

**DEPARTMENT OF CLIMATE CHANGE
OZONE LAYER PROTECTION AND
LOW CARBON ECONOMY DEVELOPMENT CENTER**

**VERIFICATION REPORT
GREENHOUSE GAS EMISSION REDUCTIONS**

(ENERGY EFFICIENT LIGHTING NAMA PILOT IN HUE CITY. VIE/401)

HANOI, 2022

DEPARTMENT OF CLIMATE CHANGE
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Consultant Unit
OZONE LAYER PROTECTION AND LOW
CARBON ECONOMY DEVELOPMENT
CENTER




Ha Quang Anh

Hanoi, 2022

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Ozone Layer Protection and Low Carbon Economy Development Center, Department of Climate Change, received an invitation to conduct the verification of CO₂ emission reductions from the Project Technical Support Office, LUX DEV for the pilot project NAMA - Energy efficient lighting system in Hue city (VIE/401).

Based on the results of the implementation of the verification, the Ozone Layer Protection and Low Carbon Economy Development Center announces the results as follows:

1. General information

a) Information about the organization performing the verification

Organization: Ozone Layer Protection and Low Carbon Economy Development Center, Department of Climate Change.

Address: No. 8 Phao Dai Lang, Lang Thuong Ward, Dong Da District, Hanoi.

Phone: 0243.7757166.

Email: ttbvozon@monre.gov.vn

b) Performance period:

Time to verify the results of CO₂ emission reductions of the project: 01/11/2022 to 30/11/2022.

Time to conduct the survey at the establishment: 7/11/2022 to 9/11/2022.

The contents of the survey at the establishment include:

- Study documents, databases and calculation data provided by the Technical Support Office of the relevant project for research to serve the verification of reduction results.

- Field survey at 03 schools and 08 streets of the project: after reviewing and comparing the minutes of installation to replace traditional bulbs and LEDs, combined with measuring the number of replacement bulbs at the site, the results of the actual quantity and quality of installed bulbs are appropriate, accurate.

Room type	Number of rooms	Number of bulbs replaced (T8 36W and T10 40W)	Number of installed LEDs (14W & 24W)
Phu Hau Primary School			
Classrooms	22	206	308
Computer room – foreign language	1	6	14
Office	4	12	14
Laboratory			
Library room	1	11	20
Function Room	4	14	32

Room type	Number of rooms	Number of bulbs replaced (T8 36W and T10 40W)	Number of installed LEDs (14W & 24W)
Summary	32	249	388
Tran Cao Van Secondary School			
Classrooms	19	221	294
Computer room – foreign language	3	24	54
Office	3	28	50
Laboratory	0		
Library room	1	12	16
Function Room	0		
Summary	26	285	414
Hue National High School			
Classrooms	42	608	775
Computer room – foreign language	4	48	72
Office	0		
Laboratory	6	208	272
Library room	1	96	102
Function Room	0		
Summary	53	960	1,221

No.	Street name	Number of SODIUM bulbs replaced (150W-250W)	Number of LED lamps installed (120W-150W-180W)	Length (m)	Description
1	Le Duan near Huong River	112	112	1,600	Urban-level roads: main arterial road, inter-regional road without median strip
2	Le Duan QL1A GPC	137	137	2,100	Urban-level roads: main arterial road, with median strip
3	Tran Hung Dao A (GPC)	34	34	314	Urban-level roads: main arterial road, with median strip
4	Tran Hung Dao B (Power pole)	30	30	462	Urban-level roads: main arterial road, with median strip
5	Dinh Tien Hoang	59	59	1,692	Regional level roads: main arterial road, inter-regional road without median strip
6	Nguyen Van Linh	135	135	2,284	Urban-level roads: main arterial road, with median strip

No.	Street name	Number of SODIUM bulbs replaced (150W-250W)	Number of LED lamps installed (120W-150W-180W)	Length (m)	Description
7	Ly Thai To A	150	150	1,450	In two-way median strip, there is a 3m wide median, sidewalk 4m
8	Ly Thai To B	54	54	1,450	1 side - 1 way, without sidewalks, single arm street light steel pole

c) Time for sampling (if necessary) at the establishment

2. The contents of verification

The information provided by the Project Technical Support Office to the consultant for verification of the project's greenhouse gas emission reduction results include:

a) The boundaries and scope of operation of the project.

Energy efficient lighting system is implemented in 54 schools (29 primary schools, 22 secondary schools and 3 high schools) and 26 streets of Hue city.

b) Infrastructure, technology and the entire operation process of the project

- Infrastructure: The lighting system of the project is in 54 schools (29 primary schools, 22 secondary schools and 3 high schools) and 26 streets of Hue city.

- Technology used: energy-saving LED technology.

