NORTHERN FUEL PIPELINE TRANSPORTATION PROJECT, THAILAND

Document prepared by BAFS Pipeline Transportation Limited (BPT)

Project title	Northern Fuel Pipeline Transportation Project, Thailand
Project ID	1852
Monitoring period	1-November-2023 to 31-December-2024
Original date of issue	23-January-2025
Most recent date of issue	20-March-2025
Version	02
***VCS Standard* Version**	4.7
Prepared by	BAFS Pipeline Transportation Limited (BPT) and ERM

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PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The objective of "Northern Fuel Pipeline Transportation Project, Thailand" is to introduce the more effective way of liquid fuel transportation by implementing the liquid fuel pipeline system from Bangkok to the northern part of Thailand, which is to be executed by BAFS Pipeline Transportation Limited (BPT).

The project enabled reduction of GHG incurred from the previous liquid fuel transportation, generated from diesel combustion of heavy trucks. Accordingly, the project baseline was the transportation of liquid fuel from Bang-Pa-In depot in Ayuthaya province to the Northern part of Thailand using heavy diesel-consuming trucks. During the project implementation, the liquid fuel of Bang-Pa-In depot in Ayuthaya province will then be transported via liquid fuel pipeline system.

The project activity installed the following items:

- Install liquid fuel pipelines with the diameter of 12 inches and 14 inches, for the total distance of 576 kilometers. The fuel pipelines have capacity of approximately 9,000 million liters from Bang-Pa-In depot in Ayuthaya province, to Phichit depot, Phichit province and then to Lampang depot in Lampang province.
- Install high-pressure pump:
    - High pressure pump (pre-booster pump) at Bang Pa In, 75 kW.
    - High pressure pump (main pump) at Bang Pa In, 1,250 kW.
    - High pressure pump (booster pump) at Kamphaeng Phet station, 2,000 kW.

During the monitoring period of 1 November 2023 – 31 December 2024, total of 1,253,783.89 tons of fuel was delivered which resulted in the total GHG emission reduction generated is at 29,094 tCO_2e per year or 33,943 tCO_2e during this monitoring period. As compared to the previous monitoring period (during 1 May 2019 – 31 October 2023), the amount GHG reduction generated from this monitoring period is higher. Also, it was slightly higher than the estimation in the project description (PD). This is due to the fact that fuel transportation was not fully operated during the last monitoring period. Also, the volume of fuel transported was higher due to increasing in customer's demand.

Regarding of co-benefits. the project also improves the cost efficiency of fuel transportation and minimal environmental impacts, because the fuel pipeline transportation is a closed system, meaning it generates significantly less environmental impacts as compared to fuel transportation by trucks that emits GHG emissions as well as air pollution. The additional benefits include the potential reductions of traffic congestion and road accidents. Additionally, this project supports the surrounding communities in various ways, including religious ceremonies, youth programs, educational support, and community safety. The project also opens to the feedback from the surrounding communities to improve and enhance its operations.

1.2 Audit History

Audit type	Period	Program	Validation/verification body name	Number of years
Validation	01/05/2019 to 30/04/2029	VCS	TÜV SÜD South Asia Pvt	10 years
1st Verification	01/05/2019 to 31/10/2023	VCS	RINA Service S.p.A	03 years 05 months 29 days
2nd Verification	01/11/2023 to 31/12/2024	VCS	Epic Sustainability	01 years 01 month 30 days

1.3 Sectoral Scope and Project Type

Sectoral scope[1]	7
Project activity type	Transport

Sectoral scope	-
AFOLU project category[2]	-
Project activity type	-

1.4 Project Proponent

Organization name	BAFS Pipeline Transportation Limited (BPT)
Contact person	Mr. Jade Tupiya
Title	Managing Director
Address	424 Kamphaeng Phet 6 Rd., Don Mueang, Bangkok, 10210 Thailand
Telephone	+662 929 5555 (ext. 216)
Email	Jade.T@fpt.co.th

[1] Projects, activities, or methodologies may be developed under any of the 16 VCS sectoral scopes: https://verra.org/programs/verified-carbon-standard/vcs-program-details/#sectoral-scopes

[2] See Appendix 1 of the VCS Standard

Organization name	Bangkok Aviation Fuel Services Public Company Limited (BAFS)
Contact person	M.L.Nathasit Diskul
Title	President and Authorized Director
Address	171/2 Kamphang Phet 6 Rd., Don Mueang, Don Mueang, Bangkok, 10210 Thailand
Telephone	+662 834 8900
Email	nathasit@bafs.co.th

1.5 Other Entities Involved in the Project

Organization name	ERM-Siam CO., LTD.
Role in the project	ERM is responsible for preparing Project Description (PD) and Monitoring Report (MR) for the Validation/Verification body according to VCS guidelines and procedures.
Contact person	Dr. Chacharee Therapong
Title	Associate Partner
Address	179 Bangkok City Tower 24th Floor, South Sathorn Road, Thungmahamek, Sathorn, Bangkok, 10120, Thailand.
Telephone	+6620743057
Email	chacharee.therapong@erm.com

1.6 Project Start Date

Project start date	1-May-2019
Justification	Official commercial operation date

1.7 Project Crediting Period

Crediting period	☐ Seven years, twice renewable ☑ Ten years, fixed

	☐ Other (state the selected crediting period and justify how it conforms with the VCS Program requirements)
Start and end date of first or fixed crediting period	01-May-2019 to 30-April-2029

1.8 Project Location

The project location and geographic coordinates are shown below.

	Route	Geographic Coordinates
From	Bang-Pa-In terminal, Bang Krasan sub-district, Bang-Pa-In District, Phra Nakhon Si Ayutthaya province	14°10'20.18" N 100°32'44.51" E
To	Kamphaeng Phet station, Ang Thong sub-district, Mueang district, Kamphaeng Phet province	16°24'2.31" N 99°31'9.47" E
From	Kamphaeng Phet station, Ang Thong sub-district, Mueang district, Kamphaeng Phet province	16°24'2.31" N 99°31'9.47" E
To	Phichit depot, Ban Na sub-district, Wachira Barami district, Phichit province	16°30'43.08" N 100°7'56.55" E
From	Kamphaeng Phet station, Ang Thong sub-district, Mueang district, Kamphaeng Phet province	16°24'2.31" N 99°31'9.47" E
To	Lampang depot, Sob Prab sub-district, Sob Prab district, Lampang province	17°54'28.80" N 99°20'22.84" E

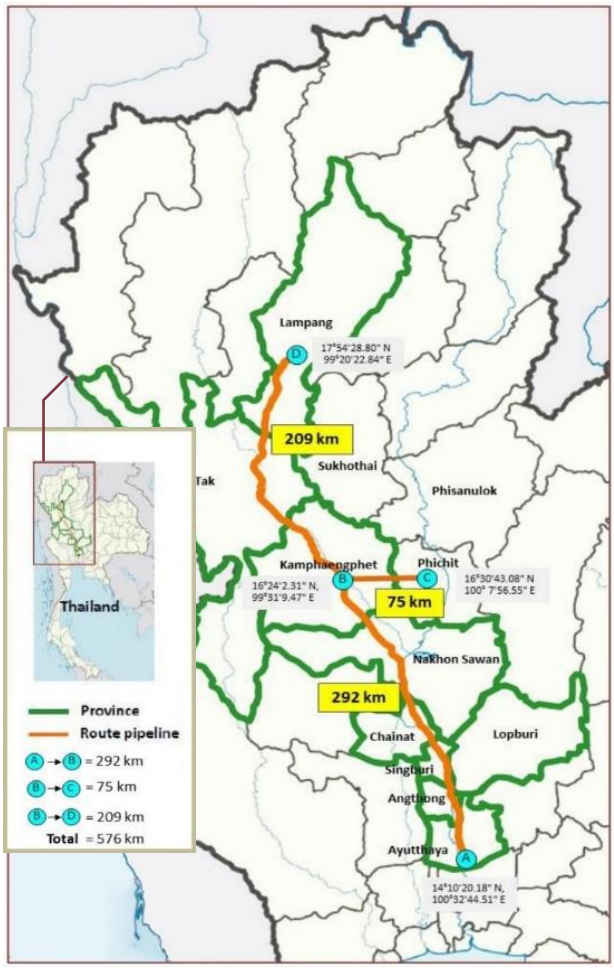

Figure 1 *Project Location starts from point (A) - Bang Pa-In Station in Ayutthaya province to point (B) – Kamphaengphet Province to (C) - Phichit Station and point (D) - Lampang Province*

