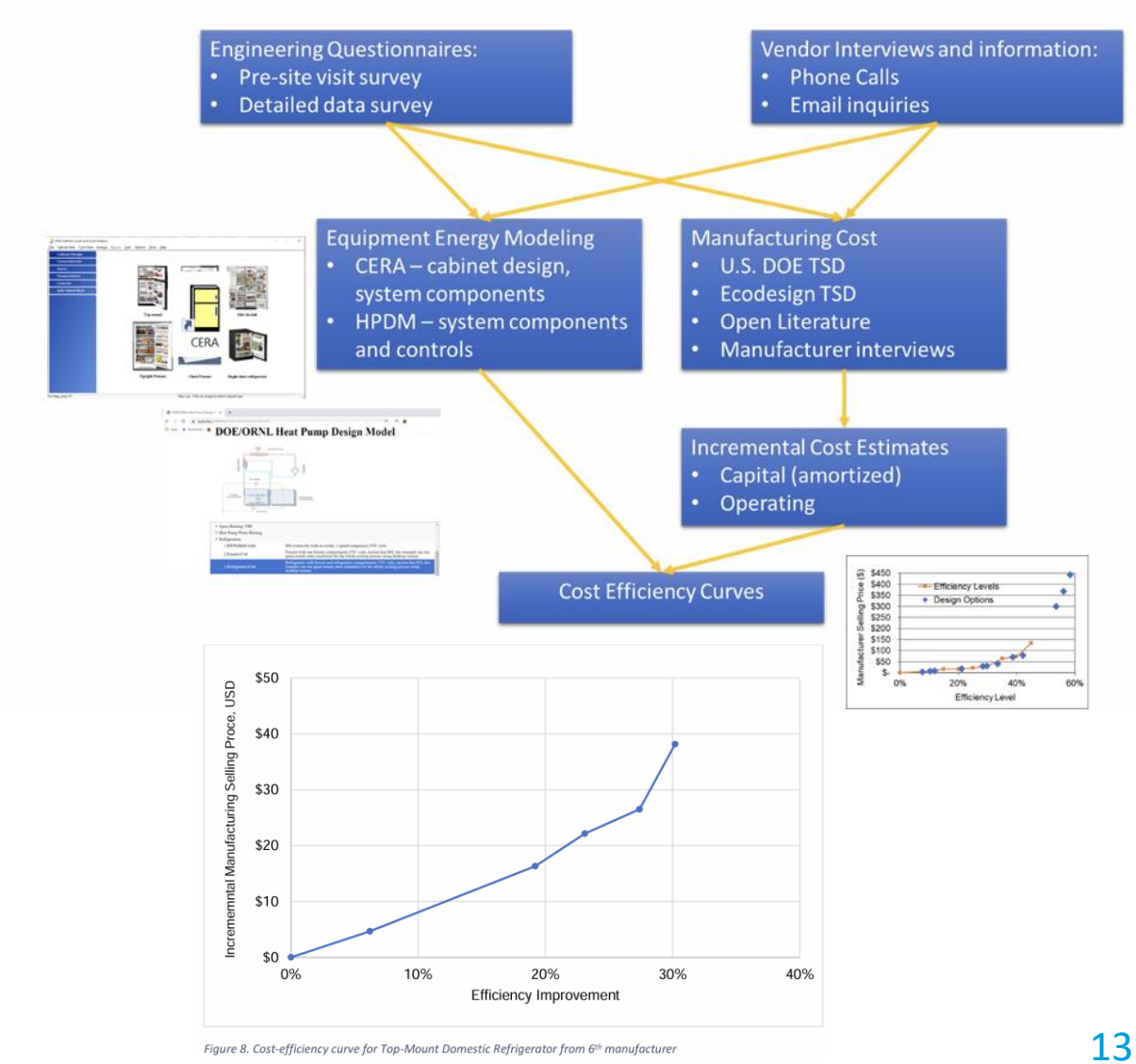

Figure 8. Cost-efficiency curve for Top-Mount Domestic Refrigerator from 6th manufacturer

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Available Funding

General notes

- Refer to document UNEP/OzL.Pro/ExCom/94/61 available at:
  Further elaboration on the operational framework to support maintaining and/or enhancing energy efficiency described in document UNEP/OzL.Pro/ExCom/93/98 (decision 93/93(d))

