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Understanding Laptop's Environmental Problems Using Life Cycle Assessment

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Abstract

This study was performed to evaluate the environmental impacts arising from the life cycle of laptops by collecting and synthesizing data from life cycle assessment (LCA) studies. The research results shows the impacts of laptops include ozone depletion, potential global warming, acidification, eutrophication, carcinogenicity, respiratory effects, ecotoxicity and resource depletion. In particular, the production of laptop case, integrated circuits and flame retardants causes major impacts such as ecotoxicity, potential global warming and fossil fuels depletion. Results of LCA for the entire life cycle of the laptop Actina 244C10 shows the use phase accounts for 60% of the total impact and the production phase accounts for 37%. The transport and endlife treatment accounts for only 3% of the impacts. As for Dell Inspiron 2500 laptop, the most important impact is the production phase (account for 62-70%), remaining 30-38% of the impact is from use phase. In Vietnam, there are no specific policies related to the management of laptops, so the propaganda, collection and handling are limited

1. Introduction

In the current trend of information technology integration and application, laptops have become more and more popular. However, the results of many studies show that laptops cause negative effects on the environment and human health throughout its life cycle [1-3]. One of the methods commonly applied in these studies is Life Cycle Assessment (LCA), which is a supporting tool in calculating the environmental burden on the input factors. and the output of the system, and at the same time supporting decisions in improving environmental performance [4-5]. The results of the assessment show that the production and use stages are the two stages with the greatest impact on the environment [1:6]. The main groups of impacts in the laptop's life cycle include: damage from fossil fuel extraction, respiratory effects, and damage caused by climate change [1]. In particular, the types of impacts that are often analyzed are ozone depletion, global warming, acidification, eutrophication, ecological toxicity, fossil fuel depletion [1-2]. The flame retardants present in laptops are strongly toxic to humans and to other ecosystems such as freshwater, marine and terrestrial ones [3]. Although causing many impacts on the environment, but currently in Vietnam there is no official study on the impact of laptops, they are only mentioned in some studies on the impact of e-waste at the recycling section [7-8]. Therefore, this study is conducted to synthesize the effects of several stages in the laptop life cycle. From there, have a more overview of these impacts, at the same time contribute to raising public awareness and laptop management in Vietnam.

2. Methodology

The research was done by collecting secondary data from domestic and international documents, articles on product life cycle assessment (LCA) and environmental impacts arising in the life cycle of the product. laptop. Evaluate the environmental impact of the laptop using the life cycle assessment tool (LCA). According to ISO 14044: 2011, assessment consists of 04 steps:

- Step 1: Define the objective and scope of the assessment;

The goal of the study is to synthesize the effects of a laptop computer in the production, use and recycling stages. The scope of the study is shown in Figure 1.

