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The Legal Measures for Controlling solar cell waste and components: A case study on post-use solar cell and component waste management.

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Abstract.

This research article found that the country's image. These wastes and components are hazardous waste by law and are not biodegradable. The Studies have found that in the National Environmental Quality Promotion and Preservation Act, B.E. 2535 (1992), lacks measures to control the disposal of solar panel waste and components after their end of life. The government has implemented the principle of public participation, which has not elicited adequate responses from private organizations and the public, failing to lead to a proper resolution of the issue. problem of solar panel waste and components after their end of life concretely, it is proposed that the law be amended to include measures that promote and facilitate the recycling of these materials. This approach would help control and mitigate pollution from solar panel waste and components, thereby alleviating the burden on the government in addressing pollution and environmental issues.The Studies have found that the National Environmental Quality Promotion and Preservation Act, B.E. 2535 (1992), lacks measures to control the disposal of solar panel waste and components after their end of life. The government has implemented the principle of public participation, which has not elicited adequate responses from private organizations and the public, failing to lead to a proper resolution of the issue. To address the problem of solar panel waste and components after their end of life concretely, it is proposed that the law be amended to include measures that promote and facilitate the recycling of these materials. This approach would help control and mitigate pollution from solar panel waste and components, thereby alleviating the burden on the government in addressing pollution and environmental issues.

Keywords: Control of post-use solar energy cell and component waste, solar cells, pollution sources, hazardous waste

Introduction

The problem of high energy price volatility Solar cells are an alternative energy source that is widely popular and is continuously being used. From the study of the environmental and economic impacts of solar cell waste management, Thailand will generate 5,000 tons of solar cell waste in 2025. By 2030, Thailand will generate at least 8,000 tons of solar cell waste per year (Department of Alternative Energy and Energy Conservation, 2024).

Solar cells are an important alternative energy source that is clean and safe, reducing risks and fluctuations in energy. Installing them in areas where the electricity grid is not accessible allows people to conveniently access electricity for their daily lives. At the same time, solar cells cause pollution and other environmental problems. Rathore N. & Lal Panwar, N.(2020)

From the data collection and report on the solar power generation system in Thailand during 2016-2017, there was an annual installed capacity of 250.80 MWp and a cumulative installed capacity of 2,697.26 MWp, divided into 2 groups according to the system connection: electricity generation connected to the distribution system (On-Grid) with a

volume of 2,663.12 MWp and electricity generation not connected to the distribution system or independent power generation system (Off-Grid) with a volume of 34.14 WMp (Ministry of Energy, 2018).

The government has a plan to promote electricity generation from solar cells to reach 15,574 MW by 2037 according to the draft Alternative Energy Development Plan (AEDP) 2018, resulting in a large amount of waste solar cells and accessories in the future. Currently, Thailand lacks a systematic and comprehensive management system and waste management technology. The average lifespan of solar panels is 20 years. It is expected that in 2022, 112 tons of solar panel waste will be generated and will increase to 1.55 million tons in 2057. If there is no plan for the impact on the environment, public health, and the economy, it may be an obstacle to the plan to promote electricity generation from solar cells (Phisit Phianmanakul et al., 2020).

When considering the amount of electricity consumption from solar cells, the increasing amount of solar cell waste and parts will develop into hazardous waste, a major pollution problem in Thailand in the future. Currently, there is no legal measure to enforce the management of solar cell waste and parts after their use. Such waste and parts will be sold to second-hand shops to be disassembled and sold as second-hand spare parts. Unusable parts will be sold as scrap materials. Unwanted parts will be discarded to public waste dumps without separation and without control by operators, regardless of the pollution and hazardous substances caused by the discarded parts. This results in a rapid increase in the amount of solar cell waste and parts after their use, affecting the environment, causing economic loss, and creating a pollution problem that is harmful to public health, causing the government to lose part of the national budget that should be used to solve the pollution problem, which is an inappropriate and inappropriate solution and a solution that addresses the root cause. In order for the problem to be solved correctly, appropriately, and appropriately, there must be legal measures to control solar cell waste and parts after their use, a major source of pollution, in order to determine shared responsibility for managing and taking back solar cell waste and parts after their use in accordance with the National Environmental Quality Promotion and Conservation Plan 2017-2036.

2) Concepts on managing pollution problems from solar cell waste and parts

This section will discuss the pollution problems caused by solar cell waste and parts after their use, including principles, concepts, and related theories that can be applied to manage and solve pollution problems caused by such waste and parts correctly and appropriately.