- An incentive-based approach: targeted levels of incentives for different levels of performance;
- Incentives are designed to avoid performance below pre-defined levels and adjusted in proportion to baseline and target performance levels;
- Success of the incentive scheme is closely linked to policies and other measures to ensure sustainable performance ensuring energy-efficient technologies continue to be adopted beyond the project timeframe;

Incentive based approach

- Three levels of energy efficiency will be considered for the calculation of the incentive.
  - The current level of energy performance of the equipment, or ***baseline level***,
  - the target that is expected to be achieved by the project, or ***target level*** and
  - the ***target level achieved*** at the end of the project
- During project submission, each enterprise would submit information on their estimated costs for achieving specified levels of target energy performance;
- There are two types of costs: ***additional capital costs (Ct)*** and **additional component costs (Ce).**
- The total incentive that would be made available to a manufacturer would be based on the additional capital costs (*Ct*) and the additional component costs (*Ce*) to achieve the target level of energy performance.

C_t for Refrigeration Equipment

Table 1. Overview of additional capital cost for refrigeration equipment

Equipment	Capacity (units per annum)	Additional capital cost (C_t in US $)***	Additional capital cost per unit to achieve maximum performance level (US $/unit)
a	b	c	d=c (max) / b (max)
Domestic refrigerator	< 30,000	100,000	2.5
	30,000 to 100,000	150,000	
	100,000	250,000	
Commercial refrigeration – chest freezers*	< 25,000	100,000	2.4
	25,000 to 75,000	120,000	
	> 75,000	180,000	
Commercial refrigeration – display cabinets**	< 5,000	100,000	16.67
	5,000 to 15,000	150,000	
	> 15,000	250,000	

* This would include refrigerated freezers used to store foodstuff typically at -18°C for long-term storage and/or direct sale.
** This would include refrigerated display (freezer or refrigerator) cabinets (RDCs) "visi-coolers", refrigerated storage (freezer or refrigerator) cabinets (RSCs), refrigerated drink cabinets or beverage coolers (RDC-BCs) "bottle-coolers", ice cream freezer cabinets (RDC-ICFs), scooping cabinets (RDC-SCs), and refrigerated vending machines (RVMs).
*** These costs include costs relating to product design for energy efficiency (US $25,000 to US $100,000), the changes in the manufacturing facilities mainly relating to energy performance testing and upgrades related to the use of more efficient components (e.g., new welding jigs for gaskets) (US $50,000 – US $125,000), training and third-party product testing and certifications (US $25,000 – US $50,000). The costs need to be periodically updated based on cost trends in the market.

When estimating the additional capital costs during the project review process, the $Ct\text{-}_{submitted}$ for the project would be compared with the cost given in the table for the relevant manufacturing capacity. The lower of either the $Ct\text{-}_{submitted}$ or the cost given in the table would be the actual additional capital costs for the project.

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Explanation of C_e calculation -1

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- When giving the baseline information, the beneficiary enterprise would provide the additional component cost ($C_{e\text{-submitted}}$) value for the targeted maximum energy-efficiency level (E-high) for each relevant type of equipment.
- The maximum additional component cost (C_e*) is estimated at the values given in the table in the next slide for the three different types of equipment and three energy-efficiency performance levels. The three energy-efficiency levels are: E-low; E-medium; and E-high.
- The E-low is expected to be equal to MEPS in that country. The E-medium is the arithmetic mean between E-low and E-high. While the E-high ideally should be equal to the BAT;
- No incentives would be available for equipment that has a target performance below the energy-efficiency level (E-low), as this equipment is not compliant with the MEPS, which is the national regulatory standard for the country.
- When the equipment has a baseline performance between low and medium energy performance levels (i.e., E-low and E-medium) and estimated target performance between E-low and E-medium, the incentive would be proportionate to the energy performance levels.
    - For example, if the energy performance level for a particular beneficiary is 75 per cent of the difference between E-low and E-medium, the levels of incentive would be estimated as 0.75 multiplied by the maximum incentive applicable for reaching the E-medium level of performance (C_{medium}).