- Operation of the project:

With funding from the Climate and Energy Fund (CEF) coordinated by the Luxembourg Ministry of Environment, Climate and Sustainable Development (MECSD), the Luxembourg Development Cooperation Agency (LuxDev) has supported and coordinated with Thua Thien Hue Provincial People's Committee to implement the project VIE/401: "Energy Efficient Lighting Pilot NAMA in Hue City". VIE/401 is a pilot project of nationally appropriate mitigation action (NAMA) that aims to achieve GHG mitigation (CO₂) through electric energy saving as a result of replacing conventional lamps (fluorescent and sodium) with more energy efficient Light Emitting Diode (LED) lamps in public schools and street lighting in Hue City. In addition, the project supports capacity building and communication activities to raise awareness about climate change and economical and efficient use of energy in schools and in the community.

Overview of project activities:

1. Conduct early-term surveys and measurements at schools and streets

- Implementation time at 54 schools: starting from 11/11/2019 to 20/12/2019.

- Implementation time at 21 streets: starting from 09/12/2019 to 13/12/2019

2. Replacing, installing and putting into use LED lighting systems at 54 schools and 26 streets in Hue city

The project has completed the installation and commissioning of LED lighting systems at 54 schools in Hue city. The total number of lamps is 18,692 bulbs / set of 1.2m long T8 LED bulbs (15,452 lamps 14W and 3,240 lamps 24W) have been installed for the lighting system of 1,343 rooms, replaced 13,676 traditional bulbs including: 1.2m long tube fluorescent lamp type T8, power 36W, T10 power 40W and LED T8 18W (poor quality & short lifespan). The service life of the LED tubes is 50,000 hours, L70 and is warranted for a period of 5 years.

The installation period is from February 5 to May 15, 2021, specifically as follows:

No.	School name	Total number of rooms with LED lamps installed to replace traditional/old bulbs	Total number of installed project LEDs	Completion date
1	TAY LOC 2 Primary School	8	114	05/02/2021
2	NGU BINH elementary school	17	240	20/02/2021
3	QUANG TRUNG Primary School	31	510	21/02/2021
4	THUY BIEU Primary School	11	154	21/02/2021
5	HUYEN TRAN Primary School	14	196	22/02/2021
6	HUONG MAI Primary School	36	404	25/02/2021
7	PHU HAU Primary School	32	388	09/03/2021
8	NGO KHA Primary School	14	162	15/03/2021
9	PHU BINH Primary School	13	172	21/03/2021
10	AN HOA 1 Primary School	30	380	24/03/2021
11	KIM LONG 1 Primary School	33	386	26/03/2021
12	PHƯỜNG ĐỨC Primary School	18	252	27/03/2021
13	KIM LONG 2 Primary School	18	248	30/03/2021
14	THUAN LOC Primary School	25	330	02/04/2021
15	LY THUONG KIET elementary school	26	378	03/04/2021
16	AN CUU Primary School	21	261	04/04/2021
17	VINH NINH Primary School	31	414	06/04/2021
18	THUY XUAN Primary School	12	144	10/04/2021
19	PHU LUU Primary School	19	228	12/04/2021
20	THUAN HOA 1 Primary School	15	212	18/04/2021
21	PHU CAT Primary School	20	284	20/04/2021
22	PHUOC VINH Primary School	14	196	21/04/2021
23	TRAN QUOC TOAN Primary School	32	474	24/04/2021
24	TRUONG AN elementary school	18	252	25/04/2021
25	PHU HOA Primary School	22	296	07/05/2021
26	XUAN PHU Primary School	30	392	08/05/2021

No.	School name	Total number of rooms with LED lamps installed to replace traditional/old bulbs	Total number of installed project LEDs	Completion date
27	THUAN THANH Primary School	21	254	10/05/2021
28	VI DA Primary School	30	416	11/05/2021
29	AN DONG 1 Primary School	16	204	15/05/2021
30	CHU VAN AN secondary school	36	536	26/02/2021
31	DUY TAN secondary school	26	326	06/03/2021
32	NGUYEN VAN LINH secondary school	33	480	10/03/2021
33	PHAN SAM NAM secondary school	32	398	13/03/2021
34	LE HONG PHONG secondary school	33	420	15/03/2021
35	NGUYEN THI MINH KHAI secondary school	21	268	17/03/2021
36	THONG NHAT secondary school	27	354	17/03/2021
37	HUYNH THUC KHANH secondary school	23	274	19/03/2021
38	PHAM VAN DONG secondary school	46	630	20/03/2021
39	TON THAT TUNG secondary school	30	354	23/03/2021
40	NGUYEN BINH KHIEM secondary school	17	244	27/03/2021
41	NGUYEN DU secondary school	10	144	31/03/2021
42	LY TU TRONG secondary school	24	302	10/04/2021
43	NGUYEN VAN TROI secondary school	15	210	13/04/2021
44	NGUYEN CU TRINH secondary school	21	310	16/04/2021
45	TRAN PHU SECONDARY SCHOOL	27	312	16/04/2021
46	TRAN CAO VAN secondary school	26	414	21/04/2021
47	NGUYEN HOANG secondary school	22	270	27/04/2021
48	HUNG VUONG secondary school	29	404	29/04/2021
49	HAM NGHI secondary school	30	472	04/05/2021
50	NGUYEN CHI DIEU secondary school	36	604	15/05/2021
51	TO HUU secondary school	19	288	
52	HUE national high school	53	1,221	05/03/2021
53	GIA HOI high school	37	526	10/04/2021
54	CAO THANG high school	43	590	29/04/2021
	Sum	1,343	18,692	