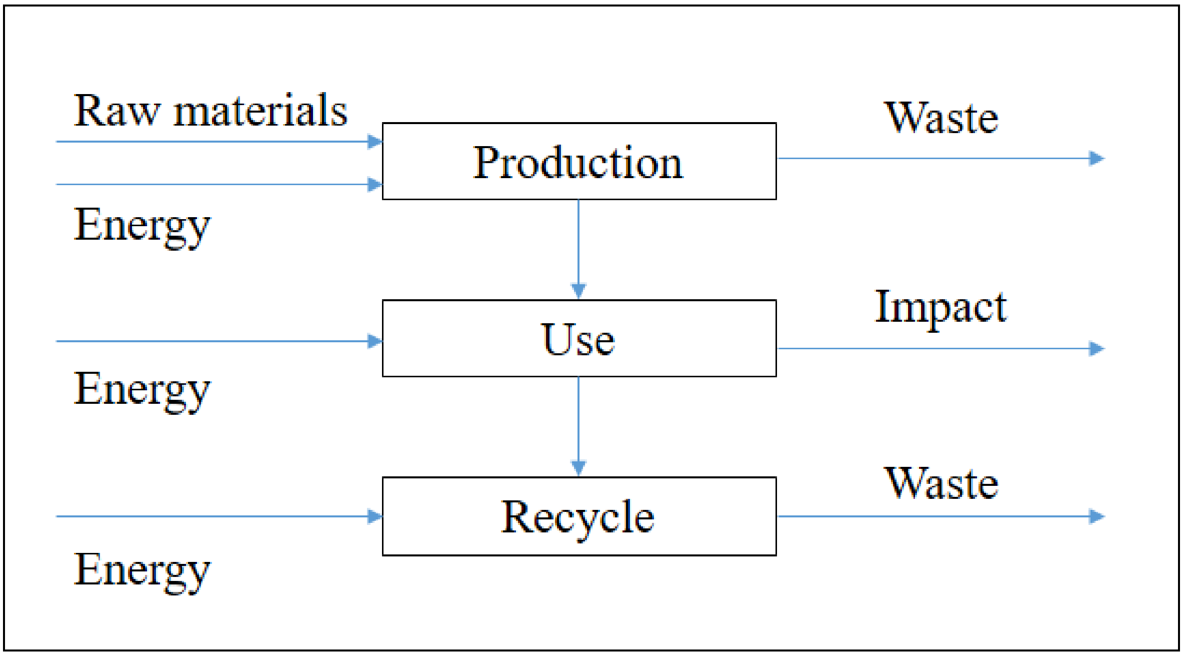

Figure 1: Research system boundary for life cycle assessment of labtop

- Step 2: Inventory analysis. Here, the study collects input (energy, materials, ...) and output (emissions into soil, water, air, ...) data through documents. secondary;

The process of manufacturing laptop covers: The functional unit used in research by David and John (2016) is a computer case with a 17.3 inch screen; Dimensions are 41.65 x 27.75 x 3.3 cm and have a mass of 870.2 g. Research was carried out on a variety of materials to compare the effects arising between materials.

Table 1. Energy used in the production of laptop cases [2]

Type of materials	Energy consumption
Aluminum	4,3 kWh
PLA	0,834 kWh/kg
PLA-DOPO	0,457 kWh/kg
Bamboo and other materials	3,7 kWh
PC-ABS	Composition of flame retardant accounts for 1.2%

- Step 3: Impact assessment. This step includes selection of impact categories and category indicators;

- Step 4: Interpretation/Explanation. Identify the significant issues and present conclusions, limitations and recommendations.

3. Results and discussion

3.1 Impact assessment

The impact categories analyzed over the life of the laptop case include: ozone depletion (OD, kg CFC), global warming (GW, kg CO_2), smoke (S, kg O_3), acid chemical (acid, kg SO_2), eutrophication (Eut, kg N), carcinogenic (Car, CTUh), non-carcinogenic (N-Car, CTUh), affecting breathing (RE, kg PM2.5), ecological toxicity (Eco, CTUe) and fossil fuel depletion (FFD, MJ surplus). The highest scores for the impact categories for each material type are presented in Table 2.

Table 2. Scores of types of impact in the production of laptop cases

Materials / Types of impact	Alluminium	PC-ABS-BDP	PLA-DOPO	Bamboo and other materials
OD	5,12E-06	4,23E-04	3,12E-05	3,56E-04
GW	1,62E02	2,46E01	8,65E00	4,03E01
S	6,78E00	4,72E-01	3,37E-01	2,09E01
Acid	9,56E-01	6,19E-02	5,25E-02	7,26E-01
Eut	4,89E-01	2,43E-02	5,37E-02	1,61E-01
Car	2,94E-05	4,16E-07	4,74E-07	3,19E-06
N-Car	3,57E-05	1,43E-06	8,95E-07	1,68E-05
RE	9,16E-02	5,13E-03	3,41E-03	1,95E-02
Eco	4,34E02	1,68E01	1,52E01	6,24E01
FFD	1,12E02	1,65E01	9,31E00	2,51E01

(David and John, 2016)