C_e for Refrigeration Equipment

Table 2. Target energy performance levels for different equipment and additional component costs (C_e*)

Particulars	Domestic refrigerator		Commercial refrigeration – chest freezer		Commercial refrigeration – display cabinet	
	kWh/year/ litre*	Additional component cost per unit (US $)	kWh/year/ litre**	Additional component cost per unit (US $)	kWh/day/ m^2***	Additional component cost per unit (US $)
	a	b	c	d	e	f
E-low	1.109		1.061		15.121	
E-medium	0.882	15	0.822	15	10.672	35
		C_{medium}		C_{medium}		C_{medium}
E-high	0.654	20	0.583	20	6.222	46
		C_{high}		C_{high}		C_{high}

Note: C_{medium} and C_{high} are incentive estimates for achieving the different levels of energy efficiency performance shown in columns (a), (c) and (e); this would be based on the consultations of the incentive levels by the Executive Committee.

* This assumes that the beneficiary produces a mix of domestic refrigerators whose kWh/year/litre has an equivalent MEPS of 1.109 that is equivalent to low energy efficiency levels for that equipment under United for Efficiency (U4E) assessment; feasible best available technology (BAT) is 59 per cent of MEPS according to Europe Ecodesign support documents.

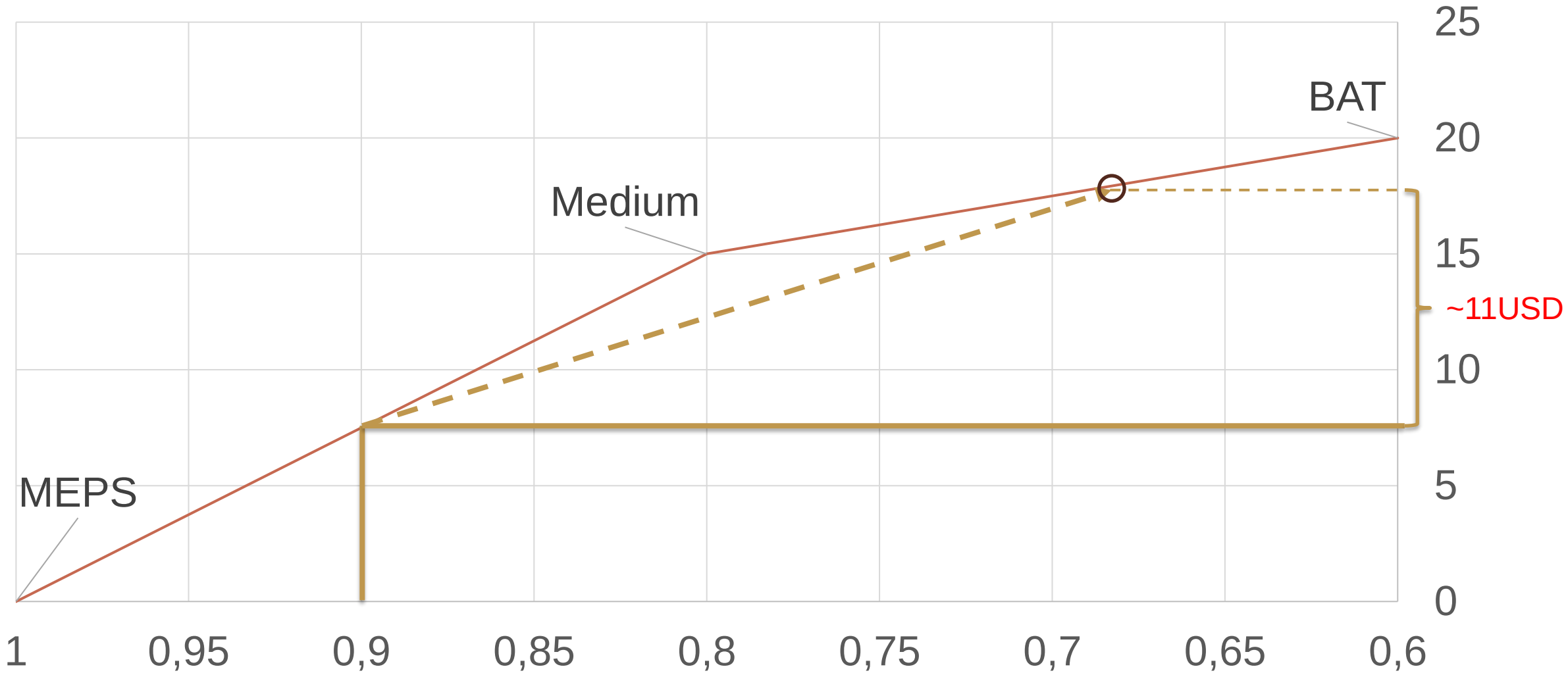
** This assumes that the beneficiary produces a mix of commercial refrigeration – chest freezers whose kWh/year/litre has an equivalent MEPS of 1.061 that is equivalent to low energy efficiency levels for that equipment under U4E assessment; feasible BAT is 55 per cent of MEPS according to Europe Ecodesign support documents.