The project has organized 02 installations of 1,564 LED luminaires (982 120W lamps, 558 lamps 150W and 24 lamps 180W) to replace HP SODIUM luminaires (894 lamps 150W and 670 lamps 250W) in 26 streets. The life of LED luminaires is 100,000 hours, L70, with a 5-year warranty.

The replacement time for phase 1 was completed on December 22, 2020 (03 streets were completed on January 25, 2021), phase 2 was completed on September 29, 2022, specifically as follows:

No.	Street name	Length (m)	Amount (luminaire)	Lamp replacement schemes		Handover date of use
				SODIUM lamp	LED lamps	
1	Le Duan (near Huong River)	1,600	112	S250W OVZ	MURA 150W NIKKON - Malaysia	22/12/2020
2	Le Duan QL1 (with median strip)	2,100	137	S250W OVZ		22/12/2020
3	Bach Dang	1,758	58	S150W ONYX	MURA 120W NIKKON - Malaysia	22/12/2020
4	Huynh Thuc Khanh	1,211	40	S150W ONYX		22/12/2020
5	Dao Duy Anh (steel pole)	710	22	S150W ONYX		22/12/2020
6	Dao Duy Anh (power pole)	610	18	S150W ONYX		22/12/2020
7	Tang Bat Ho	2,732	68	S150W ONYX		22/12/2020
8	Dinh Tien Hoang	1,692	59	S150W PHILIP		22/12/2020

No.	Street name	Length (m)	Amount (luminaire)	Lamp replacement schemes		Handover date of use
				SODIUM lamp	LED lamps	
9	Nguyen Trai	2,464	88	S150W PHILIP		22/12/2020
10	Mai Thuc Loan	850	30	S150W PHILIP		22/12/2020
11	Yiet Kieu	630	16	S150W ONYX		22/12/2020
12	Thai Phien	15	36	S150W ONYX		22/12/2020
13	Nguyen Chi Thanh	1,305	34	S150W ONYX		22/12/2020
14	An Duong Vuong	22	119	S250W Z2		22/12/2020
15	Tran Phu	154	35	S150W Z2		22/12/2020
16	Nguyen Van Linh	2,284	135	S150W MD013		22/12/2020
17	Tran Hung Dao A (in front of Dong Ba market)	314	24	S250W ONYX	SMART HYDD 150W-180W HOSCALIGHTING - China	25/01/2021
18	Tran Hung Dao B (electricity pole)	462	40	S250W ONYX		25/01/2021
19	Ly Thai To A	145	150	S250W OVZ	MAGOLIA 150W BELED - Vietnam	29/09/2022
20	Ly Thai To B (2nd paragraph)	145	54	S250W OVZ	MAGOLIA 120W BELED - Vietnam	29/09/2022
21	Cau Dinh market	980	67	S150W PHILIP		29/09/2022
22	Bui Thi Xuan	258	60	S150W PHILIP		29/09/2022
23	Dang Huy Tru	11	30	S150W PHILIP		29/09/2022
24	Le Ngo Cat	23	54	S150W ONYX		29/09/2022
25	Minh Mang	16	44	S150W ONYX		29/09/2022
26	Hoang Quoc Viet	800	34	S150W ONYX		29/09/2022
Total		23,291	1,564			

During the construction and dismantling process, the supplier, Dien Quang Lamp Company, collected and transported T8 and T10 fluorescent bulbs at the school to treat hazardous waste according to strict control procedures to ensure safety, integrity and environmental friendliness. Hue Environment and Urban Construction Company (HEPCO) is a consultant to handle fluorescent light bulbs in schools. The results of acceptance of the treatment showed that 8,657 fluorescent light bulbs were treated according to standard procedures such as crushing, solidifying with high-grade concrete and being buried at Loc Thuy landfill, thereby contributing to reducing emissions to the environment of an estimated amount of at least 34,628 mg mercury (Hg).