Of the four materials analyzed, aluminum was the one with the highest scores among 8 out of 10 impact categories, followed by bamboo, while PC-ABS-BDP and PLA-DOPO scored not too much.
Manufacture of integrated circuits: Research by Ran et al. (2011) [9] inventoryed and calculated the raw material demand and emissions of Integrated Circuits (IC), a basic component in all electronic devices as indicated in Table 3.
The manufacturing of integrated circuits requires large amounts of materials, especially high purity chemicals and gases. At the same time, they also have a relatively high potential for global warming due to the generation of many greenhouse gases.
Flame retardant manufacturing process in laptop computers : In the study of Niels et al. (2016) [3], the emission factors of flame retardants found in a laptop with a 4-year lifespan are shown in Table 4. In addition to the impacts on the air, water and soil environment in all stages of the flame retardant life cycle, the study also calculates the factors specific to the toxicity of the flame retardant to the ecosystems (Table 5).
Manufacturing and using Actina 244C10 computer : The functional unit selected in this study is the Actina 244C10 laptop model, manufactured in 2000 with a 15-inch screen and weighing 2,679 g. Using an assumed 5-year period with 253 working days/year, 8 hours/day (4 hours plugged in and 4 hours working with batteries), the computer has an energy consumption of 379.5 kWh. The results of inventory analysis for types of damage at different stages in the life cycle of the Actina 244C10 computer [1] are presented in Table 6. From the 11 impact categories analyzed, fossil fuels are the most valuable at the production and use stage. Meanwhile, at the end of the life cycle, the ecological

toxicity has the highest value. In addition, the impact types in the two stages of production and use have higher value than the treatment at the end of the life cycle.

Process of manufacturing and using Dell Inspiron 2500 computer: Dell Inspiron 2500 has a weight of 3,779 g, in which the weight of material components and energy used for each component [9] is shown in the following Table 7.

Total energy demand in the material production phase is 280-665 MJ and CO_2 emissions in this period are 16-41 kg. In particular, the energy used to exploit and process precious metals is quite high compared to other metals, especially gold. Along with using a lot of energy, gold is also the metal with the highest CO_2 emissions. Next, the calculation results of total energy consumption and CO_2 emissions during computer manufacturing and assembly [9] are shown in Table 8.

The results of inventory analysis show that total energy use for all the above processes is 1,036 - 1,981 MJ and 77 - 149 kg CO_2 emissions per laptop.

Impact from the production of laptop cases: Based on the materials studied, aluminum accounted for the highest score for most impact categories (8 out of 10). In particular, the ecological toxicity has the highest impact score, followed by the potential for global warming and the impact on the depletion of fossil materials. This proves the importance of researching biological materials for application in production, they not only help save resources but also minimize environmental impacts. However, it is necessary to expand research to select suitable materials, limit pollution from recovery and recycling because each type of biological material has its own challenges in the production and recycling process. For bioplastics, the technical and economic efficiency is a major challenge as they require strict source separation before recycling. As for the sustainability of materials from bamboo blends, it will depend greatly on the bamboo production and auxiliary processes. Although the research results show the need for the development of biological materials, for materials with a metal shell (aluminum is representative), the use of this material can be improved by increasing recycled content to compensate for metal mining needs.

Impact from the production of integrated circuits: In addition to the consumption of energy and materials like other industrial processes, the semiconductor industry also uses a variety of chemicals (Sulfuric acid, Phosphoric acid, Fluorhydric acid) and require high purity gases for treatment. In particular, this production process generates a large amount of greenhouse gases such as CF4, C3F8, SF6, and NF3 and is a high risk of environmental pollution.

Impact of flame retardants in laptop computers: Most of the life cycle stages of flame retardants are released into the atmosphere, except the phase of discharge treated in the form of landfill is emissions. into surface water. In which, the stage of discharge that is not treated according to standards is the one with the highest emission coefficient. The results of the study also showed that the flame retardants were toxic to most of the analyzed ecosystems. In which, ATO is the highest emission into water and air environment in freshwater and seawater ecosystems. Particularly for terrestrial ecosystems, ATO emits the highest in the air environment, while in water it is TBBPA. In particular, DecaBDE has the most impact on humans in both air and water emissions with a high emission factor that is superior to other substances.