1.9 Title and Reference of Methodology

Type (methodology, tool or module).	Reference ID, if applicable	Title	Version
Methodology	AM0110	AM0110 Modal shift in transportation of liquid fuels	02.0

1.10 Double Counting and Participation under Other GHG Programs

1.10.1 No Double Issuance

Is the project receiving or seeking credit for reductions and removals from a project activity under another GHG program?

☐ Yes ☒ No

If yes, provide required evidence of no double issuance as outlined by the VCS Standard.

1.10.2 Registration in Other GHG Programs

Was the project registered or seeking registration under any other GHG programs?

☐ Yes ☒ No

1.11 Double Claiming, Other Forms of Credit, and Scope 3 Emissions

1.11.1 No Double Claiming with Emissions Trading Programs or Binding Emission Limits

Are project reductions and removals or project activities also included in an emissions trading program or binding emission limit? See the *VCS Program Definitions* for definitions of emissions trading program and binding emission limit.

☐ Yes ☒ No

1.11.2 No Double Claiming with Other Forms of Environmental Credit

Has the project activity sought, received, or is planning to receive credit from another GHG-related environmental credit system? See the *VCS Program Definitions* for definition of GHG-related environmental credit system.

☐ Yes ☒ No

1.11.3 Supply Chain (Scope 3) Emissions

Do the project activities affect the emissions footprint of any product(s) (goods or services) that are part of a supply chain?

☒ Yes ☐ No

The project switches the transportation mode of liquid fuel produced from producers. The liquid fuel was previously transported through heavy diesel trucks before changing into pipeline system. Therefore, the project activity will affect in reducing GHG scope 3 emissions of producers on the liquid fuel transportation.

Is the project proponent(s) or authorized representative a buyer or seller of the product(s) (goods or services) that are part of a supply chain?

☒ Yes ☐ No

The PP is a service provider (seller) to liquid fuel producer who offers liquid fuel transportation services via pipeline system from Bang Pa-In station to Phichit and Lampang depots in Thailand.

Has the project proponent(s) or authorized representative posted a public statement on their website saying, "Carbon credits may be issued through the Verified Carbon Standard project no.1852 for the greenhouse gas emission reductions or removals associated with BPT Liquid Fuel Transport."

☒ Yes ☐ No

The PP posts a public statement on the website mentioned that "Carbon credits may be issued through the Verified Carbon Standard project no.1852 for the greenhouse gas emission reductions or removals associated with BPT Liquid Fuel Transport.". The statement is available at https://www.fpt.co.th/en/NFPT/

1.12 Sustainable Development Contributions

The implementation of project activities contributed 3 mains SDGs including SDG no, 8, 9 and 13 which also contributed Thailand's 20-year national strategic development 2018 - 2037 as follows:

- During this monitoring period (during 1 November 2023 – 31 December 2024), BPT employed in average of 125 job positions in the projects having average employee salary of 6,489,976 THB/month or 51,794 THB/person-month. This is estimated to create an employment value of more than 1,864,601,450 million THB within the project lifetime. This contribution is in line with SDG no.8 - 8.5.1 Average hourly earnings of employees, by sex, age, occupation and persons with disabilities as well as national strategy development plan[3]: The National Strategy for National Competitiveness Enhancement - indicator: national income, expansion of the gross domestic product (GDP), and income distribution.
- The project reduces GHG emission per liquid of fuel transport into northern part of Thailand from 76 gCO2e/ton.km to 4.35 gCO2e/ton.km which contributed to SDG no. 9 - 9.4.1 CO2 emission per unit of value added well as national strategy development plan[3]: The Strategy for Eco-Friendly Development and Growth – indicators: reduction of greenhouse gas (GHG) emissions and creation of a bio-based economy value.
- The project reduces amount of on-road fuel transport and traffic congestion of Thailand. 29,094 tCO_2e GHG emission could be reduced per year or 34,043 tCO_2e were reduced during this monitoring period. An estimation of 727,350 tCO_2e could be reduced over 25 years of project lifetime. This contributed to SDG no. 13 - 13.2.2 Total greenhouse gas emissions per year well as national strategy development plan: The Strategy for Eco-Friendly Development and Growth – indicators: reduction of greenhouse gas (GHG) emissions and creation of a bio-based economy value.

[3] https://oia.coj.go.th/th/content/category/detail/id/8/cid/5885/iid/93993

Table 1: Sustainable Development Contributions

Row number	SDG target	SDG indicator	Net impact on SDG indicator	Current project contributions	Contributions over project lifetime
1	8.5	8.5.1 Average hourly earnings of employees, by sex, age, occupation and persons with disabilities	The project employed an average of 125 positions during this monitoring period with the employment expense of 51,794.69 THB/person-month.	The project employed an average of 125 positions during this monitoring period with the average employment expense of 51,794.69 THB/person-month.	The project employment is expected to create an employment value of more than 1,942 million THB within the project lifetime.
2	9.4	9.4.1 CO_2 emission per unit of value added	The project reduces GHG emission per liquid of fuel transport into northern part of Thailand from 76 gCO_2e/ton.km to 4.35 gCO_2e/ton.km. (based on project calculation).	The project reduces GHG emission per liquid of fuel transport into northern part of Thailand from 76 gCO_2e/ton.km to 4.35 gCO_2e/ton.km. (based on project calculation).	The project reduces GHG emission per liquid of fuel transport into northern part of Thailand from 76 gCO_2e/ton.km to 4.35 gCO_2e/ton.km. (based on project calculation).

3	13.2	13.2.2 Total greenhouse gas emissions per year	Implement activities to decrease GHG emission per year by 29,094 tCO2e at this monitoring period	The project reduces amount of on-road fuel transport and traffic congestion of Thailand. 29,094 tCO_2e of GHG emission could be reduced per year or 33,943 tCO_2e were reduced during this monitoring period.	The implementation of the project can directly reduce on-road transport GHG emissions in a more environmentally friendly approach. An estimation of 727,350 tCO_2e could be reduced over 25 years of project lifetime.

1.13 Commercially Sensitive Information

There is no commercially sensitive information.