3. *Collect surveillance measurement data after installing LED lighting systems in schools and streets.*

4. *Calculate the results of energy savings consumed by LEDs project (MWh/year) and greenhouse gas emission reduction results (tCO₂/year)*

c) Sources and sinks of greenhouse gas emissions and greenhouse gases of the project

The sources of greenhouse gas emissions from the electricity consumption of the lighting system of 54 schools (29 elementary schools, 22 junior high schools and 3 high schools) and 26 selected streets of the project in Hue city are

selected based on the National grid emission factor database issued by the Department of Climate Change, Ministry of Natural Resources and Environment.

d) The expected greenhouse gas emission level of the project when greenhouse gas emission reduction technologies and measures are not applied

The total greenhouse gas (GHG) emissions of traditional lighting systems (without energy-saving LED lighting systems) as of 31/12/2022 is 2,567.5 tons of CO₂/year.

e) Technologies and measures to mitigate greenhouse gas emissions have been implemented

f) Methods for determining greenhouse gas emission reduction levels of technologies and measures to mitigate greenhouse gas emissions

- Base GHG emissions are greenhouse gas emissions (tCO₂/year) determined in a typical scenario (of traditional lighting systems) in the absence of project intervention.

- Project GHG emissions are greenhouse gas emissions (tCO₂/year) of project LED lighting systems after being installed and put into use.

- GHG emissions reduced by project interventions (tCO₂/year) are the difference between the base CO₂ emissions and the average annual project CO₂ emissions calculated based on monitoring and measurement data through the project's MRV system.

The GHG emissions of the project (tCO₂/year) = [the base GHG emissions (tCO₂/year) – GHG emissions of the project (tCO₂/year)]

g) Reliability and uncertainty of the project's greenhouse gas emission mitigation

Estimating certainty is an essential element of a complete calculation process of greenhouse gas emissions. Uncertainty is calculated for the constituent parts of the greenhouse gas inventory such as activity data, emission factors and other estimation parameters for sectors. The IPCC guidelines have therefore developed a structured approach to estimating uncertainty. Calculating the value of uncertainty is not aimed at the accuracy of greenhouse gas emissions results, the purpose of which is to make improvements and decide on the methodology for future greenhouse gas inventories. Uncertainty assessment for GHG emissions/uptake sources was carried out in accordance with the tier 1 approach Chapter 3, Part 1, IPCC Guidelines 2006.

The uncertainty of greenhouse gas emissions when calculated for traditional lamps, and greenhouse gas emissions when installing energy-saving LEDs, are calculated as follows:

No.	Emission sources	GHG emissions reduction (tCO ₂)	Uncertainty (±%)		
			GHG emissions	Activity data (AD)	Emission factor (EF)
1	School	1,386.6	8.6	5	7
2	Street route	1,180.9	12.2	10	7
		2,567.5	10.4		

Uncertainty of GHG emissions levels of LED lighting systems project at 54 schools and 26 streets:

No.	Emission sources	GHG emissions reduction (tCO ₂)	Uncertainty (±%)		
			GHG emissions	Activity data (AD)	Emission factor (EF)
1	School	508.9	8.6	5	7
2	Street route	657.0	12.2	10	7
		1,165.9	10.4		

Uncertainty of greenhouse gas emission reduction after installing LED lights at 54 schools and 26 routes:

No.	Emission sources	GHG emissions reduction (tCO ₂)	Uncertainty (±%)		
			GHG emissions	Activity data (AD)	Emission factor (EF)
1	School	877.6	8.6	5	7
2	Street route	524	12.2	10	7
		1,401.6	10.4		

The uncertainty for greenhouse gas emission reduction should be taken from the average value of the uncertainty of the greenhouse gas emissions inventory when calculating for traditional lamps and when installing energy-saving LEDs.

h) Greenhouse gas emission reduction levels of applied measures of the project

As of December 31, 2022, the calculation results of GHG emissions when using LED lighting systems at 54 public schools and 26 streets is 1,165.9 tons of CO₂. The amount of GHG emission reduction achieved when using LED lights at 54 schools and 26 roads is estimated at 1,401.6 tons of CO₂.

Np.	Project's LED installation site	Amount	LED lighting system uptime	Total GHG emissions of traditional lighting systems (tCO ₂)	Total GHG emissions of project LED lighting system (tCO ₂)	Total GHG emission reduction of project LED lighting system (tCO ₂)
I	School	54		1,386.5	508.9	877.6
1	Primary education	29	15/05/2021 to 31/12/2022	604.7	192.8	411.9
2	Middle School	22		617.3	254.5	362.8
3	Senior High School	3		164.6	61.6	102.9

Np.	Project's LED installation site	Amount	LED lighting system uptime	Total GHG emissions of traditional lighting systems (tCO ₂)	Total GHG emissions of project LED lighting system (tCO ₂)	Total GHG emission reduction of project LED lighting system (tCO ₂)
II	Street	26		1,180.9	657.0	523.9
1	Phase 1	18	01/02/2021 to 31/12/2022	1,111.5	625.7	485.9
2	Phase 2	8	01/10/2022 to 31/12/2022	69.4	31.3	38.1
Sum				2,567.5	1,165.9	1,401.6