Table 3. Input and output energies for a mold of size 1 cm^2

Inputs	Coefficient	Unit	Output	Coefficient	Unit
Silicon sheet	1.38	cm^2	Trifluormethan (HFC-23)	4.21E-09	kg
Electricity	1.27	kWh	Perfluoroethane (C_2F_6)	9.92E-11	kg
Gas	0.16	kWh	Tetrefluormethane (CF_4)	4.81E-11	kg
N_2 (highly pure)	6.06E-01	kg	Perfluorpropane (C_3F_8)	2.40E-07	kg
O_2 (highly pure)	4.13E-03	kg	Sulfure hexafluoride (SF_6)	4.83E-05	kg
Ar (highly pure)	2.34E-03	kg	Nitrogentrifluoride (NF_3)	8.76E-06	kg
H_2 (highly pure)	6.34E-05	kg			
Sulfuric acid (highly pure)	7.33E-03	kg			
Phosphoric acid (highly pure)	3.32E-03	kg			
H_2O_2 (highly pure)	2.04E-03	kg			
C_3H_8O/isopropyl alcohol (IPA) (highly pure)	2.78E-03	kg			
Ammonium huydroxide (highly pure)	1.09E-03	kg			
Fluorhydric acid (highly pure)	5.53E-04	kg			
NaOH (highly pure)	2.04E-03	kg			
Water	7.88	kg			
CF_4 (highly pure)	5.94E-05	kg			
C_2F_6 (highly pure))	6.89E-05	kg			
CHF_3	5.66E-06	kg			
NF_3 (highly pure)	3.02E-04	kg			
SF_6 (highly pure)	8.96E-06	kg			

Table 4. Lifecycle emission factors of flame retardant

Phases and compounds	Environmental media	Emission factors
Production of FR (Flame retardant)		
DecaBDE (Decabromo diphenylether)	Air	1.1E-5
	Water	1.8E-5
	Soil	3.1E-5
TBBPA (Tetrabromobisphenol A)	Air	1.0E-6
	Water	2.0E-7
ATO (Antimony trioxide)	Air	7.6E-5
	Surface water	2.8E-7
	Wastewater	4.7E-8
Use		
DecaBDE	Air	0.0019
ATO	Wastewater	1.0E-4
FR inorganics	Water	1.0E-4
FR organic (less volatile)	Water	5.0E-4
	Air	5.0E-4
Fire accident		
FR organics	Air	3.0E-7
ATO	Air	0.84
FR inorganics	Air	0.084
Disposal (treated according to the standards)		
All FR	Air	0.001
Disposal (landfilling)		
All FR	Surface water	3.8E-8
Disposal (incineration)		
ATO	Air	0.001
	Surface water	0.003
FR inorganics	Air	0.001
	Surface water	0.003
FR organics	Air	3.0E-8
Disposal (treated unfollowed the standards)		
FR organics	Air	3.0E-7
ATO	Air	0.005
ZHS (Zinc hydroxystannate)	Air	0.037
ATH (Aluminium trihydroxide)	Air	0.037

Table 5. Specific toxicity of flame retardants

Flame retardants	Human toxicity (DALY/kg)		Freshwater ecotoxicity (Species x yr/kg)		Saltwater ecotoxicity (Species x yr /kg)		Terrestrial ecotoxicity (Species x yr /kg)	
	Emitted to:		Emitted to:		Emitted to:		Emitted to:	
	Freshwater	Air	Freshwater	Air	Freshwater	Air	Freshwater	Air
AlPi	1.6E-09	5.9E-08	6.9E-09	2.8E-09	6.0E-09	4.5E-09	9.8E-13	9.7E-07
APP	7.2E-09	2.7E-07	7.9E-10	3.3E-10	6.9E-10	5.0E-10	9.0E-13	1.2E-07
ATH	7.6E-10	3.0E-08	7.3E-10	8.1E-11	5.3E-10	6.3E-10	3.3E-29	7.7E-08
ATO	7.8E-11	8.5E-10	**6.0E-08**	**6.7E-09**	**5.2E-08**	**2.3E-08**	1.9E-27	**1.7E-06**
BDP	ND	ND	1.9E-09	6.8E-13	1.4E-09	9.4E-11	7.6E-18	7.1E-11
DecaBDE	**2.0E-03**	**7.1E-04**	ND	ND	ND	ND	ND	ND
DOPO	1.2E-09	4.4E-09	1.4E-08	3.3E-09	1.2E-08	8.0E-09	3.7E-13	8.2E-07
RDP	ND	ND	2.2E-09	2.0E-11	1.4E-09	3.9E-09	1.0E-17	1.1E-09
TBBPA	3.9E-08	5.1E-07	2.6E-08	2.1E-10	2.1E-10	1.5E-09	**2.0E-12**	3.4E-09
ZHS	ND	ND	2.1E-08	2.3E-09	1.8E-08	7.9E-09	6.5E-28	5.9E-07
ZS	ND	ND	2.1E-08	2.3E-09	1.8E-08	7.9E-09	7.0E-28	5.9E-07

