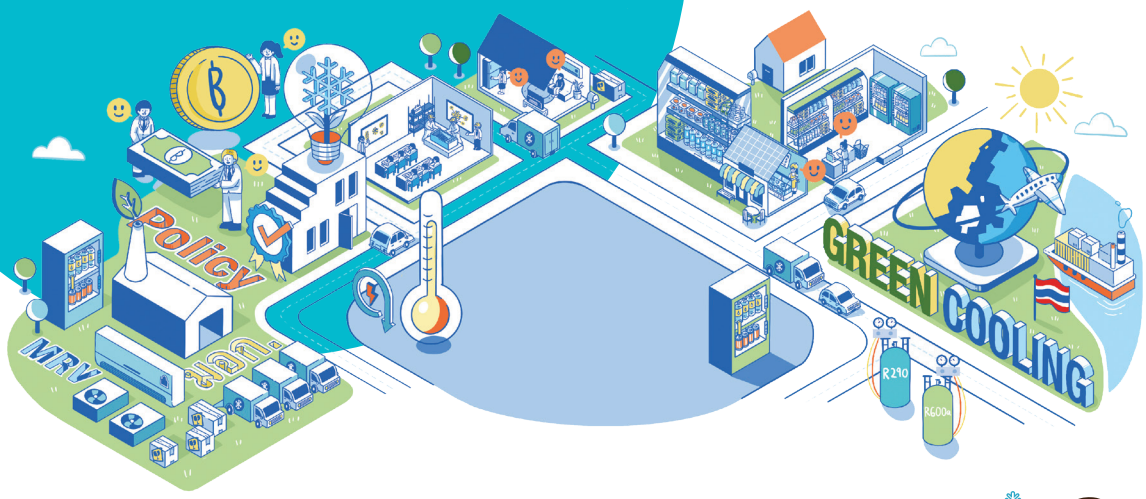
Handing Over Protocol for the Project MRV of Thailand RAC NAMA



NAMA Facility

On behalf of:
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

Department for Business, Energy & Industrial Strategy

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Department of Alternative Energy Development and Efficiency
MINISTRY OF ENERGY

EGAT

Handing Over Protocol for the Project MRV of Thailand RAC NAMA

Contents

Abbreviations

AC	Air Conditioning or Air Conditioner
BAU	Business as Usual
BUR	Biennial Update Report
DEDE	Department of Alternative Energy Development and Efficiency
DIW	Department of Industrial Works
EEI	Electrical and Electronic Institute
EGAT	Electricity Generating Authority of Thailand
EPPO	Energy Policy and Planning Office
GHG	Greenhouse Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
KMUTNB	King Mongkut's University of Technology North Bangkok
MRV	Measurement, Reporting and Verification
NAMA	Nationally Appropriate Mitigation Action
NC	National Communications
NDC(s)	Nationally Determined Contribution(s)
OB	Oversight Board
ONEP	Office of Natural Resources and Environmental Policy and Planning
RAC	Refrigeration and Air Conditioning
TGO	Thailand Greenhouse Gas Management Organizaton
UNFCCC	United Nations Framework Convention on Climate Change

Background and Aim

The project "RAC NAMA" or Refrigeration and Air Conditioning – Nationally Appropriate Mitigation Action aims to support Thailand in initiating a sustainable transformation in the cooling sector by promoting climate-friendly and energy-efficient cooling technologies. The project is funded by the NAMA Facility[1] and is implemented by GIZ together with the Office of Natural Resources and Environmental Policy and Planning (ONEP), the Department of Alternative Energy Development and Efficiency (DEDE) and the Electricity Generating Authoring of Thailand (EGAT). It provides demand-oriented policy advice, technical assistance, support for financial mechanisms and market introduction. The project provides technical and policy advice on the topic of Measurement, Reporting, and Verification (MRV) specific to the RAC sector. Within the framework of the project, the MRV Working Group was established in 2018 to support the effective implementation of the Project MRV system of the RAC NAMA Project.

Aiming to promote the market introduction of green cooling technologies, the RAC NAMA Fund was established in 2018 together with EGAT as the host and project fund manager. With EUR 8.3 million, the fund launched financing mechanisms for targeted beneficiaries, especially: local producers, consumers, trainings and testing facilities. Specifically with the support provided to local producers and consumers, greenhouse gas (GHG) emissions reductions are achieved. The **Project MRV Tool (Package)** and the corresponding **MRV Tool Guidelines** were created for the purpose of tracking emissions reductions achieved through measures directly supported by the RAC NAMA Fund, i.e. along the financing mechanisms.

In its Nationally Determined Contributions (NDCs), Thailand has committed to reducing GHG emissions by 20% in 2030 under a business-as-usual (BAU) scenario and an additional 5% with internationally supported mitigation actions. The RAC NAMA project has been included in the country's NDC roadmap as one of the mitigation actions under the IPPU sector. As such, the international support received by Thailand for the RAC NAMA project and resulting emissions reductions will be reported in the framework of its Biennial Update Reports (BUR) and National Communications (NC) to be submitted to the UNFCCC. Further, Thailand has the opportunity to report post-project mitigation as part of its NDCs as well.