*** This assumes that the beneficiary produces a mix of commercial refrigeration – display cabinets whose kWh/day/square metre has an equivalent MEPS of 15.121 that is equivalent to low energy efficiency levels for that equipment under U4E model regulation; E-medium and E-high are based on the intermediate- and high-efficiency level suggested by the U4E model regulations for the commercial refrigeration equipment.

Explanation of C_e calculation -2

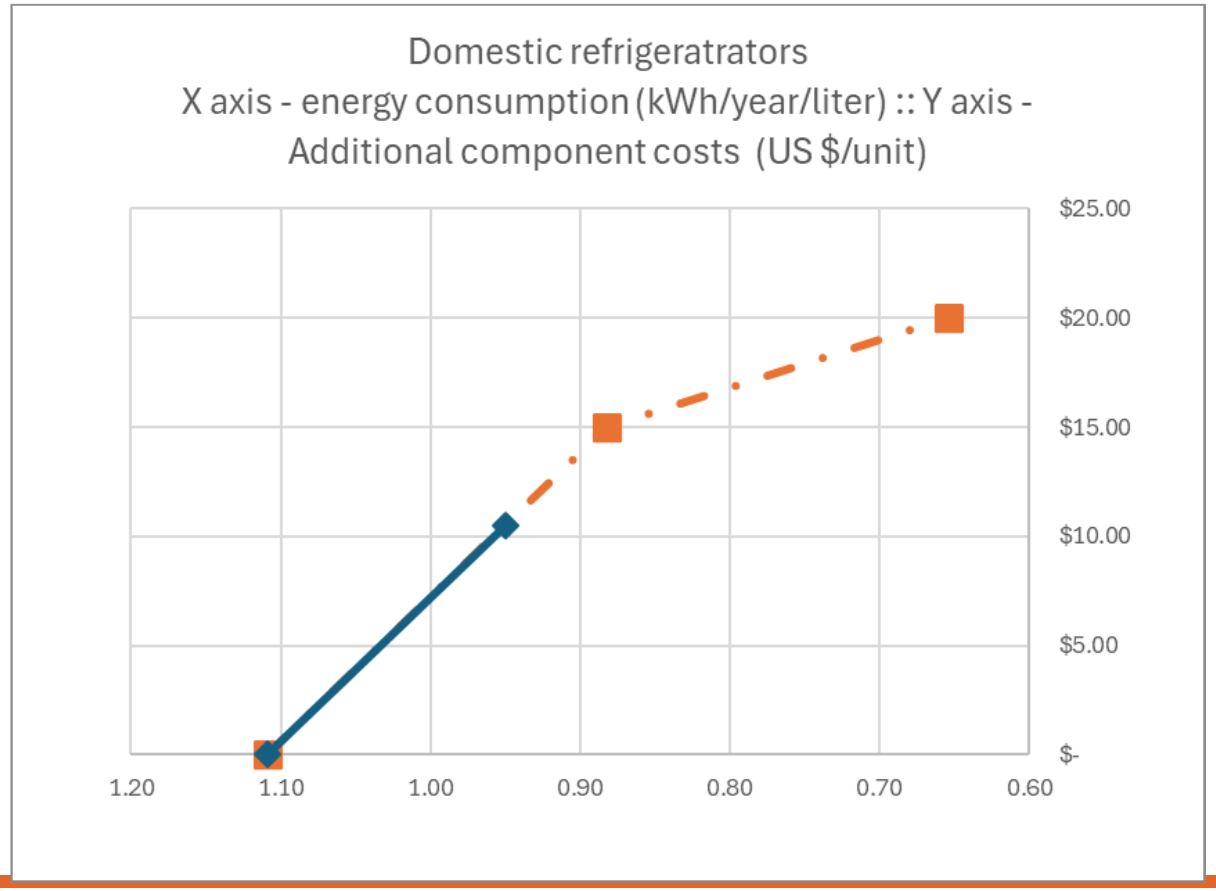
- The maximum incentive will be available for enterprises that have equipment with a baseline performance level of E-low and propose to reach a target of E-high.
- No incentive would be available for enterprises that have a baseline level above E-high, as that would mean that the enterprise already had the necessary capabilities to achieve a high energy-efficiency level.
- incentive levels below one third of the additional component costs would not be attractive enough for the industry to participate in the incentive scheme.