*(*Niels *et al., 2016)*

** Note: ND – not detected*

Table 6. Damage types in life cycle of Actina 244C10 computer

Types of impact	Unit	Total	Production	Use	Endlife
Carcinogenic	DALY	$1.08x10^{-4}$	$5.92x10^{-5}$	$4.86x10^{-5}$	$6.34x10^{-7}$
Respiration due to organics		$1.83x10^{-7}$	$1.16x10^{-7}$	$5.74x10^{-8}$	4.38E-10
Respiration due to inorganics		$3.64x10^{-4}$	$1.18x10^{-4}$	$2.38x10^{-4}$	$5.38x10^{-7}$
Climate change		$1.22x10^{-4}$	$3.39x10^{-5}$	$8.71x10^{-5}$	$6.18x10^{-7}$
Radiation		$1.21x10^{-6}$	$1.21x10^{-6}$	$0.00x10^{-0}$	$3.99x10^{-9}$
Ozone layer		$2.81x10^{-7}$	$2.74x10^{-7}$	$6.25x10^{-9}$	4.02E-11
Ecotoxicity	PAF·(m^2·yr)	$1.90x10^{2}$	$8.81x10^{1}$	$8.31x10^{1}$	**$1.88x10^{1}$**
Acidification/Eutrophication	PDF·(m^2·yr)	$1.00x10^{1}$	$3.31x10^{0}$	$6.51x10^{0}$	$1.75x10^{-2}$
Land use		$5.65x10^{0}$	$5.50x10^{0}$	$0.00x10^{0}$	$1.12x10^{-2}$
Minerals	MJ surplus	$2.91x10^{1}$	$2.90x10^{1}$	$0.00x10^{0}$	$2.29x10^{-2}$
Fossil fuels		**$4.15x10^{2}$**	**$1.29x10^{2}$**	**$2.82x10^{2}$**	$4.02x10^{-1}$

Table 7. Composition of materials, energy used and CO_2 emission per laptop

Materials	**Material weight for each laptop** (gam)	**Energy used for each laptop** (MJ)	**CO_2 emissions per laptop** (kg CO_2)
ABS	373	27 - 36	1.4 - 1.8
PC	406	43 - 51	2.5 - 2.9
Other plastics	343	37	1.9
Glass	300	13 - 20	0.8 - 1.2
Copper	270	9.2 - 26	0.55 - 1.6
Alluminium	512	66 - 80	3.6 - 4.3
Steel	871	26 - 78	1.8 - 5.1
Gold	0.36	21 - 244	0.85 - 15
Silver	1.4	0.48 - 17	0.03 - 1.06
Epoxy	244	33 - 64	1.7 - 3.5
Paladi	0.06	3.9 - 12	0.25 - 0.83
Niken	0.99	0.09 - 0.2	0.006 - 0.013
Zinc	0.1	0.002 - 0.008	0.001
Neodymi	0.02	0.007 - 0.02	0.001
Tin	9.3	2.2 - 2.9	0.11 - 0.19
Lead	6.1	0.08 - 0.1	0.09 - 0.18
Other	442	-	-
Total	**3,779**	**280 - 665**	**16 - 41**