2 SAFEGUARDS AND STAKEHOLDER ENGAGEMENT

2.1 Stakeholder Engagement and Consultation

2.1.1 Stakeholder Identification

Stakeholder Identification	Stakeholder identification approach is in line with EIA requirement prescribing that the stakeholders are those who are either directly or directly influence/interest to the project and are located within 3 km radius of the project boundary. The identified stakeholders are the following government agencies, community leaders, citizens, establishments /shops, etc.
Legal or customary tenure/access rights	The project received legal approval for project construction, operation and legal rights from Thailand department of highways. The collective and conflicting rights, held by stakeholders, indigenous people (IPs), local communities (LCs), and customary rights holders are addressed as part of EIA measures.
Stakeholder diversity and changes over time	The following stakeholders have been consulted and engaged by the projects: **Area 1:** • Local government agencies: 84 agencies • Vulnerable group (Schools, temples, hospitals): 44 organizations • Community leaders: 97 villages • Local citizens: 434 citizens **Area 2:** • Local government agencies and vulnerable group (Schools, temples, hospitals): 12 organizations • Community leaders: 9 villages • Local citizens: 32 citizens

	It is expected that there is no change in stakeholder diversity due to project activities.
Expected changes in well-being	The project is not expected to have any negative changes to the well-being of the stakeholders. Due to the close monitoring of the potential environmental and social impact the project may have. In addition, the company will be supporting various community activity. Activities such as and not limiting to, traditional festivals, important local days, sporting events, educational opportunities and public health. The company will also be providing additional jobs for the local community. Tasks that do not include special set of skills, housekeeper, office cook, gardener, etc.
Location of stakeholders	Stakeholders are individual listed above that are located within 3 km. radius of the project fuel pipeline.
Location of resources	**Area 1:** located at the Bang Pa-in oil Phra Nakhon Si Ayutthaya Province Go to Kamphaeng Phet. Total distance is approximately 367 kilometers. **Area 2:** located at Kamphaeng Phet Pressure Booster Station to the oil depot. Destination Nakhon Lampang, Lampang Province. Distance approximately 209 kilometers.

Stakeholder Consultation and Ongoing Communication

Ongoing consultation	A communication channel has been set up for the village headman or community leaders to communicate directly to the public relation officers. In addition, the stakeholder can raise any concern or feedback via a complaint box. The feedback box is in two areas in the Phichit Oil Depot. 1) around the security center building in front of the project facility 2) Around the project office building and the oil depot area. Stakeholder can raise concern by contacting tel. no. 02-573-7444

Date(s) of stakeholder consultation	Area 1: 28 August 2020 – 26 October 2020 Area 2: 5 June 2022 – 19 June 2022
Communication of monitored results	Any feedback collected from the communication channel will be collected and address every 3 months as per requirement of EIA. Additionally, the BPT also conducts local community survey to communicate the results, evaluate satisfaction as well as ask for concern/recommendation with citizens who live near fuel pipeline and oil depot. This process is set and measured which will be evaluated annually.
Consultation records	To make the local stakeholders feel less concern about the project. The company will do a visit to local communities and businesses that are located within 500 meters of the pipeline. To clarify the project details and for the stakeholders to fully understand the project, but as well as to listen to their opinion and suggestions to minimise any potential impact to the local livelihood. As well as to reduce their level of concern about the project. The community will also be informed every 3 months about any update regarding the pipeline project.
Stakeholder input	Due to the communication channel and the frequent visit to the local community. The company has listened to the community needs and has implemented projects to help accommodating their concerns.

2.1.2 Free, Prior, and Informed Consent

Consent	The project is located at property right of Thailand government authority which is legally approved. Therefore, this is not applicable for IPs, LCs and customary rights holders.
Outcome of FPIC	This section is not applicable to the project activities.

2.1.3 Grievance Redress Procedure

Grievances received	Resolution and outcome

The project should assign staff to regularly participate in community's activities and to conduct on-going community relation continuously.	The project assigned staff to regularly engage with local community located within 50 meters from petrol line to listen and build an understanding of project to local people. The project also participates in community event/festival and support communities in infrastructure development and provide educational grant to local students. The project also involves the surrounding communities in regular satisfaction and feedback surveys regarding its activities and their impacts.
The project should inspect the pipeline and soil surface condition to be in normal condition and, repair road damage along the pipeline and remove the excess soil from canal from land slide.	The project conduct Rights of way surveillance by inspecting pipeline patrolling by staff on a daily basis to observe soil surface and pipeline condition and report by monthly. If there're any issues, the project will directly resolve the case immediately.

2.1.4 Public Comments

Summary of comments received	Actions taken
The company has not received any complaints from the community outside of public comment period during this monitoring period.	Even though the company has not received any complaints. If the community would like to raise any issue, the company has set up a comment box where the local community can drop a note about any concerns or complaints they may have.

2.2 Risks to Stakeholders and the Environment

2.2.1 Management Experience

BPT has extensive experience in providing fuel transportation services through pipelines across multiple projects. Currently, BPT operates three fuel pipeline reception points. To operate in Thailand, BPT complies with an Environmental Impact Assessment (EIA), which is a regulatory requirement in the country. The EIA monitoring report has been prepared in the bi-annual basis since the project's construction, giving BPT substantial experience in environmental management. Additionally, BPT engages third-party consultants with expertise in EIA preparation to assist with the bi-annual EIA process including community survey. The company also employs third-party consultants to help develop carbon credit projects in line with VCS standards and ensure that all requirements are satisfactory met.

2.2.2 Risk assessment

	Risk identified	Mitigation or preventative measure(s) taken
Natural and human-induced risks to stakeholders' wellbeing	Soil Resources and Erosion	The construction and operation of oil pipelines can impact the soil characteristics in the area, potentially causing soil subsidence. To mitigate this risk, the company has implemented measures pipeline patrolling. Officers conduct daily inspections to observe soil subsidence, report monthly, and summarize the findings every six months.
Risks to stakeholder participation Working conditions Safety of women and girls Safety of minority and marginalized groups, including children	Local communities (including (including woman and girls/children, minority, and marginalized groups) conducting dangerous activities along the pipeline.	Public relation officers have reached out to the local community (including woman and girls/children, minority, and marginalized groups) and agencies, requesting to avoid any activities that could potentially damage the pipeline. In case of any maintenances of roads, electricity, telephone lines etc., the public relations will be informed before the activity commences. The company will send over a coordination officer that will help the local agencies to conduct their work to avoid accident and pipeline damage. Regarding on stakeholders in the project (including both male and female employees), the PP provides appropriate safety measures in line with Thai regulations EIA requirements and to ensure safety. The project does not employ people who identified as girl/children, minority and marginalized group. The examples of mitigation and preventive measures implemented in the projects are, providing safety training to workers, strictly wearing appropriate PPE, inspecting machinery and equipment for damage prior use, and providing workers for an annual health check-up.

Pollutants (air, noise, discharges to water, generation of waste, and release of hazardous materials and chemical pesticides and fertilizers)	Potential fuel leakage from pipeline	The project officers will do a daily pipeline inspection (Pipeline Patrol) to check the integrity of the pipes and ensure that there is no leakage. Also, data about the pipeline condition will be collected each month. Where no abnormalities have been detected yet. The project implements a monthly Cathodic Protection system maintenance and corrosion monitoring and performs an intelligent PIG for every 10 years to ensure that there's no leakage across pipeline.
	Noise pollution	Workers who have to work in an environment (for more than 8 hours per day) where the noise level is above 90 decibels, will be provided with an earmuff that meet the required standards and qualification set by the law. Also, an appropriate use of lubricants on machinery to help reduce the noise pollution has also been implemented.

2.3 Respect for Human Rights and Equity

2.3.1 Labor and Work

	Risks identified[4]	Mitigation or preventative measure(s) taken
Discrimination	Discrimination within the workers and staffs	The project operations do not discriminate against employees. The company's Code of Conduct specifies treating employees with care and providing equal and consistent opportunities for all. Also, BPT is a company under BAFS, which has established human rights regulations related to discrimination that all employees need to comply.