As RAC NAMA project reaches the end of its implementation in July 2021, this **"Handing Over Protocol for the Project MRV for Thailand RAC NAMA"** aims to enable the following beyond project duration: (1) continued use of the Project MRV Tool and (2) reporting of the emissions reductions achieved through the project. Towards this aim, the current Project MRV Scheme and existing resources (i.e. Project MRV Tool and MRV Tool Guidelines) are described. This document also provides recommendations for assigning roles and responsibilities beyond project duration to enable continued monitoring and reporting of the emissions reductions achieved (and yet to be achieved) by the RAC NAMA Project – as a result of stakeholder discussions. Finally, this document summarizes the emissions reductions achieved so far, thereby providing a sample representation of elements when reporting mitigation to the UNFCCC.

[1] NAMA Facility is a multi-donor facility that provides tailor-made support for the implementation of highly ambitious and transformational NAMAs in developing countries. The Facility conducts competitive calls and selects the most ambitious and promising NAMA Support Projects for funding. For more information, visit: https://www.nama-facility.org/

Project MRV Scheme and Resources

Project MRV Scheme for RAC NAMA's Emissions Reductions

The Project MRV Scheme illustrated below (Fig.1) focuses on the emissions reductions achieved through the RAC NAMA project, more specifically through the different financing mechanisms launched by the RAC NAMA Fund for different target groups. The fund supported **banks** in operating a credit card scheme for consumers of domestic refrigerators that natural refrigerants and are highly energy-efficient. Further, the fund supported **producers** of commercial refrigerators, ACs (split-type and portable), and chillers through (sub-) grants and credit lines for the production line conversion and market introduction & sales promotion of green cooling technologies.

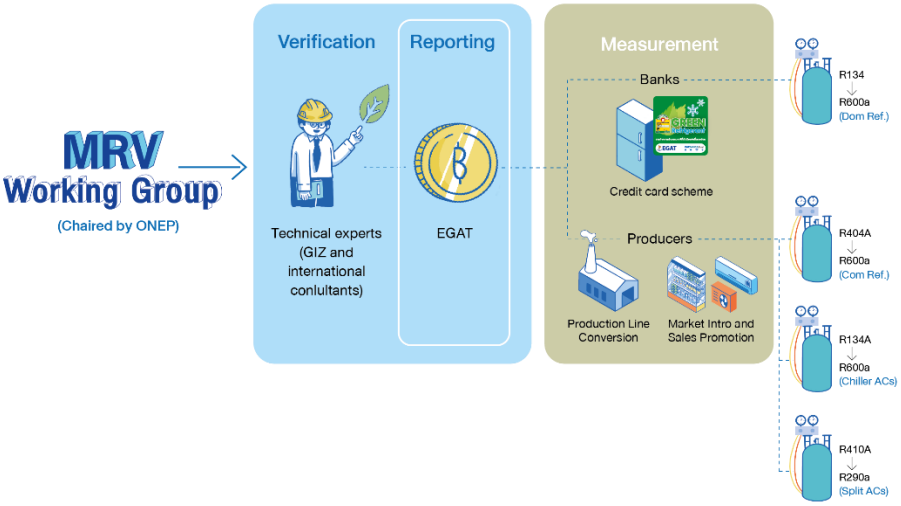


Figure 1. Current Project MRV Scheme for RAC NAMA Emissions Reductions

Recipients of this direct support, the participating banks and producers, have a reporting obligation to EGAT (as the host and project fund manager of the RAC NAMA Fund) and thereby carry out the **measurement** component of the Project MRV scheme. This reporting takes place according to the duration, frequency, and format agreed within their legal contract. While the credit card scheme ended in 2019 and no further reports or results are expected, *Annex I* provides more information on the financing mechanisms of the RAC NAMA Fund and outlines the reporting timelines that producers follow after receiving support for production line conversion and market introduction & sales promotion. Data reported to EGAT includes information required to estimate the resulting emissions reductions (e.g. production volume, technical specification of baseline unit and new unit).

The **reporting** component of the MRV Scheme are carried out jointly by EGAT (being the recipient of the measured data) and the Project MRV Tool which is operated with technical support from GIZ and its external experts. Current reporting elements have been defined by the purpose of the Project MRV Scheme and Tool, that is to track the emissions reductions achieved through the measures directly supported by the RAC NAMA Fund. The reporting elements generated by the tool are categorized into refrigerant-related and energy-related emissions reductions per subsector; they are estimated per unit over its lifetime and can be summarized yearly. Further elaboration is provided in the next subsection on the Project MRV Tool.

The **verification** component of the Project MRV Scheme takes place at different levels: (1) checking producer reports for correctness and completeness, (2) built-in plausibility checks within the MRV Tool, (3) technical verification from GIZ and external experts, and (4) expert discussion through the MRV WG. Verification instruments 1 and 2 are described in steps (i.e. with a checklist) in the MRV Tool Guidelines. GIZ is also currently working on providing another verification step, i.e. at the level of the producers; this will be provided in the form of a checklist for them to quickly assess the overall plausibility of the data they include in their reports to EGAT. This additional checklist will be included in the final version of the MRV Tool and MRV Tool Guidelines.

The MRV Working Group (WG) was established in 2018 to support the effective implementation of the Project MRV system of the RAC NAMA Project. The MRV WG is chaired by ONEP and consists of representatives from 5 agencies: ONEP, DIW, EGAT, DEDE, and TGO. GIZ acts as the technical advisor. The MRV WG was involved in reviewing the methodology and the technical assumptions behind the MRV Tool. During project duration, progress on mitigation results are also reported to the MRV WG (and then reported to the Oversight Board or OB Meeting of the RAC NAMA project, which acts as a steering committee for the project).