No.	Project's LED installation site	Amount	GHG emissions reduction (tCO ₂)	Forecast of average annual GHG emission reduction (tCO ₂ /year) in the following years (applying the 2020 emission factor of 0,8041 tCO ₂ /MWh and assuming that the total annual average electricity savings of 1.109 MWh/year remains unchanged)								Total GHG emission reduction of the project (tCO ₂)
			2021-2022	2023	2024	2025	2026	2027	2028	2029	2030	2021-2030
I	School	54	877.6	585.0	585.0	585.0	585.0	585.0	585.0	585.0	585.0	5,558.2
II	Street	26	524	405.8	405.8	405.8	405.8	405.8	405.8	405.8	405.8	3,770.3
1	Phase 1	18	485.9	253.5	253.5	253.5	253.5	253.5	253.5	253.5	253.5	2,513.8
2	Phase 2	8	38.1	152.3	152.3	152.3	152.3	152.3	152.3	152.3	152.3	1,256.5
	Sum		1,401.6	990.9	990.9	990.9	990.9	990.9	990.9	990.9	990.9	9,328.4

The total GHG emission reduction from the time of installation to 2030 of the LED lighting system in 54 public schools and 26 streets is: 9,328.4 tons of CO₂.

3. Evaluation of the calculation of greenhouse gas emission reduction of the project

Based on the information provided by the Project Technical Support Office, the consultant has conducted a verification of the project results of greenhouse gas emission reduction, including:

Regarding measures to reduce greenhouse gas emissions:

The use of LED lights by the project is in line with the energy sector's greenhouse gas emissions mitigation measures in the 2020 Nationally Determined Contributions report “E3. Use energy-saving lighting”: By 2030, the use of energy-efficient lighting (LEDs) will increase from 17% in 2014 to 70% of all lights in 2030 to replace filament lamps (or other similar traditional lamps).

According to the 2022 Nationally Determined Contribution Report, for the Energy sector, solutions to reduce greenhouse gas emissions mentioned include: Use of high-performance air conditioning and refrigeration equipment in commercial and residential services; **use energy-saving lighting**; use of solar water heaters; use biogas and cleaner fuels instead of coal in rural household cooking; use measures to improve energy efficiency in industries; use of high-performance electrical and refrigeration equipment in service, trade and commerce; improvement, development and application of technology in the production of building materials; energy efficient use in transportation; limiting fuel consumption for motor vehicles; switch modes of passenger and cargo transport; increase the load factor of the car; use of biofuels; use motorcycles, cars, electric buses.

Therefore, the technology and measures to reduce greenhouse gas emissions that have been implemented, the use of energy-saving LED technology, is completely appropriate.

a) Methods for determining the expected emission level when greenhouse gas emission reduction technologies and measures are not applied, greenhouse gas emission reduction levels and emission factors are applied

Methods for determining expected emissions when greenhouse gas emission mitigation technologies and measures are not applied:

On the basis of the report on the results of measurement and calculation of energy saving and CO₂ emission reduction of LED street and school lighting systems in Hue city, technical guidance document on measurement, reporting and verification (MRV) as well as some issued documents provided by the Project Technical Support Office, LUX DEV.

The method of determining the expected emission level without applying technologies and measures to reduce greenhouse gas emissions is stated in the report as follows: Base greenhouse gas emissions are greenhouse gas emissions (tons of CO₂/year) determined in a normal scenario (of traditional lighting systems) in the absence of project intervention.

About performance metrics:

To calculate the power consumption of traditional lighting systems (without LED lights installed) in schools, the project implements: Verify and survey the early period data of traditional lights. This activity includes: collecting information of the lighting systems transmitting rooms such as the number, type of lamp, nominal power of the lamp, lighting area and operating status of the lighting system, based on proposed numbers to support of each school; Measure the actual power consumption and average illumination of traditional lighting systems in sample rooms.

Early measurements showed that traditional bulbs including T8 and T10 fluorescent lamps had a significant decrease in actual capacity over time, only about 77% of the nominal power on average is remained. The measurement

results also showed that the fluorescent bulbs at the fields attenuated the luminous flux a lot above the nominal level. T8 and T10 fluorescent lamps have an actual measured average luminous flux reduced to 65% of the nominal level.

In order to calculate the power consumption of the traditional lighting system (when LED lights are not installed) at the streets, the project has conducted to collect relevant statistics of the lighting systems at the streets including: number of luminaires, lamp type, rated power and operating time to calculate the power consumption of SODIUM high-pressure lamp lighting systems at 26 selected streets.

Measurement results show that the traditional lighting system of about 29% of the total streets has an average illuminance that does not meet the standards. Most of the traditional lights are high pressure Sodium (HPS) lamps with capacity of 150W and 250W have been used for 15-20 years; luminous flux has decreased due to overexposure; low brightness and does not reach the standard average luminance and illuminance.