Table 8. Energy use and CO_2 emissions in the production and assembly process

Process	**Standardized unit**	**Use of fossil fuels (MJ/standard unit)**	**Electricity use (kWh/standard unit)**	**Total energy used for each laptop (MJ)**	**Total CO_2 per laptop** (kg CO_2)
Manufacturing Semiconductors	cm^2 silicon	3.20	1.51	247 - 405	21 - 33
Manufacture of printed circuit boards	m^2	93	28	30 - 43	2.4 - 3.4
Producing silicon chips	cm^2 silicon	-	0.34	60	5.3
LCD production and assembly	15 inch	-	-	264 - 932	13 - 60
Computer assembly		85	35	435 - 541	35 - 47

Impact of computers Actina 244C10: Research results show that the main impacts affected by the laptop's life cycle include losses due to fossil fuel extraction (accounting for 46.7%), and absorption due to inorganic substances (accounting for 23.6%) and damage caused by climate change (accounting for 7.95%). The production stage (including the extraction and processing of raw materials) and the usage stage (electricity consumption) are the main factors influencing the types of impact. In which, the stage that has the most impact on the environment is the use stage (accounting for 60% of the total impact), the second phase contributing to the environmental impact is the production stage (accounting for 37%), Transport and the last stage of the life cycle only account for about 1% of the total impact. This is explained by the fact that electricity production in Poland depends heavily on fossil fuels: coal, lignite and gas. Coal mining not only has a direct impact on this non-renewable resource, but the burning of fuel also contributes significantly to respiratory damage (due to NOx and SO_2 emissions) and climate change impacts.
Impact of Dell Inspiron 2500 Computer: For Dell Inspiron 2500, production stage accounts for 62-70% of total primary energy of the entire life cycle. For the production and assembly phases, total energy usage is 1036 - 1981 MJ and 77-149 kg CO_2 emissions per laptop. In which, the production of semiconductors contributes 20%, the assembly phase contributes about 27%, the largest contributor is the production and assembly phase of LCD (about 47%). During the usage period, the electricity demand is calculated to be 62.7 kWh/year, corresponding to the primary energy use of 623 MJ/year and 1781 MJ over the 2.9 year life of the machine. The total CO_2 emissions of this laptop are 56 kg/year and 159 kg over the entire life cycle.

3.2 Explanation of the results

Laptop case manufacture: Research is conducted with the aim of understanding how to promote the sustainability of electronic devices through the choice of materials for laptop cases. The results show the diversity of materials used in the manufacture of computer cases. In particular, increasing the recycling rate in both aluminum and fossil plastic materials can bring environmental benefits compared to the exploitation and use of fossil fuels. But biological materials, although having a positive effect on fossil material reserves, can also cause negative effects in the auxiliary processes. Although research has been done on many different materials, but has not shown that the dominant material. Therefore, further research is needed to identify additional positive and negative impacts on the environmental and economic performance of the materials used to manufacture laptop cases.
Integrated circuit manufacturing: In addition to calculating the needs for materials, energy, chemicals, etc. used for manufacturing, this study also addresses the challenge of data collection for

processes. semiconductor, which is the production that takes place in many locations around the world and is limited to data updates. Therefore, it is necessary to regularly update material flow data (eg chip board size and thickness) in accordance with current technologies. At the same time, it is necessary to expand the research to obtain accurate results for the effects of the semiconductor manufacturing process.

Manufacture of flame retardants in notebook computers: The types of impacts associated with fossil energy use dominate most stages of the flame retardant life cycle. Only a small fraction of the flame retardant is emitted by evaporation during use and during fire and explosion incidents. Meanwhile, improper waste disposal causes the biggest difference in the impact of flame retardants due to dioxin emissions. Research shows that to improve the environmental performance over the life cycle of flame retardants, the stage of waste disposal is of the utmost importance. However, it is necessary to expand the scope and boundaries of the system in subsequent LCA studies to more fully describe the environmental impact of the flame retardant present in the laptop.

Production and use of the Actina 244C10 laptop: From the results of the LCI and LCIA stages, the impact of the stages is ranked and prioritized as Table 9.