Resources: Project MRV Tool and MRV Tool Guidelines

Emissions from the RAC sector arise from **direct and indirect emissions**, from **refrigerant use and electricity consumption** respectively, which are attributed to the IPPU and energy sectors under the IPCC 2006 Guidelines. These emissions take place at different points in the life cycle of RAC equipment – in the manufacturing, during operation, and at the end-of-life. The project MRV Tool was developed using the **Tier 2 Methodology according to the IPCC 2006** guidelines, following the subsector categories provided and collecting data at the equipment level.

Mitigation is determined by comparing the baseline scenario and project activity, i.e. the resulting baseline and project models respectively. The **project model** is the unit resulting from activities (credit-card financing scheme, production line conversion, market introduction and sales promotion) directly supported by the RAC NAMA Fund. The baseline scenario describes what would have happened in the absence of project activity. This is what the tool refers to as the **baseline model**. In both cases (baseline and project), direct (refrigerant-related) and indirect (energy consumption-related) emissions are considered. **Annual direct emissions** (for baseline and project) are calculated based on the initial refrigerant charge and emission factor for the different stages during the equipment life cycle where emissions occur. **Annual indirect emissions** (for baseline and project) are calculated by estimating the average annual electricity use, using application specific methodologies and multiplying it with the national grid emission factor[2].

To facilitate the calculation of emissions and resulting mitigation from measures directly supported by the RAC NAMA Fund, the **Project MRV Tool (Package)** has been developed as an excel-based tool that accommodates the reporting scheme of the relevant financing mechanisms (i.e. A for consumer finance, B2 for market introduction, C for production line conversion – *see Annex I*). It covers the 4 subsectors in which mitigation activities are intended, namely: domestic refrigeration, ACs (split-type and portable), commercial refrigeration, and chillers.

[2] Source of national grid emission factor: http://www.eppo.go.th/index.php/en/en-energystatistics/co2-statistic?orders[publishUp]=publishUp&issearch=1

In addition, the fund and the tool also accommodate equipment that do not exactly match these subsectors and are placed in the “No Default” category. In its final form, the Project MRV Tool Package consists of a **master mitigation file** and seven (7) **monitoring tool files**. A monitoring tool file is provided for each financing mechanism and the concerned subsector. It monitors the number of units produced and the corresponding technical specifications (as reported by the producers) to enable calculation of baseline emissions, project emissions, and finally the resulting mitigation within the tool. The master mitigation file summarizes the resulting calculations from each monitoring file and thereby captures the overall mitigation based on the financing mechanisms.

The **MRV Tool Guidelines** provides a detailed description on the methodology used and its application to the Project MRV Tool, elaborating assumed parameters, baselines, and calculations used. Further, it provides a practical guidance for the use of the MRV Tool package by (1) describing the structure of the monitoring files and the master mitigation file and (2) elaborating a step-by-step guidance on the practical use of the tool from input to editing technical databases, to verification, and to interpretation of results.

During the MRV Tool Training on 27-28 January 2021, exercises on using and interpreting the producer reports for the purpose of the MRV Tool were carried out. In the section on Project MRV Tool, an overview of all data requirements for the tool was also provided.

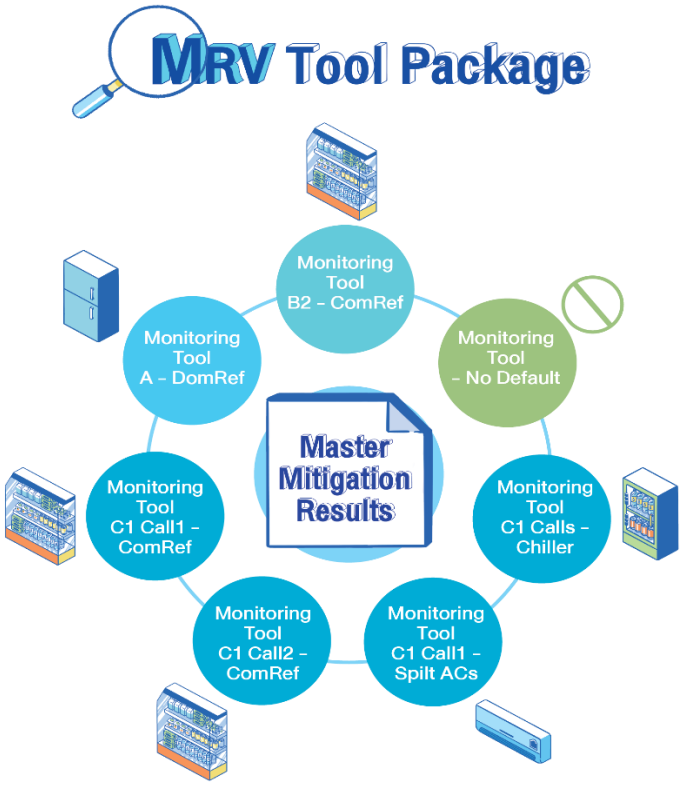


Figure 2. MRV Tool Package

Beyond Project Duration

Post-Project MRV Scheme

During project implementation, GIZ and its technical experts were an essential element of the Project MRV Scheme, developing the tool and catering to the emissions reductions that result from measures directly supported by the RAC NAMA Fund. Together with the project, the RAC NAMA Fund will ends its operations in June 2021 and no new mitigation measures will be funded. However, ongoing contracts from specific financing schemes (grants and credit lines for the production line conversion as well as for market introduction and sales promotion) will proceed and result to emissions reductions. Consequently, beneficiaries will continue to report to EGAT until the termination of their contract and EGAT will continue to receive key input data for the Project MRV Tool. Against this background, several discussions were held with the key stakeholders to define roles and responsibilities for the post-project MRV Scheme that would enable Thailand to continue tracking the emissions reductions from the RAC NAMA project and to report them to UNFCCC in the context of internationally supported mitigation as well as domestic mitigation.