The solution to calculate the electricity consumption of traditional lamp lighting systems is to compare the total luminous flux of the replaced traditional lamps and the installed LED lights in each room. If any room does not have a difference with the increased luminous flux, the total number of traditional bulbs that have been replaced for that room will remain the same for the calculation. The increased number of differential luminous fluxes, due to the increase in average illuminance per room, will be used to calculate the assumed number of traditional luminaires to be added to the traditional luminaire lighting system of each room, to be able to emit a luminous flux equal to the total luminous flux of the project's LED. The Lumen method, commonly used to calculate indoor lighting, is applied to recalculate the number of traditional lamps required to emit a differential luminous flux.

To calculate the electricity consumption of street lighting systems, the nominal wattage of traditional lamps was used to calculate the electricity consumption of traditional lighting systems.

The calculation method:

Power consumption of traditional lights at schools=

$$W/fixture_{b,u,i} \times Nb_{u,i} \times Hours_{b,u,i}$$

$W/fixture_{b,u,i}$: Demand, also known as capacity of traditional lighting (base) according to each type of lamp class i in group u, power Watts

$Nb_{u,i}$: Number of replaced (base) traditional luminaires, adjusted for inoperable luminaires, of class i in group u.

$Hours_{b,u,i}$: The number of annual operating hours of the traditional luminaire in operation, of class i in group u, the number of hours and adjusted to represent an annual value.

Emissions from electricity consumption of traditional lights at schools=

Electricity consumption in the year (MWh) x National grid emission factor.

The application of the above methodology is in accordance with the guidelines of the AMS-II.N. Economical and efficient energy activities through the installation of efficient lighting and/or energy control systems in buildings.

Power consumption of traditional street lights =

Number of base luminaires

x Nominal wattage of traditional luminaire

x Number of annual operating hours of traditional lighting systems

x System outage factor (Lamp outage factor is the average time x Annual lamp failure factor)

Emissions from the power consumption of traditional lights in the streets=

Electricity consumption for the year (MWh) x National grid emission factor.

The application of the above methodology is in accordance with the guidelines of the AMS-II L: Energy consumption activities due to the application of high-performance outdoor and street lighting technologies.

On the mitigation of greenhouse gas emissions:

Thus, the total GHG emission reduction from the time of installation to 2030 of the project's LED lighting system in 54 public schools and 26 streets is: 9,328.4 tons of CO₂.

However, the report does not provide data on greenhouse gas emissions for each period: the period from installation to 31/12/2022 and the period 2023 to 2030, as well as the reduction of GHG emissions for each of these periods.

On the emission factor applied:

The project has applied a 2020 grid emission factor of 0.8041 tCO₂/MWh which is reasonable, ensuring reliability and accuracy. This is the factor that has been researched, developed and issued by the Department of Climate Change, the Ministry of Natural Resources and Environment in collaboration with relevant agencies according to Official Letter No. 1316/BDKH-TTBVTOD dated December 31, 2021 of the Department of Climate Change on the calculation of the emission factor of the Vietnamese power grid in 2020. In the dispatch, it states: "The Department of Climate Change would like to announce the results of calculating the emission factor of Vietnam's power grid in 2020 to relevant agencies, organizations and units for reference and uniform application to programs and projects according to exchange mechanisms, carbon credit offsets, related greenhouse gas emission mitigation activities; Develop a normal emissions scenario for updating Nationally Determined Contributions; Develop plans to mitigate greenhouse gas emissions of relevant sectors."

b) Information system and database on greenhouse gas emissions and greenhouse gas emission reduction of the project

The project used Excel and SPSS (Statistical Package for the Social Sciences) to build databases for storing early and supervisory data to serve before and after calculations. Data collection, aggregation, and reporting forms are designed on Excel spreadsheets, facilitating the aggregation, processing, and analysis of quantitative and computational data using basic mathematical and arithmetic functions. Data analysis mainly involves the calculation and comparison of the required key measurement parameters according to the Calculation Equations. The database system of the project is divided into 2 parts: 1) a database of storage, updating and processing and 2) a database of analysis and calculation results

- The database of storage, updating and processing include Excel databases that store periodic measurement and monitoring data, and SPSS program databases for synthesis, processing, and analysis, including the SPSS database of 1,343 departments, a total of 54 schools, and of each school. For streets, the SPSS database stores separate monitoring data of 18 streets installed in phase 1 and 08 routes for installation of phase 2.

- The database of analysis and calculation results including tables summarizing the results of processing, analysis and calculation.

c) The mitigation of greenhouse gas emissions achieved during the 10-year period of the project

The total energy saving result of the project in 10 years, from 2021-2030 is 10,441MWh (10,441 GWh), which contributes to reducing emissions of about 9,328.4 tons of CO₂ from the national grid.