Table 9. Impact rating of the Actina 244C10 computer according to ISO 14044: 2011

Stage	Critical level	Influence level	Contribution percentage
Use	Most important	Significantly influenced	60%
Production	Very important	Very influenced	37%
Transport and end life treatment	Not important	Not significantly influenced	1%

The use period is the most important stage in the laptop computer's lifecycle with respect to the environmental burden, the study has calculated. However, the results of this study have some limitations because they were not made on the exact data provided by the manufacturer. Therefore, the proposed study needs to analyze additional impacts from electricity use such as assessing the energy saving mode of using laptops or analyzing other power generation structures from energy sources. renewable (wind, solar, hydropower)

Production and use of Dell Inspiron 2500 laptops: The main results of the study show that the production stage accounts for a higher proportion than the use stage in energy consumption and carbon emissions (Table 10).

Table 10. Impact rating of Dell Inspiron 2500 computer according to ISO 14044: 2011

Stage	Critical level	Influence level	Contribution percentage
Use	Most important	Significantly influenced	62 - 70%
Production	Very important	Very influenced	30 - 38%

The results of the study show that the production stage is the most important in the total impact, significantly higher than the use stage. The research results are the basis to help guide the next research on LCA for laptops. The study proposes a number of new approaches such as data collection and the development of more accurate characterization methods for quantifying additional impact categories or studying environmental strategies through extension. lifespan of the computer to reduce the impact from the period of use.

3.2 Used laptop management in Vietnam

In Vietnam, there are no specific policies and laws on e-waste management in general and laptops in particular, they are only part of the solid waste management programs and policies and hazardous waste. The legal documents related to electronic waste management include: Decision 2149/QD-TTg on approving the national strategy for integrated management of solid waste to 2025 - vision to 2050; Law on Environmental Protection 2014; Circular No. 36/2015/TT-BTNMT on hazardous waste management; Decree No. 38/2015/ND-CP on Waste and scrap management; Decision No. 16/2015/QD-TTg Regulating the recovery and treatment of discarded products. The Vietnam Recycling Program and the Recycling Trip have been piloted in Hanoi, HCMC. HCM and An Giang to collect and treat professionally discarded electronic devices to maximize resource recovery and improve environmental efficiency. In addition, the Vietnam Recycling program also cooperates with universities to propagate and raise awareness for students. Although these programs have brought positive results in raising public awareness about the harmful effects of e-waste, including laptops. But the target audience for these programs is quite small, the deployed area is small and the amount of e-waste collected is modest compared with the generated amount. Therefore, it is necessary to replicate these programs to many localities across the country to achieve more positive results.
Because Vietnam does not have complete statistics on the number of laptops in use across the country, the study has calculated the number of laptops based on the needs of the intellectual class. . Because intellectuals are a key force contributing to the country's socio-economic development, they have income and a need to use higher technology products [10]. According to statistics of Nguyen Chi Dung (2015) [11], Vietnam's intellectual contingent has about 2.5 million people (accounting for 2.15% of the population). Based on the percentage of intellectuals mentioned above and the current population of Vietnam, the study has calculated the number of people of the intellectual contingent at the time of the study as follows:

Current intellectual team = 97,693,725 people x 2.15% = 2,100,415 people

Next, the study estimates the number of laptops in use with the assumption that each intellectual person uses one laptop.

Number of laptops used = Number of people in the intellectual team = 2,100,415 laptops

Assuming that the laptop is used for 5 years with 253 working days/year, 8 hours/day (4 hours plugged in and 4 hours working with battery), the power consumption during use is 379,5 kWh per computer [1].

Total electricity consumed during use = 379.5 kWh x 2,100,415 units = 797.107.492 kWh

The above results show that the number of laptops in use and the power consumption of all computers in the country is very large. This is the reference data for the next studies to calculate the exact emissions and find the appropriate management policies.

4. Conclusion

Throughout its life cycle, laptops cause effects such as ozone depletion, global warming potential, acidification, eutrophication, cancer, respiratory effects, ecological toxicity, depletion resources. In this paper, it was shown that the production and use are the two stages thatcontribute the most to the environmental impact of the laptop. While many laptop LCA studies have been performed, the results differ widely due to uncertainty in the calculation assumptions and product complexity. In Vietnam, the number of laptops being used and the power consumption of all computers across the country is very large. However, our country does not have specific policies related to the management of laptops, so the propaganda, collection, management and handling activities are still limited.

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