The resulting post-project MRV Scheme have been separated for direct and indirect emissions mitigation as illustrated in *Figures 3 and 4* respectively. In the **measurement** component of the scheme, banks have been omitted since the credit card scheme for consumers ended in 2018 and the banks no longer report to EGAT. Only producers with ongoing contracts and reporting obligations are included in the measurement component of this post-project MRV scheme. As in the current case, the data is aggregated by EGAT and used as input for the MRV Tool. The **verification** aspect is carried out by EGAT and the MRV Tool, in which plausibility and verification checks have been built in – as elaborated In the MRV Tool Guidelines. For direct emissions mitigation (*Figure 3*), the resulting data is reported to ONEP who aggregates all national data on mitigation measures. For indirect emissions mitigation (*Figure 4*), EGAT reports the data to EPPO as the responsible line ministry for collecting information on mitigation measures in the energy sector.

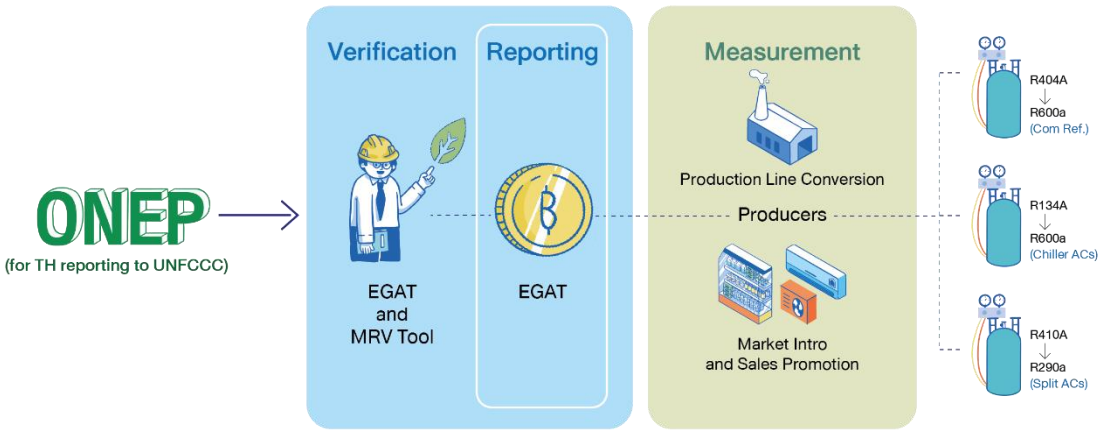


Figure 3. Post-project MRV Scheme for Direct Emissions Mitigation

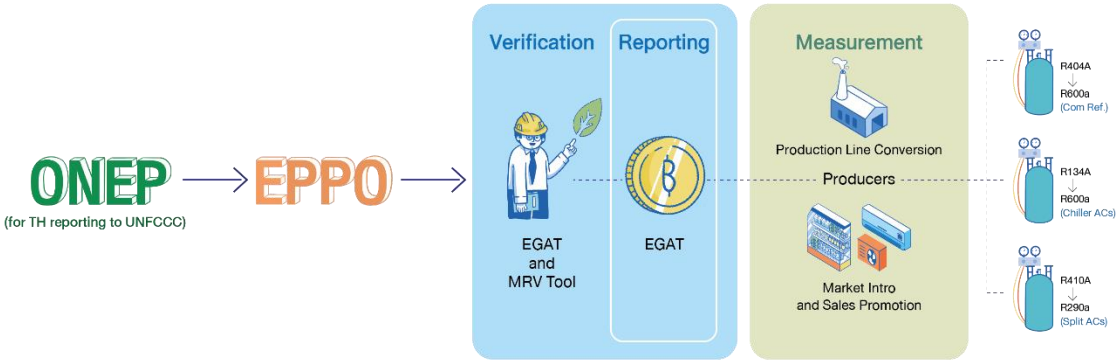


Figure 4. Post-project MRV Scheme for Indirect Emissions Mitigation

Domestic Mitigation and Reporting

<u>Capturing Domestic Mitigation</u>

Emissions take place at different points in the life cycle of RAC equipment, i.e. during **manufacturing, operation, and end-of-life**. This means that mitigation and reduction of emissions may also take place at these different points during the lifetime of a RAC equipment. Hence, where an equipment is produced, operated, and disposed affects the way mitigation is counted within specific boundaries – e.g. within Thailand.

The **Project MRV Tool** captures both the **overall mitigation** and the **domestic mitigation** resulting from the measures directly supported by the RAC NAMA Fund – they are provided as separate sheets within the master mitigation file. To capture the domestic share of mitigation, units going into the domestic market need to be distinguished from units going into the export market. As presented in *Figure 5*, **direct domestic mitigation (i.e. from replacement of refrigerant)** is accounted for at manufacturing, operation, and end-of-life in domestic units, but is only accounted for at manufacturing for export units. On the other hand, for **indirect domestic mitigation (i.e. from increased energy efficiency)** which is only accounted for during operation, only domestic units count. The Project MRV Tool Guidelines explain the approach for estimating the domestic mitigation and how the calculation is implemented within the tool.