The division by period from 2021-2022 and 2023-2030 is reasonable in order to make transparent data and calculation results on the amount of electricity saved through the installation of the project's lighting system.

d) Evaluation of the results of the implementation of the facility's greenhouse gas emission reduction plan and the greenhouse gas emission quota granted to the project

After the project ends, the monitoring, measurement and periodic reporting of the project's measurement results will be continued by the Department of Natural Resources and Environment of Thua Thien Hue province, which has been assigned by the Provincial People's Committee according to official letter No. 11020/UBND-XD dated October 18, 2022. The project management office will have a specific handover plan and technical guidance training to carry out the monitoring, measurement, calculation and reporting of results periodically as planned.

- With the total reporting period of the project's energy saving and CO₂ reduction results of 10 years, from 2021-2030, the inspection and supervision will continue to be carried out at least 04 times, in the years 4, 5, 8, 0. The results of 1-time inspection monitoring are valid for 2 years. The next round of inspection monitoring should be carried out in 2024, 2026, 2028 and 2030. The results of such inspections can be applied to report for 2024-2025, 2026-2027, 2028-2029, and 2030.

- For LED street lighting systems, biennial monitoring aims to determine and update measurement parameter values including data on the number of project's LED bulbs in operation, monitoring the number of hours of operation for a period of at least 90 days to extrapolate the annual operating time of the LED system. The wattages of the project luminaires do not need to be re-evaluated after having been initially determined at the time of project implementation.

- For school LED lighting systems, biennial monitoring aims to determine and update measurement parameter values including data on the number of LED bulbs in operation, average monthly (hour) operation time of LED lighting systems in sample rooms classified by room type or circuit measurement to calculate the amount of electricity consumed by each room type. The monitoring can use sample sizes for room types like early period surveying or monitoring measurements. The sample size that needs to be determined for monitoring must be at least 95% of the confidence interval and 10% error/range of the sample selection.

4. Contents that need to be amended, supplemented and completed in the project's greenhouse gas emission reduction report

a) On the results of the reduction of greenhouse gas emissions

After the project ends, the monitoring, measurement and periodic reporting of the project's measurement results will be continued by the Department of Natural Resources and Environment of Thua Thien Hue province, which has been assigned by the Provincial People's Committee according to official letter No. 11020/UBND-XD dated October 18, 2022. The project management office will have a specific handover plan and technical guidance training to carry out the monitoring, measurement, calculation and reporting of results periodically as planned.

The project calculated the annual reduction in greenhouse gas emissions based on the annual reduction in electricity consumption multiplied by the grid emission factor. When reporting on the reduction of greenhouse gas emissions to 2030 of the country as well as ministries, sectors and localities, the project should recalculate the greenhouse gas emission reduction from 2023-2030 on the basis of applying the grid emission factor of the published years (2030 still applies the

factor of 2029 since the factor is usually calculated and published the following year).

Therefore, the project transferee needs to report the results to 2030 based on the calculation of emissions reduction according to the annual national grid emission factor from 2022 to 2030.

b) Regarding the identification of emission sources and sinks have been presented in the greenhouse gas emission reduction report

The emission sources presented in the Report on results of measuring & calculating electricity saving and reducing CO₂ emissions of LED street lighting systems and schools in Hue city are from electricity consumption at 54 schools (29 primary schools, 22 secondary schools and 3 high schools) and 26 streets of Hue city. The identification of these emission sources is appropriate and accurate as these are the objects outlined in Project VIE/401.

c) Regarding the method of calculating the reduction of greenhouse gas emissions, the emission factor has been applied.

Regarding the method of calculating the reduction of greenhouse gas emissions: it is necessary to calculate greenhouse gas emissions correctly over time from the completion of the installation of LED lighting systems and into use.

The installation period for LEDs for schools is carried out from February 5 to May 15, 2021.

The replacement time for LED lighting for phase 1 of the streets is completed on December 22, 2020 (03 streets are completed on January 25, 2021), phase 2 is completed on September 29, 2022, specifically as follows:

Based on the time of completion of the installation, for the lighting system of schools, the reduction in greenhouse gas emissions of 2021 should be calculated according to the operating time of LEDs from 15/5 to 31/12 in 2021. After that, the operating period is calculated from 1/1 to 31/12 of the following years.

For the lighting system of streets, the greenhouse gas emission reduction of 2021 for 18 streets installed in phase 1 is calculated according to the operating time of LEDs from 01/01 to 31/12/2021, while 8 routes installed in phase 2 should be calculated according to the operating time from 30/9 to 31/12 in 2021. After that, the operating period will be calculated from 1/1 to 31/12 of the following years. The above calculation aims to ensure transparency and consistency for the reduction of greenhouse gas emissions of the project.

Regarding grid emission factor, the 2020 grid emission factor of 0.8041 tCO₂/MWh applied to calculate greenhouse gas emissions is reasonable, reliable and accurate.

When providing data on the total GHG emissions of the traditional lighting system and LED lighting system of the project from installation to 31/12/2022, it is also necessary to provide in the report the data on the total GHG emissions of the traditional lighting system and LED lighting system of the project period of 2023-2030 and from installation to 2030.

d) Regarding methods of quality control and quality assurance of greenhouse gas inventories.