[4] The identified risks and commensurate mitigation or preventative measure(s) for forced labor, child labor, and human trafficking, must be inclusive of staff and contracted workers employed by third parties.

Sexual harassment	Sexual harassment within the workers and staffs	The project operations do not have sexual harassment. The company's Code of Conduct emphasizes the importance of treating employees with dignity and respect for their human rights and individual responsibilities. Also, BPT is a company under BAFS, which has established human rights regulations related to sexual harassment that all employees need to comply. It is stipulated that no actions constituting sexual harassment towards other employees shall be taken.
Gender equity in labor and work	Gender inequity in labor and work	The project operations ensure gender equity in labor and work. The company's Code of Conduct emphasizes the importance of providing fair compensation to all employees based on their knowledge, skills, responsibilities, and performance. Furthermore, any rewards or disciplinary actions must be conducted fairly and with integrity.
Forced labor	Forced labor	The project operations do not forced labor. The company's Code of Conduct emphasizes the importance of treating employees with dignity and respecting their individual rights and responsibilities. Also, Under BAFS's human rights regulations, regular assess on human rights violations are mandated.
Child labor	No risk identified	The BPT is a company under BAFS group that set up human rights policy[5] . BPT supports and respects the protection of human rights and ensures that the company does not engage in any human rights violations, including child labor.
Human trafficking	No risk identified	The project operations do not involve human trafficking. The company strictly adheres to laws prohibiting the use of human trafficking.

[5] https://www.bafsthai.com/storage/document/sustainability/sustainability-management/human-rights-policy-th.pdf , https://www.bafsthai.com/en/sustainability/social/human-rights

2.3.2 Human Rights

Risks identified	Mitigation or preventative measure(s) taken
No risk identified	The BPT is a company under BAFS group that set up human rights policy in line with United Nations Global Compact ILO Declaration on Fundamental Principles and Rights at Work and others that are prescribed by Thailand regulation. The policy and practice guidelines indicate to not involving in human rights violations by requiring all directors, executives, and employees of BAFS and subsidiaries to comply with the Code of Conduct on human rights.

2.3.3 Indigenous Peoples and Cultural Heritage

Risks identified	Mitigation(s) or preventative measure taken
No risk identified	According to the Thailand EIA guidelines[6] for the petroleum pipeline transport system, the company should engage with all the stakeholders related to the project in order to raise concern, feedback, interest, and exchange information prior to project construction and operation. The company shall identify stakeholders based on geography by considering both direct and indirect impacts caused to stakeholders. Specifically, the stakeholders those received direct impacts and benefits from the project. The company should allow them to give their opinions and suggestions to prevent and mitigate impacts. The engagement should cover distributing public information regarding the activities and conducting stakeholder analysis to determine the stakeholder engagement approach. The project should host community engagement at least twice to understand the need and their concerns regarding the construction. Accordingly, the PP has followed the EIA guidelines by conducting community engagement for the local people (non were identified as indigenous people or cultural heritage) living in the area for the purpose of mutual understanding regarding the project's impact, mitigation, and preventive measures adopted during the project. Moreover, the project ensures to support the various activities of

6 https://eiathailand.onep.go.th/wp-content/uploads/2023/03/17-eia-guideline-petroleum-transport-system-2564.pdf

	the community in the area. Activity such as participating in traditional festivals, important days of the community. But as well as supporting the local sport activity and providing education and access to public health services for the local community.

2.3.4 Property Rights

Risks identified	Mitigation or preventative measure(s) taken
No risk identified	As mentioned in section 2.1.1, the project received legal approval for project construction, operation and legal rights from Thailand department of highways. The collective and conflicting rights, held by stakeholders, indigenous people (IPs), local communities (LCs), and customary rights holders are addressed as part of EIA measures. Property rights of stakeholders, IPs, ICs, and customary rights holders are to be in line with Thailand regulation and EIA measures. In case of property rights issue, the company has set up a comment box where the local community can drop a note about any concerns or complaints they may have.

2.3.5 Benefit Sharing

Summary of the benefit sharing plan	BPT has guidelines outlined in its Code of Conduct regarding social and environmental responsibilities, emphasizing community and social activities. The focus is on the development of society, communities, and the environment, as well as supporting public benefit activities. Therefore, in the implementation of the fuel pipeline project, the company has supported stakeholder activities on various occasions, including supporting government and community activities. For benefit sharing activities in this monitoring report, BPT will focus on supporting community activities in the surrounding areas, enhancing the educational capabilities of local youth, and collaborating with local government agencies to organize social activities. Additionally, BPT will support travel safety during major festivals in Thailand.

Benefit sharing during the monitoring period	During the monitoring period, BPT conducted benefit-sharing activities, which included: • On November 2, 2023, hosting a religious event at Luang Sop Prab temple, Sop Prab Subdistrict, Sop Prab District, Lampang Province on 2 November 2023. • On January 11, 2024, organize a community relations event to distribute royal jasmine rice to the communities near the Lampang fuel depot on 11 January 2024 • On January 12, 2024, organized a community relations event to support and distribute prizes and gifts for the 2024 National Children's Day to local communities, government agencies, and local administrative organizations around the Phichit fuel Depot. • On January 12, 2024, organized a community relations event to support and distribute prizes and gifts for the 2024 National Children's Day to local communities, government agencies, and local administrative organizations around the Lampang fuel Depot. • On February 15, 2024, donated computer desks and office partitions to Wat Ban Khok School (Mongkhon Prachasarn) to support the school's technology education for students. • On March 22, 2024, provided funding and participated in the Lampang Province Coffee Council meeting. • On April 11, 2024, provided funding for drinking water to the Sop Prap District Office and local health agencies. This support was aimed at establishing an operations center to prevent and reduce road accidents during the Songkran Festival from April 11 to 17, 2024. The initiative was designed to reduce road accidents and facilitate safe travel for the public during the Songkran Festival. Additionally, they funded the road accident reduction project at the Mae Kua Subdistrict Administrative Organization in Lampang Province. • On April 11, 2024, prizes were donated to the Sop Prap Subdistrict Municipality Office for the "Songkran Festival Tradition Project" of 2024.

	• On May 23-24, 2024, conducted surveys to assess community satisfaction with the pipeline and fuel storage facilities. Additionally, they distributed rice from the "Good Soldier Project" to those who participated in the survey.

2.4 Ecosystem Health

	Risk identified	Mitigation or preventative measure(s) taken during the monitoring period
Impacts on biodiversity and ecosystems	Soil resource erosion	The company has a team that is responsible for taking care of environmental problems resulting from activities from Phichit oil Depot and Lampang oil Depot. The project conducts a daily pipeline inspection by observing soil condition or erosion and to prepare inspection report by monthly. The company also have a public insurance system to cover the damages to life and/or property resulting from transporting the fuel.
Soil degradation and soil erosion		
Water consumption and stress	Pollution in water resource	The project installed an “Oil Separator” at Phichit Oil Depot and Lampang Oil Depot, which help treat water that is drained form fuel storage tanks. To prevent contaminating the water before draining the wastewater into the reservoir.
	Maintenance and cleaning of fuel tank	Wastewater generated from this activity must be treated before disposed back into the water system.
	Spare water tank available at all sites	Inside Phichit Oil Depot and Lampang Oil Depot have a water reserve tank. This will ensure that sufficient water is available throughout the year in case of emergency.
	Drainage system blockage	The conditions of the drainage channels will be monitored in order to avoid any blockage problem. Daily check of the condition of the pipes and cleaning staff to help maintain the drainage systems.
	Heavy rain leading to flood	A pond within the project area where rainwater can retreat to and be kept for no less than 3 hours.