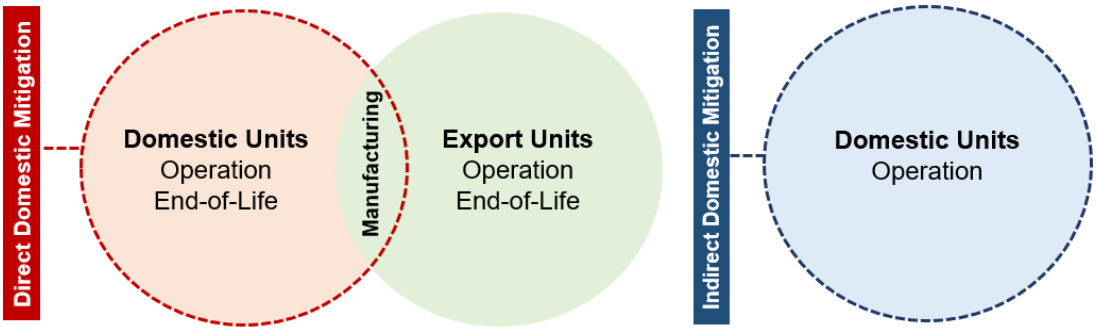


Figure 5. Capturing direct and indirect domestic mitigation along the life cycle of RAC equipment

Reporting Domestic Mitigation

Thailand reports it's national GHG emissions as part of their National Communications (NC) and Biennial Update Reports (BUR) to the UNFCCC Secretariat. Also included in the BUR is the reporting of the status quo of mitigation action and support received for climate change activities (such as technology transfer, capacity building, mitigation, and adaptation). The guidelines for the preparation of the BUR asks Parties to provide the following information for each mitigation action or group of mitigation actions, to the extent possible:

a) Name and description of the mitigation action, including information on the nature of the action, coverage (i.e. sectors and gases), quantitative goals and progress indicators;
b) Information on:
   i. Methodologies
   ii. Assumptions
   iii. Objectives of the action
   iv. Steps taken or envisaged to achieve that action
   v. Progress of implementation of the mitigation actions
   vi. Progress of implementation of the underlying steps taken or envisaged
   vii. Results achieved, such as estimated outcomes (metrics depending on type of action) and estimated emission reductions, to the extent possible
   viii. Information on international market mechanisms.

The RAC NAMA project is part of the Thailand's NDC Roadmap on Mitigation 2021-2030; and to fulfill its reporting obligation, the domestic mitigation attributed to the RAC NAMA project should be captured and reported in the BURs.

In agreement with the NAMA Facility, mitigation attributed to the RAC NAMA project during the project duration (i.e. until July 2021) will be counted as internationally supported mitigation action and thereafter as domestic mitigation action – as presented in *Figure 6*.

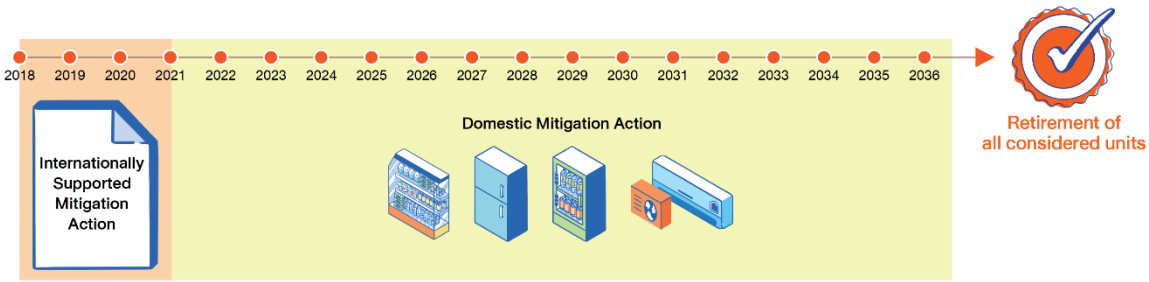


Figure 6. Internationally supported and domestic mitigation action from the RAC NAMA project

Because RAC equipment mitigates over their lifetime, mitigation of units introduced before July 2021 can be accounted for until they are considered to be retired, i.e. at the end of their lifetime. For example, household refrigerators were supported by the project through a credit card scheme in 2018. At the points of its introduction in 2018, mitigation from manufacturing can be accounted for. From 2019 onwards, mitigation from operation can be accounted for – of that mitigation after July 2021 counts towards what Thailand can report as domestic mitigation action.

Progress Update

In the subsequent sections, the most up-to-date results from the Project MRV Tool are presented, based on the reports provided by beneficiaries of RAC NAMA Fund to EGAT. To see which reports have been included in this update of the results, see Annex I on Financing Mechanisms and Reporting Timelines. The results shown include both overall mitigation and domestic mitigation.

Overall Mitigation refers to all emissions reductions resulting from all units / equipment that were directly supported by the RAC NAMA Fund; it does not distinguish between mitigation that takes place within and beyond Thailand. The overall mitigation shown in this progress update (*Figures 7, 8, 9*) is based on units already introduced into the market or **"stock"**. The results show **actual mitigation,** i.e. mitigation that has already occurred – since introduction into market and until the present) and **projected mitigation** (i.e. mitigation that will still occur – from the present until stock is retired or reached the end of its lifetime). In this progress update, actual mitigation is considered until 2020 and projected mitigation from 2021 onwards (in blue), since not all reports in the year of 2021 have been submitted.