2.1) Theoretical principles and concepts The impact on the environment is a problem that every country is aware of and gives great importance to. This is because pollution and environmental problems cause great damage to the ecosystem and economy regardless of area. Pollution and environmental problems have become common problems for every country that must help solve, treat, and restore the ecosystem, environment, and nature to a good condition. In order to be consistent with the economic and social development of the country, we present the theoretical principles and concepts related to environmental management that can be applied to solve pollution and environmental problems in the country.

2.1.1) The principle of sustainable development The principle and concept of sustainable development is the approach to stop the destruction of resources. It is the idea of protecting the world's resources by using limited natural resources for a long time, worthwhile, and not depleting natural resources. It is the sustainable use of resources, i.e. using resources in accordance with the potential of the environment. The use of resources that are consistent with the potential of the environment, that is, using them does not damage the environment or resources or is inefficient to the point where they cannot create new products. It can be said that the principle of sustainable development is the economics of sufficiency,

that is, economic success must not create a burden on the environment and quality of life for the next generation. Everyone has equal rights in the ownership of natural resources and the right to use natural resources without obstruction under the condition that the use must not destroy natural resources and the environment. The principle of sustainable development has been applied to the management and planning of the environment as an example in the development of countries, especially developing countries, namely, slowing down and suppressing environmental destruction. This idea led to the establishment of the environmental organization of the United Nations, namely The Unite Nations Environment Program (UNPE) and the Environmental Fund. Later, the United Nations established the World Commission on Environment and Development (WCED). The Commission was established in 1984, named the “Brundt Land Report”, which studies the creation of a balance between the environment and development. Refers to the environmental and development crisis (The United Nations Conference on Environment and Development: UNCED) or the so-called "Earth Summit" in Rio de Janeiro, Brazil, in June 1992, where leaders of 179 countries attended the meeting and accepted the principles showing their acceptance of the principles of the United Nations Conference on Environment and Development (Mallikamalai., S. (2002) which are important principles of the concept of sustainable development.

When considering the concept of sustainable development, it is found that economic and social development for the well-being of the people in the country will go hand in hand with the protection of the rights and benefits of the people. In other words, development that prioritizes the rights and benefits of the people is not just economic development. The importance of the rights and benefits of the people will include the right to a place to live and to make a living without environmental pollution. The people will be happy and will not have pollution and environmental problems, such as the problem of degraded areas, the problem of garbage and hazardous waste remaining due to insufficient collection officers from related government agencies, etc. If the environmental management plan is properly planned, the problem of pollution from hazardous waste will be properly solved without affecting the health and hygiene of the people, society as a whole, the environment, and the image of Thailand. The people will be safe living in a good environment free from pollution. 2.1.2) The Polluter Pays Principle (PPP) The Polluter Pays Principle is a concept that takes polluters or those who create pollution problems to be responsible for the pollution problems that they have caused. The basic concept of the Polluter Pays Principle comes from the awareness that: “Every human being has the absolute right to live in a good environment.” This is related to the principle of sustainable development, which requires everyone in society to change their thinking, way of life, and production methods, leading to no or minimal environmental damage, allowing consumption and production to continue, benefiting the people of the present and future generations.

The principle of the polluter pays is a guideline to ease the government’s burden in solving pollution and environmental problems. In the past, polluters did not participate in the responsibility of solving the problem, leaving the government alone with limited budget and personnel. Solving the problem was unsuccessful, causing pollution residues that caused widespread damage, requiring time to fix. The damage that occurred was not limited to damage to life and body, but also included damage to property and may violate the rights and freedoms of others, such as the restriction of hazardous waste or the discharge of wastewater, which may cause people to be harmed or pets to die, etc. (Wongbandit, A.2002). The principle of the polluter pays is appropriate to apply to solving pollution and environmental problems in order to make the polluters who created the problem responsible and accountable for solving the pollution problems instead of leaving the government to solve the problem

alone. Meanwhile, the polluters who benefit have no duty to solve the pollution problems they created. Holding polluters accountable for solving the pollution problems they create is a way to organize society to create legitimacy that polluters must take responsibility for solving pollution and environmental problems, which will allow the country's economic and social development to proceed smoothly without destroying the environment and creating sustainable economic development without destroying the environment and creating pollution problems.