2.4.1 Rare, Threatened, and Endangered species

Species or habitat	The project has no impact to local species and habitat.
Areas needed for habitat connectivity	The project has no impact to local species and habitat.

	Risks identified	Mitigation or preventative measure(s) taken
Habitats for rare, threatened, and endangered species	No risk identified	The operation of the fuel pipeline does not take place in areas that are habitats for protected animals. Most of the fuel is transported through underground pipelines, and continuous monitoring for leaks ensures that there is no impact on habitats for rare, threatened, and endangered species.
Areas for habitat connectivity	No risk identified	The operation of the fuel pipeline does not take place in areas that are habitats of animals. Most of the fuel pipelines are buried under roads, and the fuel release and storage facilities are also not located in animal habitats.

2.4.2 Introduction of species

Species introduced	Classification	Justification for use	Adverse effects and mitigation
N/A.	N/A.	N/A.	N/A.

Existing invasive species	Mitigation measures to prevent the spread or continued existence of invasive species
N/A.	N/A.

	Risks identified	Mitigation or preventative measure(s) taken
Invasive species	No risk identified	BPT's project operations do not involve the import or use of invasive species. However, the company complies with Thailand's laws regarding the import and export of animals.

2.4.3 Ecosystem conversion

	Risks identified	Mitigation or preventative measure(s) taken

Ecosystem conversion	Not applicable	This project does not apply to ARR, ALM, WRC or ACoGS projects. Therefore, this section is not applicable.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

- During this monitoring round, the company has changed its legal name from Fuel Pipeline Transportation Limited (FPT) to BAFS Pipeline Transportation Limited (BPT).
- During this monitoring period, Electric Vehicles (EVs) are introduced and used in the project.

Item	Change From	To	Explanation
Company legal name	Fuel Pipeline Transportation Limited (FPT)	BAFS Pipeline Transportation Limited (BPT)	The company legal name is changed from Fuel Pipeline Transportation Limited (FPT) to BAFS Pipeline Transportation Limited (BPT)
Electric Vehicles (EVs) are introduced and used in the project.	4 Fossil Fuel vehicles for pipeline inspection	2 Fossil Fuel vehicles and 2 EV vehicles for pipeline inspection	Previously, pipeline inspection vehicles ran solely on fossil fuels. Now, some of these vehicles have been replaced by electric vehicles (EVs). The use of EVs for pipeline inspections began in May 2024.

3.2 Deviations

3.2.1 Methodology Deviations

- There is no methodology deviation.

3.2.2 Project Description Deviations

- The company legal name is changed from Fuel Pipeline Transportation Limited (FPT) to BAFS Pipeline Transportation Limited (BPT)

Item	Change From	To	Explanation
Company legal name	Fuel Pipeline Transportation Limited (FPT)	BAFS Pipeline Transportation Limited (BPT)	The company legal name is changed from Fuel Pipeline Transportation Limited (FPT) to BAFS Pipeline Transportation Limited (BPT).

- During this monitoring period, some electric Vehicles (EVs) are introduced and used in the project as pipeline inspection vehicles. The monitoring data will be done through invoices from external EV charging stations. However, for internal charging station (at BPT own station), monitoring data will be based on either electricity meter or PEA invoice depending on each location.

Item	Change From	To	Explanation
Electric Vehicles (EVs) are introduced and used in the project.	4 Fossil Fuel vehicles for pipeline inspection	2 Fossil Fuel vehicles and 2 EV vehicles for pipeline inspection	Previously, pipeline inspection vehicles ran solely on fossil fuels. Now, some of these vehicles have been replaced by electric vehicles (EVs). The use of EVs for pipeline inspections began in May 2024.

3.3 Grouped Projects

- There is not a grouped project.

3.4 Baseline Reassessment

Did the project undergo baseline reassessment during the monitoring period?

☐ Yes ☒ No

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	$EF_{BL,j}$
Data unit	g CO_2 per ton.km
Description	Baseline emission factor for transportation of liquid fuel in route j (g CO_2 per ton.km, that is g CO_2 per ton of liquid fuel and km travelled)
Source of data	Default value according to AM0110 Modal shift in transportation of liquid fuels (https://cdm.unfccc.int/UserManagement/FileStorage/PJK3ZX1INM857VFQYEC0OBSL4H9A62)
Value applied	76
Justification of choice of data or description of measurement methods and procedures applied	Default value according to AM0110 Modal shift in transportation of liquid fuels Condition: This default emission factor of 76 g CO_2/tonne.km if trucks consume petro diesel or gasoline in the host country
Purpose of data	Calculation of baseline emissions
Comments	-

Data / Parameter	EF_{grid}
Data unit	g CO_2 per MWh
Description	Emission factor for grid electricity system
Source of data	Default value from the study of emission factor for electricity generation of Thailand in year 2010, TGO (As shown in the Appendix D)
Value applied	0.51
Justification of choice of data or description of measurement methods and procedures applied	This default value is the national EF_{grid} from the study of emission factor for electricity generation of Thailand in year 2010, TGO, which its calculation is complied with Methodological Tool (Version 02.2.1) "Tool to calculate the emission factor for an electricity system"
Purpose of Data	Calculation of project emissions
Comments	-

Data / Parameter	AD_j
Data unit	km
Description	Distance of the baseline route j (km)
Source of data	from the project participants
Value applied	<table><tr><th>Route</th><th>Distance (km)</th></tr><tr><td>AD_{j1}</td><td>501</td></tr><tr><td>AD_{j2}</td><td>367</td></tr></table>
Justification of choice of data or description of measurement methods and procedures applied	According to AM0110 Modal shift in transportation of liquid fuels, if such historical records are not available or if more than one route was used prior to the implementation of the project activity, then the project participants shall provide, with justification, a route between origin and destination which leads to the least fuel consumption. In this project, AD j is identified as the distance route of installed pipeline in the project activity. <table><tr><th>Route</th><th>Detail</th></tr><tr><td>AD_{j1}</td><td>Route from Bang Pa In depot in Ayuthaya province, to Lampang depot in Lampang province</td></tr><tr><td>AD_{j2}</td><td>Route from Bang Pa In depot in Ayuthaya province, to Phichit depot in Phichit province</td></tr></table>
Purpose of Data	Calculation of baseline emissions
Comments	-

4.2 Data and Parameters Monitored

Data / Parameter	$COEF_{i,y}$
Data unit	t CO_2 per L
Description	CO_2 emission coefficient of diesel
Source of data	Calculation from default values of NCV and CO_2 emission factor for combustion (in Appendix B and C).
Description of measurement methods and procedures to be applied	According to "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 02), the CO_2 emission coefficient ($COEF_{i,y}$) is calculated based on net calorific value and CO_2 emission factor of the fuel type i.
Frequency of monitoring/recording	-
Value monitored	0.00271

Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	Calculation of project emissions
Calculation method	According to "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 02), the CO_2 emission coefficient ($COEF_{i,y}$) is calculated based on net calorific value and CO_2 emission factor of the fuel type i, as follows: $COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i,y}$ where NCV i,y The weighted average net calorific value of the fuel type i in year y (GJ/mass or volume unit) $EF_{CO2,i,y}$ = The weighted average CO_2 emission factor of fuel type i in year y (tCO_2/GJ)
Comments	Update default value based on current version of IPCC Guidelines for National Greenhouse Gas Inventories

Item	Detail
$NCV_{i,y}$	Default NCV value in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, in Appendix B
$EF_{CO2,i,y}$	Default EF CO 2,i,y value in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, in Appendix C

Data / Parameter	$T_{j,y}$
Data unit	tonnes
Description	Amount of liquid fuel transported by the pipeline in route j in year y, and Amount of liquid fuel transported by trucks in in year y
Source of data	Measurements
Description of measurement methods and procedures to be applied	The amount of liquid fuel transported in route j in year x is recorded from on-line measure (SCADA) at the pipeline outlet stations.