Ce



Example of C_e calculation

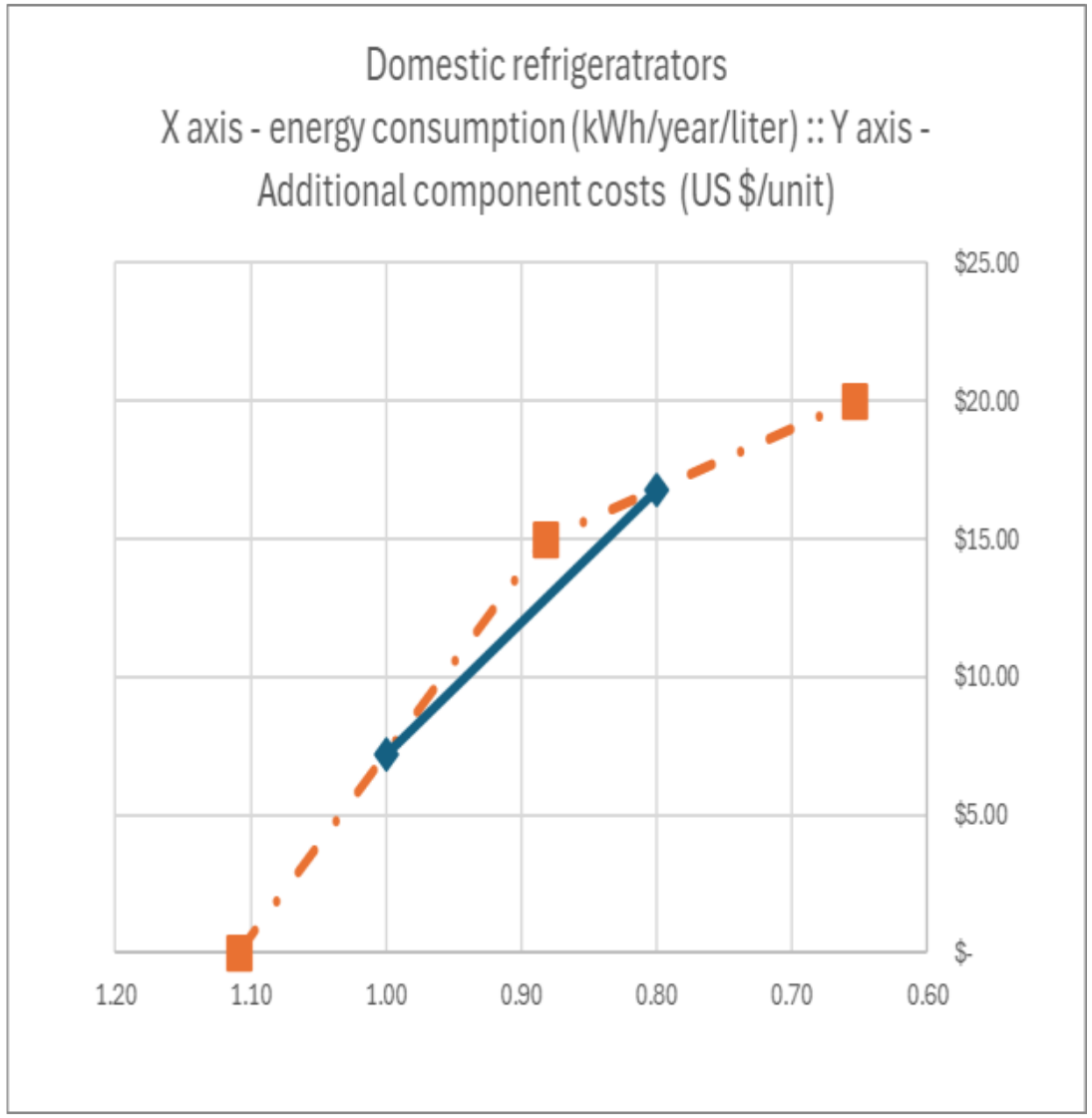
- if the incentive level for a particular product is US $5 per unit for achieving a specified level of energy performance compared to the baseline, and the R_{cost} is 0.4 because the cost of components in a country is lower than the costs given in table 2, the incentive applicable for the project would be US $2 after adjustment.