Quality control and quality assurance are carried out by the parties involved in the MRV project, including the MRV Technical Supervision Unit (CTDA Group) and the MRV Management Unit (Lux PMU and Technical Support office). This is the process of self-validation, recognition and adoption of data collection methods, measurement/calculation methods and GHG emission reductions as well as sustainable development co-benefits that the MRV Management Unit (PMU and Technical Support office) reports to Thua Thien Hue People's Committee.

The internal verification mechanism is carried out in consultation with members of the Project Working Group, the Technical Assistance office and the Luxembourg PMU.

Regarding uncertainty, it is recommended to use the calculation of uncertainty according to the IPCC Guidelines 2006 as follows:

Uncertainty of GHG emissions of traditional lighting systems from installation to 31/12/2022:

Emission sources		Emissions (A)	Uncertainty of emissions (B)	(A*B) ²	Uncertainty of activity data	Uncertainty of the emission factor
Electricity consumption	School	1,386.60	8.60%	14,227.68	5.0%	7.0%
	Street	1,180.90	12.21%	20,778.42	10.0%	7.0%
Sum		2,567.50	7.29%	35,006.10		

Uncertainty of GHG emissions of project's LED lighting systems from installation to 31/12/2022:

Emission sources		Emissions (A)	Uncertainty of emissions (B)	(A*B) ²	Uncertainty of activity data	Uncertainty of the emission factor
Electricity consumption	School	508.90	8.60%	1,916.45	5.0%	7.0%
	Street	657.00	12.21%	6,431.57	10.0%	7.0%
Sum		1,165.90	7.84%	8,348.02		

Thus, the uncertainty from installation to 31/12/2022 of the greenhouse gas emissions reduction of the project should be calculated as the average of the uncertainty when calculating greenhouse gas emissions from power consumption of traditional lighting systems and project's LED lighting systems: **7.56%**.

Uncertainty of GHG emissions of traditional lighting systems from 2023-2030:

Emission sources		Emissions (A)	Uncertainty of emissions (B)	(A*B) ²	Uncertainty of activity data	Uncertainty of the emission factor
Electricity consumption	School	7,394.91	22.36%	2,734,238.04	10.0%	20.0%
	Street	6,860.23	22.36%	2,353,140.39	10.0%	20.0%
Sum		14,255.15	15.82%	5,087,378.43		

Uncertainty of GHG emissions of project's LED lighting systems from 2023-2030:

Emission sources		Emissions (A)	Uncertainty of emissions (B)	(A*B) ²	Uncertainty of activity data	Uncertainty of the emission factor
Electricity consumption	School	2,714.36	22.36%	368,386.65	10.0%	20,0%
	Street	3,613.91	22.36%	653,017.15	10.0%	20,0%
Sum		6,328.27	15.97%	1,021,403.80		

Since this is a forecast metric, the uncertainty from 2023-2030 of the greenhouse gas emissions reduction of the project is higher and should also be calculated as the average of the uncertainty when calculating greenhouse gas emissions from power consumption of traditional lighting systems and project's LED lighting systems: **15.9%**.

dd) Information systems, databases on greenhouse gas emissions and greenhouse gas emission reduction

The project used Excel and SPSS (Statistical Package for the Social Sciences) to build databases for storing early and supervisory data to serve before and after calculations.

The use of Excel and SPSS programs is consistent with the goals and activities of the project. SPSS software is a computer program for statistical analysis, scientific data analysis and application to the fields of social sciences. The functions of the software include: Data analysis, calculation of statistical parameters and interpretation of results; Summarize, synthesize data and present data in the form of tables, graphs, maps; Data management.

However, it is necessary to arrange more rationally the Database that stores the results of analysis and calculations, including tables summarizing the results of processing, analysis and calculation.

In the new database system, there are only:

- Results of calculating electricity consumption and savings by using LED lighting projects in 54 public schools and 26 streets (period from installation to 31/12/2022).

- Results of calculating GHG emissions and GHG emissions reduction by using LED lighting projects at 54 public schools and 26 streets (from installation to 31/12/2022).

Contents need to be supplemented:

- Results of calculating the amount of electricity consumed and saved by using LED lighting projects in 54 public schools and 26 streets (2023-2030 and from installation to 2030).

- Results of calculating GHG emissions and GHG emissions reduction by using LED lighting projects in 54 public schools and 26 streets (period 2023-2030 from installation to 2030).

5. Project recommendation

Request the Project Technical Support Office, LUX DEV to revise, supplement, explain and improve the greenhouse gas emission reduction report according to the above comments and send this Notice together with the revised and supplemented greenhouse gas emission reduction report, complete to send it to the competent authorities as prescribed in Decree No. 06/2022/ND-CP.

The Ozone Layer Protection and Low Carbon Economy Development Center notifies the Project Technical Support Office, LUX DEV to edit and implement./.

DIRECTOR



Ha Quang Anh