	<table><tr><th>Route</th><th>Detail</th></tr><tr><td>T_{j1}</td><td>Amount of liquid fuel transported in trucks in route from Bang Pa In depot in Ayuthaya province, to Lampang depot in Lampang province</td></tr><tr><td>T_{j2}</td><td>Amount of liquid fuel transported in trucks in route from Bang Pa In depot in Ayuthaya province, to Phichit depot in Phichit province</td></tr></table>
Frequency of monitoring/recording	Monitoring: each liquid fuel batch
Value monitored	<table><tr><th>Route</th><th>Ton</th></tr><tr><td>T_{j1}</td><td>433,042.89</td></tr><tr><td>T_{j2}</td><td>820,741.01</td></tr></table>
Monitoring equipment	Meter (Endress+Hauser model Proservo NMS80)
QA/QC procedures to be applied	The meter is calibrated yearly to ensure the accuracy of measurement
Purpose of the data	Calculation of baseline and emission reduction
Calculation method	-
Comments	-

Data / Parameter	$FC_{i,j,y}$
Data unit	Liters
Description	Quantity of fuel type consumption in process j during the year y
Source of data	Fuel invoice from fuel supplier Note: there is no ex-ante calculation
Description of measurement methods and procedures to be applied	Amount of fuel consumption in the project activity
Frequency of monitoring/recording	Monthly
Value monitored	14,489.46

Monitoring equipment	Fuel invoice of each vehicle from service provider
QA/QC procedures to be applied	-
Purpose of the data	Calculation of project emissions
Calculation method	-
Comments	-

Data / Parameter	$EC_{p,y}$
Data unit	MWh
Description	Quantity of electricity consumed by the project activity in year y
Source of data	Measure by electrical power meter
Description of measurement methods and procedures to be applied	• Amount of electricity consumption (for high pressure pumps) and its measurement by electrical power meter. Amount of electricity consumption for EVs used for pipeline inspections, it will be measured by receipt issued from charging station and log-sheet.
Frequency of monitoring/recording	Monthly
Value monitored	6,082.85
Monitoring equipment	• Bang Pa-in Station: Electrical meter,Elite 400 • Kamphaeng Petch Station: Electricity Invoice from Thailand Provincial Electricity Authority (PEA) • Phichit Station: Electrical meter, Janitza UMG 96 RM • Lampang Station: Schneider EasyLogic PM2200 • For EVs, the data monitoring will be done through invoices from EV charging stations. However, if charging at BPT own station, monitoring will be based on either electricity meter or PEA invoice depending on each location. • For EVs, monitoring will be done through invoices when using EV charging stations. However, if charging at a station, monitoring will be based on the PEA invoice.

QA/QC procedures to be applied	The meter is IEC61010 1, IS14697, and IEC62053 certified and will be calibrated regularly based on manufacturer guideline or every two years.
Purpose of the data	Calculation of project emissions
Calculation method	-
Comments	-

4.3 Monitoring Plan

The organization chart of operational and management structure that will be implemented in order to track and monitor emission reductions from the project activity is shown in Figure below.

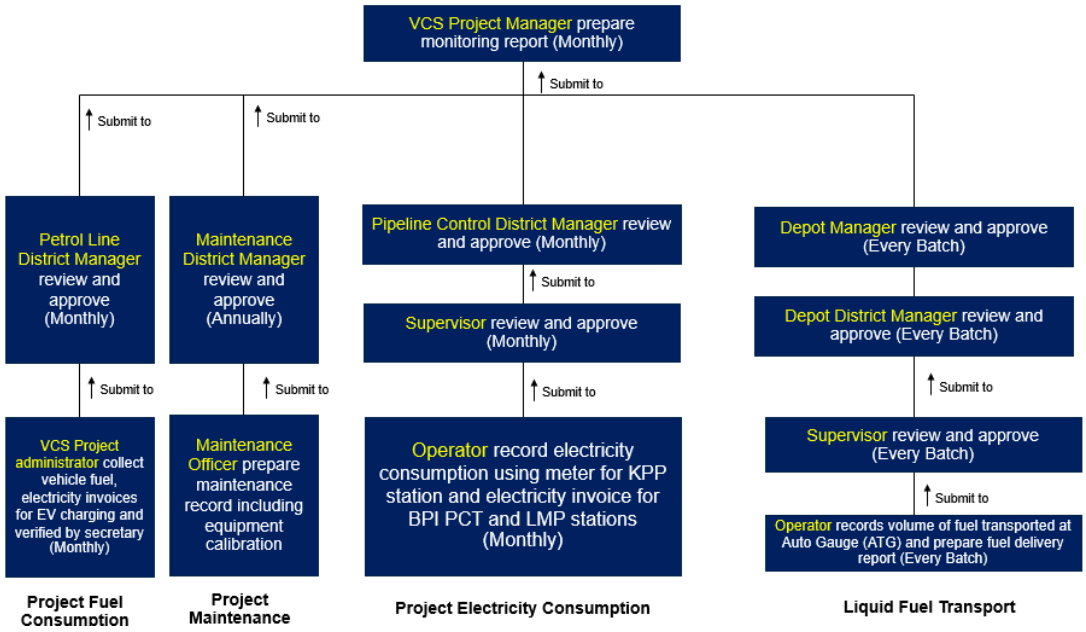

Figure 2 Organization structure of the project

From **Figure 2**, under the supervision of the VCS Project Manager team, the function managers which are as follows:

- Petrol Line District Manager
- Maintenance District Manager
- Pipeline Control District Manager
- Depot Manager / Depot District Manager

- These function managers will be responsible to review and approve the relevant monitoring data which will be recorded with project staff kept in a systematic and transparent manner. The monitoring data will be collected and summarized by at least monthly.

- BPT has preventive maintenance measures laid out clearly, with responsible person assigned, duration and units identified. Key items noted include Pipeline Pump & Motor, MOV Valve, Pressure Control Valve and Controller, SCADA system, and metering.
- To substantiate, there are pipeline maintenance and monitoring processes in the duration of BPT operations. Maintenance officers are to consistently examine pipelines, with an emphasis in pipeline surface coating, pipe joints and main valve checks, including inspection of piping areas and other obstacles at hand. Following practices are expected:

    a) Monitoring for pipeline cracks through inspection of pipeline areas and signs illustrating pipeline locations.

    b) Pipeline maintenance by inspection and identification of pipeline collapses and soil erosion in area of soft soil, a steep path, or one with running water, in accordance to the standards.

    c) Inspect for pipeline cracks by monitoring pipeline coating failures.

    d) Maintenance of erosion preventing systems, such as monitor the level of voltage used to protect against pipeline erosion, monitor the pipeline erosion, monitor electricity allocation system feeding to Cathodic protection system.

Additionally, BPT has internal pipeline inspection gauge (PIG): There are cleaning PIG used to maintain the pipeline's internal cleanliness; gauging PIG to inspect internal abnormalities, and intelligence PIG to inspect the safety, the surface, the state and the location of pipeline.