Example 1: Illustration of additional costs (i.e., the difference between the two US $/unit levels for the component costs) to be available for moving from a baseline of 1.109 kWh/year/litre to 0.95 kWh/year/litre; the additional cost for achieving this target compared to the baseline level based on the model would be US $10.51.

The dotted line shows cost increases that would occur for higher levels of energy-efficient equipment i.e., equipment with energy consumption of 1.109 kWh/year/litre and 0.654 kWh/year/litre.

Example of C_e calculation



Example 2: Illustration of additional costs (i.e., the difference between the two US $/unit levels for the component costs) to be available for moving from a baseline of 1.00 kWh/year/litre to 0.80 kWh/year/litre; the additional cost for achieving this target compared to the baseline level based on the model would be US $9.6.

The dotted line shows cost increases that would occur for higher levels of energy-efficient equipment i.e., equipment with energy consumption of 1.109 kWh/year/litre and 0.654 kWh/year/litre.

C_t for AC Equipment

Table 3. Target energy performance levels for different equipment and additional capital costs

Equipment	Capacity (units per annum)	Additional capital cost (US $)	Additional capital cost per unit to achieve maximum performance level (US $/unit)
a	b	c	d=c (max) / b (max)
Residential air conditioner	< 30,000	100,000	2.50*
	30,000 to 100,000	120,000	
	100,000	250,000	
Commercial air conditioner	< 10,000	100,000	5.00**
	10,000 to 50,000	125,000	
	> 50,000	250,000	

* For 1.5 TR capacity mini-split air conditioner (AC) unit; additional cost may vary for different cooling capacities.
** For 10 TR packaged AC unit; additional cost may vary for different cooling capacities.

Ce for AC Equipment

Table 4. Target energy performance levels for different equipment and additional component costs (C_e*)

Particulars	Residential air conditioner		Commercial air conditioner	
	SEER(compared to MEPS level)	Additional component cost per unit (US $)	IEER (compared to MEPS level)	Additional component cost per unit (US $)
RE-low	1.00		1.00	
RE-medium	1.50	34	1.40	132
		C_{medium}		C_{medium}
RE-high	2.00	45	1.67	176
		C_{high}		C_{high}

Note: C_{medium} and C_{high} are incentive estimates for achieving the different levels of energy-efficiency performance shown in the previous columns.

The energy performance levels (E-low, E-medium and E-high) would be estimated as the ratio of these levels to MEPS (RE-low, RE-medium, RE-high); this is to account for differences in the energy-efficiency performance ratios (Integrated Energy Efficiency Ratio (IEER), Seasonal Energy Efficiency Ratio (SEER), Combined Seasonal Performance Factor (CSPF), Annual Performance Factor (APF)) used in different countries for measuring energy-efficiency performance.

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C_e adjustment!