2.1.3 The principle of extended liability (Extended Producer Responsibility: EPR) is the development of laws to keep up with changes in the economy, society, and the environment. It creates mechanisms, duties, and responsibilities of operators (manufacturers, importers, and agents). In short, it is to increase responsibility and set policies for solar cell operators to be responsible for scrap and parts, not leaving the government alone to solve the problem while operators benefit from the sale of products but lack responsibility for scrap and parts. It creates criteria for environmental responsibility and fairness, reduces the government's burden of allocating budget and personnel to solve the problem, and expands the responsibility of operators by specifying the duty to take back scrap and parts, and take financial responsibility. This is a measure to create appropriate responsibility for solving the scrap and parts problem, which operators still lack responsibility for. Operators should participate in taking responsibility throughout the life cycle of solar cells, in addition to taking responsibility for the quality of the product according to the general principles already in place by law. It expands the responsibility to take responsibility for society and the environment. In summary, operators should be responsible for scrap and parts of products, starting from the production process until the final cycle of product disposal. It is considered very appropriate to apply to the responsibility of solar cell product manufacturers to be responsible for their product scraps and parts. It is a new concept that is different from the old concept that requires responsibility only for the quality or defects of the product. It expands the duties and responsibilities of solar cell product manufacturers who are lacking to be responsible for their product scraps and parts.

It creates legitimacy in participating in the responsibility for society and the environment equally because the manufacturers benefit from selling the products but lack the responsibility for the problem of solar cell scraps and parts. The extended product liability (EPR) is a policy principle that sets goals and selects environmental policies based on the principle that business operations must be responsible for society and the environment (Corporate Social Responsibility - CSR) and is linked to the principle of sustainable development. The author believes that applying the extended liability principle to solve the problem of solar cell scraps and parts may increase product costs. If we consider from the perspective that environmental costs are the shared responsibility of everyone in society, it is appropriate to apply it to solve the problem of solar cell scraps and parts after the end of use, which is hazardous waste that tends to increase. It creates a mechanism for social and environmental responsibility that will allow the manufacturers to be responsible for their product scraps and parts from the beginning to the end of the product life cycle, such as the duty to take back product scraps. The duty to pay disposal fees, etc. Expand the duties and responsibilities in the missing parts to be complete according to the product life cycle. Create social and environmental responsibility with shared but different responsibilities.

2.2) Increase in solar cell waste and parts The use of solar cells in the country tends to increase. In addition, the government promotes the installation of solar cells, such as the Alternative Energy Development Plan 2018-2037 (AEDP2018) by the Department of Alternative Energy Development and Energy Conservation, Ministry of Energy. The purpose is to support people to produce electricity for their own use to solve the problem of

continuously rising energy prices. It is an improvement in the quality of life of people and the environment because electricity produced from solar cells is clean energy that reduces greenhouse gas emissions, which is the cause of global warming. From the disclosure of Dr. Jiraporn Sirikham, Deputy Governor of Strategy, Electricity Generating Authority of Thailand (EGAT), the future trend will have waste from solar panels. It is expected to increase further according to the Power Development Plan (PDP), which estimates that in 2022, there will be 112 tons of waste from solar panels, which will increase to 1.55 million tons in 2057 (Energy News Center, 2021). According to the disclosure of Thai PBS reporters who surveyed a warehouse in Rangsit, Pathum Thani Province, there were more than 3,000 solar panels imported from China (Thai PBS, 2024). The number of solar cell installations has increased, and the government lacks measures to set guidelines to bring private organizations and the public, who are producers and consumers, to participate in taking responsibility for solving the pollution problem caused by waste and pieces of solar cells after their use ends. The government is the only organization that must plan and set guidelines for solving the pollution problem using the government budget. If the government gives importance to the problem and uses the principles of participation of private organizations, the public, and the principle of expanding producer liability to create continuity in taking responsibility for solving the problem, the economic, social, and environmental systems will be fair, creating stability for the development of the country's economy, society, environment, and industry, especially in the use and planning of natural resources to prevent pollution and environmental problems from occurring later on. The natural resources used must not be completely destroyed by human exploitation of those natural resources. (Phiermanakul, P. & Liangboonlertsai, C.(2024)