Domestic Mitigation refers to emissions reductions resulting from units directly supported by the RAC NAMA Fund and for which the mitigation takes place in Thailand, as explained in the previous chapter and illustrated in *Figure 5* (Capturing direct and indirect domestic mitigation along the life cycle of RAC equipment). The domestic mitigation shown in this progress update (*Figures 10, 11, 12*) is also based on the "stock". The results show emissions considered to be **internationally supported** (i.e. until July 2021) and **domestically supported** (i.e. from July 2021 onwards), as previously elaborated in *Figure 6* of this document.

Overall Mitigation Results

Direct and Indirect Overall Mitigation

		Total GHG Emissions Reductions per year (tCO_2eq)												
		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Dom Ref	per year	590	1.675	1.675	1.675	1.675	1.675	1.675	1.675	1.675	1.675	1.675	1.675	1.675
Com Ref	per year	0	1.229	27.568	43.740	43.740	43.740	43.740	43.740	43.740	43.740	43.740	43.740	43.740
Split AC	per year	0	0	1	1	1	1	1	1	1	1	0	0	0
Chiller	per year	0	0	0	1	1	1	1	1	1	1	1	1	1
Other	per year	0	1	14	15	15	15	15	15	15	15	15	51	30
Dom Ref	accumulated	590	2.265	3.940	5.615	7.289	8.964	10.639	12.314	13.988	15.663	17.338	19.013	20.687
Com Ref	accumulated	0	1.229	28.797	72.538	116.278	160.018	203.759	247.499	291.239	334.980	378.720	422.461	466.201
Split AC	accumulated	0	0	1	1	2	2	3	3	4	5	5	5	5
Chiller	accumulated	0	0	0	2	3	4	5	6	8	9	10	11	12
Other	accumulated	0	1	16	30	45	59	74	88	103	118	132	183	213
TOTAL EMISSIONS REDUCTIONS (tCO2eq per year)		**590**	**2.905**	**29.258**	**45.431**	**45.431**	**45.431**	**45.431**	**45.431**	**45.431**	**45.432**	**45.431**	**45.467**	**45.446**
ACCUMULATED		**590**	**3.496**	**32.754**	**78.185**	**123.617**	**169.048**	**214.480**	**259.911**	**305.342**	**350.774**	**396.205**	**441.672**	**487.119**

Figure 1. ***Overall mitigation results from Project MRV Tool, including both direct and indirect mitigation***
(in red: actual emissions reductions from stock; in blue: projected emissions reductions from stock)

Direct Overall Mitigation

		GHG Emissions Reductions per year (tCO_2eq)												
Direct Emissions		**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Dom Ref	R134a	38	16	16	16	16	16	16	16	16	16	16	16	16
Com Ref		0	124	2.394	4.018	4.018	4.018	4.018	4.018	4.018	4.018	4.018	4.018	4.018
	R134a	0	124	2144	3529	3529	3529	3529	3529	3529	3529	3529	3529	3529
	R404A	0	0	249	489	489	489	489	489	489	489	489	489	489
Split AC		0	0	0	0	0	0	0	0	0	0	0	0	0
	R410A	0	0	0	0	0	0	0	0	0	0	0	0	0
	R32	0	0	0	0	0	0	0	0	0	0	0	0	0
Chiller		0	0	0	1	1	1	1	1	1	1	1	1	1
	R134a	0	0	0	0	0	0	0	0	0	0	0	0	0
	R407C	0	0	0	1	1	1	1	1	1	1	1	1	1
Other		0	1	7	7	7	7	7	7	7	7	7	44	30
	R134a	0	0	0	0	0	0	0	0	0	0	0	0	0
	R410A	0	1	7	7	7	7	7	7	7	7	7	44	30
	R404A	0	0	0	0	0	0	0	0	0	0	0	0	0
Dom Ref	accumulated	38	54	70	86	102	118	134	150	166	182	198	215	231
Com Ref	accumulated	0	124	2.518	6.535	10.553	14.571	18.589	22.607	26.625	30.643	34.661	38.678	42.696
Split AC	accumulated	0	0	0	0	0	0	0	0	0	0	0	0	0
Chiller	accumulated	0	0	0	2	3	4	5	6	8	9	10	11	12
Other	accumulated	0	1	7	14	21	27	34	41	47	54	61	105	134
Total per year (from refrigerant r		38	141	2.417	4.042	4.042	4.042	4.042	4.042	4.042	4.042	4.042	4.079	4.065
Total accumulated		38	179	2.595	6.637	10.679	14.721	18.763	22.805	26.846	30.889	34.931	39.010	43.074

Figure 2. ***Direct overall mitigation, resulting from refrigerant replacement***
(in red: actual emissions reductions from stock; in green: projected emissions reductions from stock)