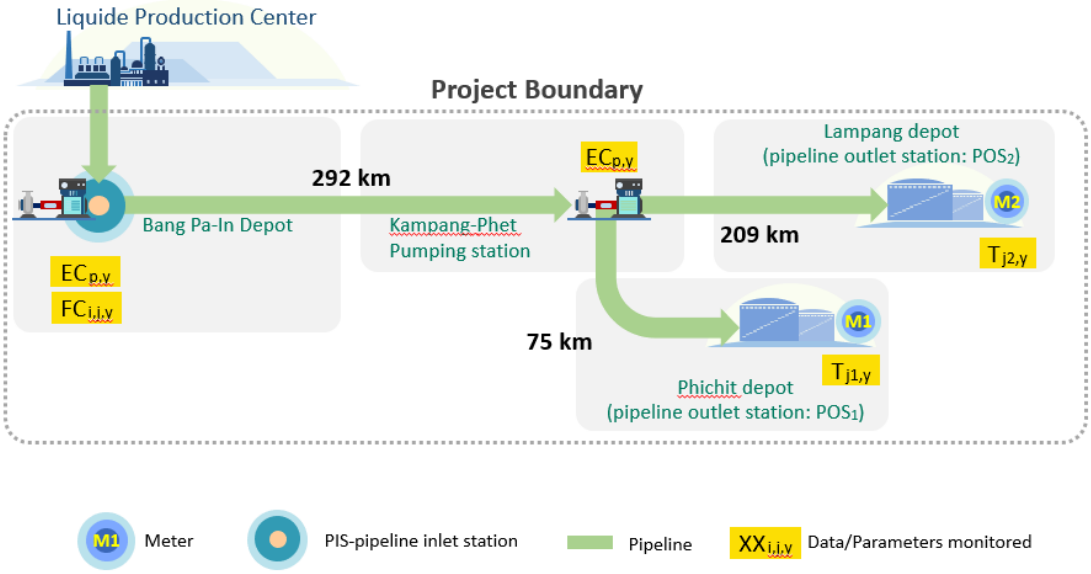

Figure 3 Monitoring Parameters of each location

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

The procedure for quantification of baseline emissions in accordance with the applied methodology is explained below.

$$BE_y = \sum (T_{j,y} \times AD_{j,}) \times EF_{BL,j} \times 10^{-6}$$

Where:

BE_y = Baseline emissions in year y (tCO_2)

$T_{j,y}$ = Amount of liquid fuel transported by the pipeline in route j in year y (ton)

AD_j = Distance of the baseline route j (km) which consider as the one way distance between the point of origin (Oj) and point of destination (dj)

$EF_{BL,j}$ = Baseline emission factor for transportation of liquid fuel in route j (g CO2 per ton.km that is g CO2 per ton of liquid fuel and km travelled). The default emission factor is 76 g CO2 /ton.km if trucks consume petrodiesel.

BE_y	$\sum (Tj,y \times ADj,)$	EFBL,j
tCO_2e	ton.km	gCO_2per ton.km
37,085	518,166,435.89	76

5.2 Project Emissions

The procedure for quantification of project emissions is in accordance with the applied methodology. Project emissions in this project activity include “electricity consumption from the grid” to operate the pipeline system in the project activity and “fossil fuel consumption” to operate the pipeline system in the project activity.

$$PE_y = PE_{EC,y} + PE_{FF,y}$$

Where:

PE_y = Project emissions in year y (tCO_2e)

$PE_{EC,y}$ = Project emissions from electricity consumption to operate the pipeline system in the project activity in year y (tCO_2e)

$PE_{FF,y}$ = Project emissions from fossil fuel consumption to operate the pipeline system in the project activity in year y (tCO_2e)

$PE_{FF,y}$	$FC_{i,j,y}$	$COEFi,y$
tCO_2e	Liters	tCO_2e per liters
38.60	14,489.46	0.00271

Note: National default values or IPCC default values in Chapter 1 of Vol.2 (energy) of the 2006 IPCC Guidelines (See Appendix B and C).

$PE_{EC,y}$	$EC_{i,j,y}$	$EF_{grid,\ y}$
tCO_2e	MWh	$tonCO_2e$ per MWh
3,102.25	6,082.85	0.51

5.3 Leakage Emissions

No leakage emissions are considered in the project.

5.4 GHG Emission Reductions and Carbon Dioxide Removals

Table 2 Summary of Net GHG Emission Reductions and Removals

Vintage period	Baseline emissions (tCO_2e)	Project emissions (tCO_2e)	Leakage emissions (tCO_2e)	Reduction VCUs (tCO_2e)	Removal VCUs (tCO_2e)	Total VCUs (tCO_2e)
1 November 2023 to 31 December 2023	5,186	311	0	4,875	0	4,875
1 January 2024 – 31 December 2024	31,899	2,831	0	29,068	0	29,068

Total	37,085	3,142	0	33,943	0	33,943

Vintage period	Ex-ante estimated reductions/ removals	Achieved reductions/ removals	Percent difference	Explanation for the difference
1 November 2023 to 31 December 2023	4,863	4,875	0.24	The ex-ante estimated reductions/removals, and the achieved reductions/removals differ insignificantly.
1 January 2024 – 31 December 2024	29,180	29,068	-0.38	The ex-ante estimated reductions/removals, and the achieved reductions/removals differ insignificantly.
Total	34,043	33,943	-0.29	The ex-ante estimated reductions/removals, and the achieved reductions/removals differ insignificantly.

APPENDIX 1: COMMERCIALLY SENSITIVE INFORMATION

Section	Information	Justification
N/A	N/A	N/A

APPENDIX B: DEFAULT NET CALORIFIC VALUES (NCVS) AND LOWER AND UPPER LIMITS OF THE 95% CONFIDENCE INTERVALSA

Fuel type English description		Net calorific value (TJ/Gg)	Lower	Upper
Crude Oil		42.3	40.1	44.8
Orimulsion		27.5	27.5	28.3
Natural Gas Liquids		44.2	40.9	46.9
Gasoline	Motor Gasoline	44.3	42.5	44.8
	Aviation Gasoline	44.3	42.5	44.8
	Jet Gasoline	44.3	42.5	44.8
Jet Kerosene		44.1	42.0	45.0
Other Kerosene		43.8	42.4	45.2
Shale Oil		38.1	32.1	45.2
Gas/Diesel Oil		43.0	41.4	43.3
Residual Fuel Oil		40.4	39.8	41.7
Liquefied Petroleum Gases		47.3	44.8	52.2
Ethane		46.4	44.9	48.8
Naphtha		44.5	41.8	46.5
Bitumen		40.2	33.5	41.2
Lubricants		40.2	33.5	42.3
Petroleum Coke		32.5	29.7	41.9
Refinery Feedstocks		43.0	36.3	46.4
Other Oil	Refinery Gas [2]	49.5	47.5	50.6
	Paraffin Waxes	40.2	33.7	48.2
	White Spirit and SBP	40.2	33.7	48.2
	Other Petroleum Products	40.2	33.7	48.2
Anthracite		26.7	21.6	32.2
Coking Coal		28.2	24.0	31.0
Other Bituminous Coal		25.8	19.9	30.5
Sub-Bituminous Coal		18.9	11.5	26.0
Lignite		11.9	5.50	21.6
Oil Shale and Tar Sands		8.9	7.1	11.1
Brown Coal Briquettes		20.7	15.1	32.0
Patent Fuel		20.7	15.1	32.0
Coke	Coke Oven Coke and Lignite Coke	28.2	25.1	30.2
	Gas Coke	28.2	25.1	30.2
Coal Tar [3]		28.0	14.1	55.0
Derived Gases	Gas Works Gas [4]	38.7	19.6	77.0
	Coke Oven Gas [5]	38.7	19.6	77.0
	Blast Furnace Gas [6]	2.47	1.20	5.00
	Oxygen Steel Furnace Gas [7]	7.06	3.80	15.0
Natural Gas		48.0	46.5	50.4
Municipal Wastes (non-biomass fraction)		10	7	18
Industrial Wastes		NA	NA	NA
Waste Oil [8]		40.2	20.3	80.0
Peat		9.76	7.80	12.5