2.2.1) Pollution from solar cell waste and parts Some solar cell waste and parts after use are sorted into second-hand spare parts. Unusable parts are mixed with general waste and released into public waste sites without a separation and prevention process. Solar cell waste and parts are not naturally degradable, such as solar cells, glass, aluminum frames, films, etc. If there is no proper management system, they will become a source of pollution that affects public health, the environment, the economy, and the image of the country, which is contaminated with hazardous substances. They are also a source of toxic contamination. 2.2.2) Impacts and pollution from solar cell waste and parts Pollution from solar cell waste and parts after use is increasing in line with the direction of solar panel installation, resulting in pollution that has subsequent impacts. Here, it can be divided into 3 types: (1) Social impacts Solar cell waste and parts after use that are discarded into public waste sites have impacts on society in terms of reduced utilization of natural resources, resulting in an impact on the economy and reduced income of the people. (2) Impacts on quality of life and biological health. People live amidst pollution contaminated with toxic substances, such as exposure to toxic substances in the air from inhalation or skin contact. (3) Biological impacts It has an impact on both land and water ecosystems. The ecosystem causes living things, plants, animals, and microorganisms living on land to be contaminated with toxins, which affects the overall ecosystem. For example, plants contaminated with toxins, when animals eat them, they receive the contaminated toxins. When humans or animals consume them, they will also receive the toxins and accumulate them in their bodies. In addition to the above impacts, the lack of a system for managing the remains and parts of solar cells after they have been used also affects the country's image in terms of tourism because Thailand is full of pollution.

3) Legal measures to control solar cell waste and parts

For part 3, we will compare legal measures to control in Thailand with other countries. It will mention laws related to the control of solar cell waste and parts after the end

of use, which is a source of pollution in Thailand. In Thailand, it is the National Environmental Quality Promotion and Conservation Act B.E. 2535. In other countries, it is the European Union Directive (EU WEEE Directive: 2012/29/EU). The European Union regulation sets the framework for the management of waste electrical and electronic equipment (Waste Electrical and Electronic Equipment or WEEE). The objective is to improve the collection, reuse, and recycling of waste electrical and electronic equipment, reducing the impact on the environment and human health.

3.1) Control of solar cell waste and parts from the source. Currently, Thailand has the National Environmental Quality Promotion and Conservation Act B.E. 2535 as the master environmental law in a holistic manner. That is, if there is a specific law, it must be enforced according to the specific law. National Environmental Quality Promotion and Conservation Act 2535 will be applied in cases where there are legal gaps or where specific laws do not stipulate in order for the law to be effective and have practical effect.(Mallikamalai S..(2002)

3.1.1) The National Environmental Quality Promotion and Conservation Act B.E. 2535 is the main law that supplements specific laws to be effective in cases where specific laws have obstacles in enforcing the law. Solving pollution and environmental problems The National Environmental Quality Promotion and Conservation Act B.E. 2535 stipulates as follows:

(1) Pollution control standards Methods for controlling the release of waste from sources into the environment to be within the specified standards. The owner or possessor of the pollution source has a duty to comply. It is divided into 2 cases as follows:

(1.1) Pollution sources whose waste emissions are controlled. Controlling the release of waste into the environment outside the area occurs when the Minister of Natural Resources and Environment announces the designation of pollution sources that must be controlled for the release of waste into public water sources or into the environment outside the area to meet the standards specified by law.

(1.2) Pollution sources whose waste emissions are not controlled Areas where waste disposal or removal of waste outside the area is not controlled, the owner or possessor is required to comply with the pollution control standards prescribed by other laws as stipulated in Section 55 of the National Environmental Quality Promotion and Conservation Act B.E. 2535. For areas where government agencies have set up a central waste disposal system, the owner or possessor of the source of pollution is required to send his or her pollution for disposal at the central waste disposal system and must pay a service fee at the rate stipulated by law. In areas where government agencies have not set up a central waste disposal system and there is no person authorized to provide waste disposal services in the area, the local official, upon the advice of the pollution control official, has the authority to determine temporary methods for waste disposal as appropriate as specified in Section 75 of the National Environmental Quality Promotion and Conservation Act B.E. 2535.