Indirect Overall Mitigation

		GHG Emissions Reductions per year (tCO_2)												
Increase of EE		**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Dom Ref	HEPS	553	1.659	1.659	1.659	1.659	1.659	1.659	1.659	1.659	1.659	1.659	1.659	1.659
Com Ref	Replacement u	0	1.105	25.175	39.722	39.722	39.722	39.722	39.722	39.722	39.722	39.722	39.722	39.722
Split AC	Replacement u	0	0	1	1	1	1	1	1	1	0	0	0	0
Chiller	Replacement u	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	Replacement u	0	1	8	8	8	8	8	8	8	8	8	7	0
Dom Ref	accumulated	553	2.212	3.870	5.529	7.188	8.846	10.505	12.164	13.822	15.481	17.139	18.798	20.457
Com Ref	accumulated	0	1.105	26.280	66.002	105.725	145.447	185.170	224.892	264.615	304.337	344.060	383.782	423.505
Split AC	accumulated	0	0	1	1	2	2	3	3	4	4	4	4	4
Chiller	accumulated	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	accumulated	0	1	8	16	24	32	40	48	55	63	71	79	79
Total per year (from EE increase)		553	2.764	26.841	41.390	41.390	41.390	41.390	41.390	41.390	41.389	41.389	41.388	41.382
Total accumulated		553	3.317	30.159	71.548	112.938	154.327	195.717	237.106	278.496	319.885	361.274	402.663	444.044

Figure 3. ***Indirect overall mitigation, resulting from increased energy efficiency***
(in red: actual emissions reductions from stock; in blue: projected emissions reductions from stock)

Domestic Mitigation Results

Direct and Indirect Domestic Mitigation

		Total GHG Emissions Reductions per year (tCO_2eq)												
		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Dom Ref	per year	590	1.675	1.675	1.675	1.675	1.675	1.675	1.675	1.675	1.675	1.675	1.675	1.675
Com Ref	per year	0	389	9.932	17.894	17.894	17.894	17.894	17.894	17.894	17.894	17.894	17.894	17.894
Split AC	per year	0	0	1	1	1	1	1	1	1	1	0	0	0
Chiller	per year	0	0	0	1	1	1	1	1	1	1	1	1	1
Other	per year	0	1	14	15	15	15	15	15	15	15	15	51	30
Dom Ref	accumulated	590	2.265	3.940	5.615	7.289	8.964	10.639	12.314	13.988	15.663	17.338	19.013	20.687
Com Ref	accumulated	0	389	10.321	28.215	46.108	64.002	81.896	99.790	117.683	135.577	153.471	171.365	189.259
Split AC	accumulated	0	0	1	1	2	2	3	3	4	5	5	5	5
Chiller	accumulated	0	0	0	2	3	4	5	6	8	9	10	11	12
Other	accumulated	0	1	16	30	45	59	74	88	103	118	132	183	213
TOTAL EMISSIONS REDUCTIONS (tCO2eq per year)		**590**	**2.065**	**11.622**	**19.585**	**19.585**	**19.585**	**19.585**	**19.585**	**19.585**	**19.585**	**19.584**	**19.621**	**19.600**
ACCUMULATED		**590**	**2.656**	**14.277**	**33.862**	**53.447**	**73.032**	**92.617**	**112.202**	**131.786**	**151.372**	**170.956**	**190.577**	**210.176**

Figure 4. Domestic mitigation results from Project MRV Tool, including both direct and indirect mitigation
(in red: emissions reductions considered as internationally supported; in blue: emissions reductions considered as nationally supported)

Direct Domestic Mitigation

		GHG Emissions Reductions per year (tCO_2eq)												
Direct Emissions		**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Dom Ref	R134a	38	16	16	16	16	16	16	16	16	16	16	16	16
Com Ref		0	68	995	1.535	1.535	1.535	1.535	1.535	1.535	1.535	1.535	1.535	1.535
	R134a	0	68	915	1412	1412	1412	1412	1412	1412	1412	1412	1412	1412
	R404A	0	0	81	123	123	123	123	123	123	123	123	123	123
Split AC		0	0	0	0	0	0	0	0	0	0	0	0	0
	R410A	0	0	0	0	0	0	0	0	0	0	0	0	0
	R32	0	0	0	0	0	0	0	0	0	0	0	0	0
Chiller		0	0	0	1	1	1	1	1	1	1	1	1	1
	R134a	0	0	0	0	0	0	0	0	0	0	0	0	0
	R407C	0	0	0	1	1	1	1	1	1	1	1	1	1
Other		0	1	7	7	7	7	7	7	7	7	7	44	30
	R134a	0	0	0	0	0	0	0	0	0	0	0	0	0
	R410A	0	1	7	7	7	7	7	7	7	7	7	44	30
	R404A	0	0	0	0	0	0	0	0	0	0	0	0	0
Dom Ref	accumulated	38	54	70	86	102	118	134	150	166	182	198	215	231
Com Ref	accumulated	0	68	1.064	2.598	4.133	5.667	7.202	8.737	10.271	11.806	13.340	14.875	16.409
Split AC	accumulated	0	0	0	0	0	0	0	0	0	0	0	0	0
Chiller	accumulated	0	0	0	2	3	4	5	6	8	9	10	11	12
Other	accumulated	0	1	7	14	21	27	34	41	47	54	61	105	134
Total per year (from refrigerant r		38	85	1.019	1.559	1.559	1.559	1.559	1.559	1.559	1.559	1.558	1.596	1.581
Total accumulated		38	123	1.142	2.700	4.259	5.817	7.376	8.934	10.493	12.052	13.610	15.206	16.787

Figure 5. Direct domestic mitigation, resulting from refrigerant replacement
(in red: emissions reductions considered as internationally supported; in green: emissions reductions considered as nationally supported)