Fuel type	English description	Net calorific value (TJ/Gg)	Lower	Upper
Solid Biofuels	Wood/Wood Waste [9]	15.6	7.90	31.0
	Sulphite lyes (black liquor) [10]	11.8	5.90	23.0
	Other Primary Solid Biomass [11]	11.6	5.90	23.0
	Charcoal [12]	29.5	14.9	58.0
Liquid Biofuels	Biogasoline [13]	27.0	13.6	54.0
	Biodiesels [14]	27.0	13.6	54.0
	Other Liquid Biofuels [15]	27.4	13.8	54.0
Gas Biomass	Landfill Gas [16]	50.4	25.4	100
	Sludge Gas [17]	50.4	25.4	100
	Other Biogas [18]	50.4	25.4	100
Other non-fossil fuels	Municipal Wastes (biomass fraction)	11.6	6.80	18.0

Notes:

[1] The lower and upper limits of the 95 percent confidence intervals, assuming lognormal distributions, fitted to a dataset, based on national inventory reports, IEA data and available national data. A more detailed description is given in section 1.5.

[2] Japanese data; uncertainty range: expert judgement

[3] EFDB; uncertainty range: expert judgement

[4] Coke Oven Gas; uncertainty range: expert judgement

[5-7] Japan and UK small number data; uncertainty range: expert judgement

[8] For waste oils the values of "Lubricants" are taken

[9] EFDB; uncertainty range: expert judgement

[10] Japanese data ; uncertainty range: expert judgement

[11] Solid Biomass; uncertainty range: expert judgement

[12] EFDB; uncertainty range: expert judgement

[13-14] Ethanol theoretical number; uncertainty range: expert judgement;

[15] Liquid Biomass; uncertainty range: expert judgement

[16-18] Methane theoretical number uncertainty range: expert judgement;

Source: https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf

APPENDIX C: DEFAULT NET CO2 EMISSION FACTORY FOR COMBUSTION

Fuel type English description		Default carbon content (kg/GJ)	Default carbon oxidation factor	Effective CO_2 emission factor (kg/TJ) [2]		
				Default value [3]	95% confidence interval	
		A	B	C=A*B*44/12*1000	Lower	Upper
Crude Oil		20.0	1	73 300	71 100	75 500
Orimulsion		21.0	1	77 000	69 300	85 400
Natural Gas Liquids		17.5	1	64 200	58 300	70 400
Gasoline	Motor Gasoline	18.9	1	69 300	67 500	73 000
	Aviation Gasoline	19.1	1	70 000	67 500	73 000
	Jet Gasoline	19.1	1	70 000	67 500	73 000
Jet Kerosene		19.5	1	71 500	69 700	74 400
Other Kerosene		19.6	1	71 900	70 800	73 700
Shale Oil		20.0	1	73 300	67 800	79 200
Gas/Diesel Oil		20.2	1	74 100	72 600	74 800
Residual Fuel Oil		21.1	1	77 400	75 500	78 800
Liquefied Petroleum Gases		17.2	1	63 100	61 600	65 600
Ethane		16.8	1	61 600	56 500	68 600
Naphtha		20.0	1	73 300	69 300	76 300
Bitumen		22.0	1	80 700	73 000	89 900
Lubricants		20.0	1	73 300	71 900	75 200
Petroleum Coke		26.6	1	97 500	82 900	115 000
Refinery Feedstocks		20.0	1	73 300	68 900	76 600
Other Oil	Refinery Gas	15.7	1	57 600	48 200	69 000
	Paraffin Waxes	20.0	1	73 300	72 200	74 400
	White Spirit & SBP	20.0	1	73 300	72 200	74 400
Other Petroleum Products		20.0	1	73 300	72 200	74 400
Anthracite		26.8	1	98 300	94 600	101 000
Coking Coal		25.8	1	94 600	87 300	101 000
Other Bituminous Coal		25.8	1	94 600	89 500	99 700
Sub-Bituminous Coal		26.2	1	96 100	92 800	100 000
Lignite		27.6	1	101 000	90 900	115 000
Oil Shale and Tar Sands		29.1	1	107 000	90 200	125 000
Brown Coal Briquettes		26.6	1	97 500	87 300	109 000
Patent Fuel		26.6	1	97 500	87 300	109 000
Coke	Coke oven coke and lignite Coke	29.2	1	107 000	95 700	119 000
	Gas Coke	29.2	1	107 000	95 700	119 000
Coal Tar		22.0	1	80 700	68 200	95 300
Derived Gases	Gas Works Gas	12.1	1	44 400	37 300	54 100
	Coke Oven Gas	12.1	1	44 400	37 300	54 100
	Blast Furnace Gas [4]	70.8	1	260 000	219 000	308 000
	Oxygen Steel Furnace Gas [5]	49.6	1	182 000	145 000	202 000

Fuel type English description		Default carbon content (kg/GJ)	Default carbon oxidation Factor	Effective CO_2 emission factor (kg/TJ) [2]		
				Default value	95% confidence interval	
		A	B	C=A*B*44/12*1000	Lower	Upper
Natural Gas		15.3	1	56 100	54 300	58 300
Municipal Wastes (non-biomass fraction)		25.0	1	91 700	73 300	121 000
Industrial Wastes		39.0	1	143 000	110 000	183 000
Waste Oil		20.0	1	73 300	72 200	74 400
Peat		28.9	1	106 000	100 000	108 000
Solid Biofuels	Wood/Wood Waste	30.5	1	112 000	95 000	132 000
	Sulphite lyes (black liquor)[5]	26.0	1	95 300	80 700	110 000
	Other Primary Solid Biomass	27.3	1	100 000	84 700	117 000
	Charcoal	30.5	1	112 000	95 000	132 000
Liquid Biofuels	Biogasoline	19.3	1	70 800	59 800	84 300
	Biodiesels	19.3	1	70 800	59 800	84 300
	Other Liquid Biofuels	21.7	1	79 600	67 100	95 300
Gas biomass	Landfill Gas	14.9	1	54 600	46 200	66 000
	Sludge Gas	14.9	1	54 600	46 200	66 000
	Other Biogas	14.9	1	54 600	46 200	66 000
Other non-fossil fuels	Municipal Wastes (biomass fraction)	27.3	1	100 000	84 700	117 000

Notes:

[1] The lower and upper limits of the 95 percent confidence intervals, assuming lognormal distributions, fitted to a dataset, based on national inventory reports, IEA data and available national data. A more detailed description is given in section 1.5

[2] TJ = 1000GJ

[3] The emission factor values for BFG includes carbon dioxide originally contained in this gas as well as that formed due to combustion of this gas.

[4] The emission factor values for OSF includes carbon dioxide originally contained in this gas as well as that formed due to combustion of this gas

[5] Includes the biomass-derived CO_2 emitted from the black liquor combustion unit and the biomass-derived CO_2 emitted from the kraft mill lime kiln.

Source: https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf

APPENDIX D: DEFAULT VALUE FROM THE STUDY OF EMSSION FACTOR FOR ELECTRICTITY GENERATION OF THAILAND IN YEAR 2010, TGO