(1.3) Objectives of setting pollution control standards It is a legal mechanism for the owner or possessor of pollution to comply with the specified standards. It will occur when the Minister of Natural Resources and Environment announces the designation of pollution sources that are controlled for the release of waste into the environment outside the area where the owner or possessor of the designated pollution source has a duty to comply with the specified standards, including the pollution control standards that the provincial governor has announced to designate the pollution control area as stipulated in Section 58 of the National Environmental Quality Promotion and Conservation Act B.E. 2535. (1.4) Criteria for setting pollution control standards According to the National Environmental Quality Promotion and Conservation Plan B.E. 2560 - 2579, the Cabinet resolved on

November 7, 260 to approve the policy and plan for the promotion and conservation of national environmental quality B.E. 2560 - 2579 as proposed by the National Environment Board. The announcement of pollution sources that must control the release of hazardous waste into the environment and pollution control standards from sources for waste management according to the Ministry of Industry's announcement on the management of waste or unused materials B.E. 2566 stipulates that factories have a duty to manage For waste management methods, 2-digit codes are given for the management of 8 types of waste or unused materials as specified in Section 1. 3-digit codes are given for the management of 85 types of waste or unused materials as specified in Section 2. Appendix 3 In summary, the waste management methods specified in Appendix 3 are, for example, reuse (Type 04), recycle (Type 05), recovery (Type 06), treatment (Type 07), disposal (Type 08), other management methods, etc. Regulations and criteria facilitate private sector participation in hazardous waste management by considering the economic, social and technological feasibility involved.

3.2) Control of foreign solar cell waste and parts. In general, EU member states have adopted the EU WEEE Directive (2012/29/EU) on waste electrical and electronic equipment covering waste from solar cells as a policy within member states to solve the problem of waste from solar cells. The main objectives are to define the responsibilities of different stakeholders. The government supports the issuance of regulations for collection, recycling, environmental protection, and public health safety. Manufacturers are legally responsible for and responsible for the disposal costs of waste from their products, such as the Federal Republic of Germany. The government has issued regulations and mechanisms for recycling waste from solar cells, using economic approaches as tools and promotion mechanisms, such as financial support, creating collection and recycling centers, which are divided into 2 forms: 1. Business to consumer and 2. Transactions, providing funds. Manufacturers must comply with the regulations and be responsible for their products sold to households both now and in the future, based on the basic concept of B2C transactions. The Italian Republic was the first country to apply the EU WEEE Directive (2012/29/EU) as a policy to solve the problem of solar cells after their end of use. The Environmental Protection Act (EPPA) applies the principle of extended producer liability (EPR) to cover transportation and disposal costs, requiring end-of-life solar cells to be considered e-waste. Manufacturers must register as members. The government collects a portion of the income tax to fund the management and collection costs and recycles end-of-life solar cells in a specified amount and refunds the manufacturer if they can prove that the end-of-life solar cells have been properly disposed of within 6 months of collection (Law No. 49 of March 2014). Compared to Germany, the financial mechanisms are different. In the Italian Republic, manufacturers are legally bound and entitled to a refund if they can prove that they have recycled end-of-life solar cells efficiently and safely, as shown in Figure 1 (Arvind Sharma et al., 2019).

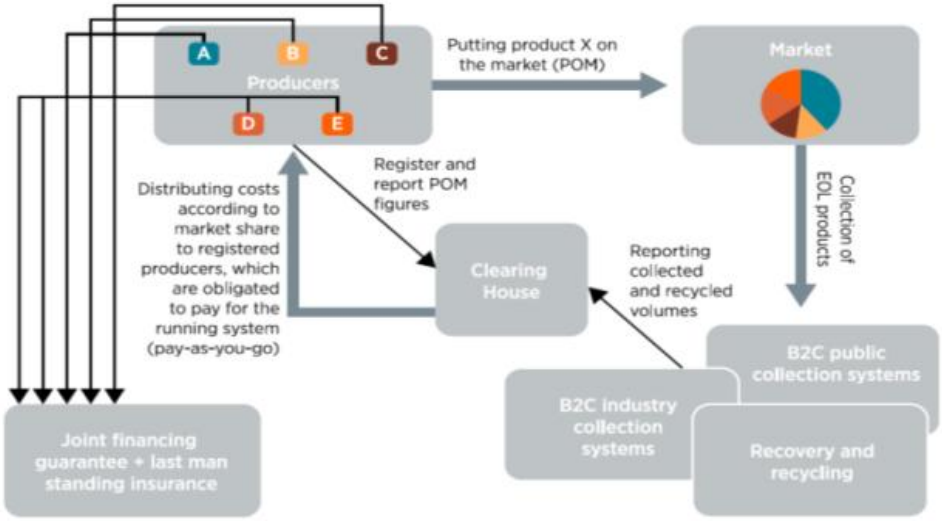

Figure 1. B2C transaction mechanism for recycling solar cells.
Source: Baldé CP et., 2015

In summary, the Federal Republic of Germany and the member states of the European Union have applied the EU Directive to solve the problem of solar cell waste and parts after use, reviewed the management model and disposal method, analyzed the policies, regulations and strategies used to manage and solve the problem of solar cell waste and parts after use appropriately, namely, applying the environmental concept of the Polluter Pays Principle (PPP) and the Common But Differentiated Responsibility Principle to solve the problem by creating duties and responsibilities of those involved in the life cycle of solar cells, with the goal of reducing the impact on the environment and creating new businesses.