Achieving maximum target levels (e.g., E-high) committed to under the project for the different types of equipment, the proportion of the actual component costs ($C_{e\text{-submitted}}$) required to achieve those targets would be divided by the maximum additional component cost C_{e*} ➔ cost adjustment ratio (R_{cost})

- If $C_{e\text{-submitted}}$ is greater than C_{e*}, R_{cost} would be 1
- If the $C_{e\text{-submitted}}$ fall lower than C_{e*}, R_{cost} would fall to values lower than 1
- R_{cost} is applicable only for component costs

Total Incentive

$$Incentive = (C_t + R_{cost} * C_{performance} * Q_{manufactured})$$

- C_t is the minimum of the $C_{t\text{-submitted}}$ and $C_{t\text{-table}}$
- R_{cost} is the $C_{e\text{-submitted}}$ /Ce*
- $C_{performance}$ is a function of the baseline energy performance of energy efficiency, target level as submitted in the project, and C_{level} which is the maximum incentive applicable for reaching medium or high levels of energy efficiency targets
- $Q_{manufactured}$ = actual quantity of equipment manufactured with target energy efficiency as submitted, for the baseline year

No incentives would be available for equipment that does not have an established mandatory MEPS in the country. Compensated lines would only export equipment at or above their domestic mandatory MEPS requirements.

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Project submission

Needed information and reporting

Needed Information

Products

- Information on the list of products;
- the quantity of equipment manufactured (Q) for the previous year and their energy consumption in kWh/year;
- the capacity in litres or square metres (sq.m);
- energy-efficiency ratio in the case of air-conditioning equipment;
- the weighted average energy consumption per litre/(kWh/year/litre or sq.m) for the different units including categories/shipment (i.e., domestic sales or export sales);
- the measurement methodology used for estimating the energy consumption per year;

MEPS

- MEPS value for each category of the equipment covered under the project – this would include national MEPS and other MEPS used for exported products;
- products exported without MEPS can only be included if their performance is equal to or greater than the national MEPS;

Target

- Information on the target energy consumption in kWh/year and the capacity in litres or sq.m for each category of the equipment proposed to be covered under the project and the additional component costs for achieving those levels for each category of equipment; and
- the estimated weighted average energy consumption per litre (kWh/year/litre or sq.m), as well as the estimated weighted average energy efficiency ratio (T);

Methodology

- the methodology used to measure energy consumption based on the corresponding energy measurement standards applicable to the project for the different products leaving the factory (national and other MEPS used for export).

Refrigerators/Chest freezers
$\overline{V_{capacity}}$ (Units/year)
$\bar{V}$ (Units/year)
$\overline{\left(\frac{kWh}{year}/litre\right)_{MEPS}}$
$\overline{\left(\frac{kWh}{year}/litre\right)_{MEPS,Target}}$
$\overline{\left(\frac{kWh}{year}/litre\right)_{U4E}}$
$\overline{\left(\frac{kWh}{year}/litre\right)_{BL}}$
$\overline{\left(\frac{kWh}{year}/litre\right)_{Target}}$
$C_{performance}$ [model-by-model], US$
$C_{t-table}$, US$
$C_{t-submitted}$, US$
Total Incentive
$E_{ind,Savings,EE}$ (tonnes CO_{2e}/yr)
$E_{dir,Savings}$ (tonnes CO_{2e}/yr)
US$/tonnes$CO_{2e}$/yr

Air Conditioning
$\overline{V_{capacity}}$ (Units/year)
$\bar{V}$ (Units/year)
MEPS Performance
Target MEPS Performance
Energy Performance
Target Performance
$C_{performance}$ (US$/Unit)
$\bar{Q}$ (TR)
Cost Adjustment (for capacity)
Result
$C_{t-table}$, US$
$C_{t-submitted}$, US$
Additional Component Cost – Project, US$
A5 Ownership
Available Incentive
$E_{ind,Savings,EE}$ (tonnes CO_{2e}/yr)
$E_{dir,Savings}$ (tonnes CO_{2e}/yr)
US$/tonnes$CO_{2e}$/yr

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Reporting of results

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Sector	Domestic Refrigerators	Chest Freezers	Display Cabinets	Residential AC	Commercial AC
Number of Manufacturing Facilities					
Improve EE: in kWh/year/litre or SEER					
Annual Indirect Emissions Reduction, CO_2e tonnes/year					
Annual direct Emissions Reduction, CO_2e tonnes/year					
Total direct & indirect emission reduction CO2e tonnes/year					
Total Additional Capital Cost, US$					
Total Additional Component Incentive, US$					
Total EE Incentive, US$					
Project average cost US$/$CO_2e$ tonnes/year					

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Thank you!

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