Indirect Domestic Mitigation

		GHG Emissions Reductions per year (tCO_2)												
Increase of EE		**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Dom Ref	HEPS	553	1.659	1.659	1.659	1.659	1.659	1.659	1.659	1.659	1.659	1.659	1.659	1.659
Com Ref	Replacement u	0	321	8.936	16.359	16.359	16.359	16.359	16.359	16.359	16.359	16.359	16.359	16.359
Split AC	Replacement u	0	0	1	1	1	1	1	1	1	0	0	0	0
Chiller	Replacement u	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	Replacement u	0	1	8	8	8	8	8	8	8	8	8	7	0
Dom Ref	accumulated	553	2.212	3.870	5.529	7.188	8.846	10.505	12.164	13.822	15.481	17.139	18.798	20.457
Com Ref	accumulated	0	321	9.257	25.616	41.975	58.335	74.694	91.053	107.412	123.772	140.131	156.490	172.849
Split AC	accumulated	0	0	1	1	2	2	3	3	4	4	4	4	4
Chiller	accumulated	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	accumulated	0	1	8	16	24	32	40	48	55	63	71	79	79
Total per year (from EE increase)		553	1.980	10.603	18.026	18.026	18.026	18.026	18.026	18.026	18.026	18.026	18.025	18.018
Total accumulated		553	2.533	13.136	31.162	49.188	67.215	85.241	103.267	121.294	139.320	157.346	175.371	193.389

Figure 6. Indirect domestic mitigation, resulting from increased energy efficiency
(in red: emissions reductions considered as internationally supported; in blue: emissions reductions considered as nationally supported)

Annex I: Financing Mechanisms of RAC NAMA Fund and Reporting Timelines of Partners Producers

"RAC NAMA Fund" was established in 2018 as a funding mechanism to promote green cooling technologies in Thailand's RAC sector. With a budget of €8.3 million (about 300 million Baht) and targeted financial mechanisms combined with technical support, the fund served the needs of different stakeholders (e.g. direct consumers, producers, training institutions). The Fund was established under the project Thailand Refrigeration and Air Conditioning Nationally Appropriate Mitigation Actions (RAC NAMA) with EGAT as the Project Fund Manager (PFM) on behalf of Thai Government. The total budget is divided into 3 components: consumer finance (Scheme A), revolving fund (Scheme B1 and B2) and grant scheme (Scheme C1 and C2) as elaborated below. The financing schemes directly contribute to the mitigation and are thereby monitored through the Project MRV Tools.

1. **Scheme A: Consumer Finance -** To support sale promotions and stimulate consumer spending for *domestic refrigerators* with high energy efficiency and natural refrigerants, the Fund initiated a 0% interest credit card campaign (with installment over for 10 months) during March 2018 – August 2018.

2. **Scheme B1: Credit Line for Production Line Conversion (Revolving Fund) -** To support producers with finance costs incurred during the production line conversion of cooling appliances and expansion towards use of natural refrigerants (e.g., equipment and raw material costs), the short-term loan was rolled out during 2019 – 2020 and was all returned to the RAC NAMA Fund. A total of 4 companies participated in this scheme, including:
    - Sanden Intercool (Thailand) Co., Ltd.
    - Songserm Commercial Refrigeration (Thailand) Co., Ltd.
    - Songserm Intercool Stainless Co., Ltd.
    - The Cool Manufacturing Co., Ltd.

3. **Scheme B2: Credit Line for Market Introduction & Sales Promotion (Revolving Fund) -** The short-term loan was launched to support the market introduction and sales promotion for cooling appliance. Two partnered producers received the support and implemented the marketing campaigns during January – December 2020, and already returned the loan back to the RAC NAMA Fund, which are:
    - Sanden Intercool (Thailand) Co., Ltd.
    - Patana Intercool Co., Ltd.

4. **Scheme C1: Sub-Grant for Production Line Conversion -** To encourage the production of climate-friendly and energy-efficient cooling technologies, the Fund provided grants for producers to convert their production lines towards the use of natural refrigerants. Partnered companies received the support during 2019 – 2021. Each company also contributed its own investment to the production line conversion, including:
    - Sanden Intercool (Thailand) Co., Ltd.
    - Songserm Commercial Refrigeration (Thailand) Co., Ltd.
    - Songserm Intercool Stainless Co., Ltd.
    - Supreme CNB Corporation Co., Ltd
    - Panasonic Appliance Cold Chain (Thailand) Co., Ltd.
    - Thermedez Co., Ltd.
    - Bitwise (Thailand) Co., Ltd.
    - Saijo Denki International Co., Ltd.
    - The Cool Manufacturing Co., Ltd. *(Withdrawn due to economic effects from COVID-19 situation)*

5. **Scheme C2: Sub-Grant for Training and Testing Facilities** - Apart from supporting the supply and demand sides, the Fund also aimed to enhance capacity of the service sector. Two sub-financial schemes were launched to support (1) trainings and (2) the improvement of testing facilities;
    - Grant was provided to the King Mongkut's University of Technology North Bangkok (KMUTNB) to establish training centers throughout the country and to carry out trainings on the topic of "Safe Use and Handling of Flammable Refrigerants".
    - Grant was provided to the Electrical and Electronic Institute (EEI) to improve its testing facility for air-conditioners using natural refrigerants.

Reporting Timelines of Partnered Producers