4) Analysis of legal issues on the control of solar cell waste and parts

Thailand has many laws enforcing the environment. Here, we will analyze the legal principles related to the control of solar cell waste and parts after use, specifically the National Environmental Quality Promotion and Conservation Act B.E. 2535 (1992), as follows:

4.1) Determination of pollution control sources Criteria for determining pollution sources The National Environment Board under the National Environmental Quality Promotion and Conservation Act B.E. 2535 (1992) is an organization that performs academic duties in setting standards and scientific criteria for pollution sources that must be controlled under social and economic conditions. By virtue of Section 32 of the National Environmental Quality Promotion and Conservation Act B.E. 2535

From the study, it was found that the National Environment Board is an organization that determines the pollution sources that must be controlled and the standards in terms of environmental quality that the owners or possessors of pollution sources must comply with the specified criteria to meet the standards before removing waste from the source into the environment outside the area in order to control pollution from the source and prevent pollution and environmental problems. The determination of criteria and standards of pollution sources that must be controlled found that the compulsion to determine the pollution control source will occur only when the pollution control source has been announced first according to the criteria stipulated in Section 55 and Section 69. And even if there is an announcement according to the criteria stipulated in Section 55 and Section 69, because the penalty for the owners or possessors of pollution sources is not afraid to comply

at all. Because the penalty for violators is set as a small criminal penalty and fine, the legal compulsion is therefore ineffective in practice.

4.2) Pollution control source standards The pollution source standards stipulated in Section 55 are effective after the announcement of the types of pollution sources that must be controlled for the release of waste to the public or to the environment outside the area as stipulated in Section 69 of the National Environmental Quality Promotion and Conservation Act B.E. 2535 (1992). If there is no announcement of pollution sources as stipulated in Section 69, the enforcement of the law will not be effective. The study found that the control of pollution to be within the pollution source standards as stipulated in Section 55 of the National Environmental Quality Promotion and Conservation Act B.E. 2535 (1992) will be effective only after the announcement under Section 69 of the National Environmental Quality Promotion and Conservation Act B.E. 2535 (1992). Therefore, if there is no announcement under Section 69, the owner or possessor of the pollution source will not have any duty to comply with the law. At the same time, even if there is an announcement under Section 69, since Section 69 lacks criminal punishment measures which are mandatory for punishing the owner or possessor of the pollution source who moves or avoids complying with the law, it is impossible to prevent and control the movement of pollution from the source comprehensively. Therefore, the lack of criminal enforcement measures in Section 69 of the National Environmental Quality Promotion and Conservation Act B.E. 2535 has resulted in the process of controlling the movement of pollution from the source or avoiding non-compliance with the law being ineffective in practice and the expansion of pollution sources still continuing.

4.3 Comparison of measures to control solar cell waste and parts in Thailand and other countries, which have different measures to control solar cell waste and parts after use, namely:

(1) Control of solar cell waste and parts after use from the source. Thailand lacks a model and process for controlling solar cell waste and parts after use. Thailand is a developing country, so it allows the use or sale of solar cell waste and parts after use as second-hand spare parts, which may be unsafe due to the deterioration of the parts.

The study found that Thailand uses measures to control pollution from the source by announcing the designation of pollution sources first. Therefore, it is not possible to prevent pollution problems caused by solar cell waste and parts after use comprehensively and effectively. Therefore, it should promote the recycling of solar cell waste and parts after use to reuse the waste and parts to create a circular society and prevent pollution problems caused by solar cell waste and parts effectively and sustainably.

(2) Disposal of solar cell waste and parts after use in developed countries of the European Union. The recycling of solar cell waste and parts after use is a method to control and dispose of solar cell waste and parts. The roles, duties, and responsibilities of those involved in solar cells are defined, starting from the operator to the consumer, which is the final step, by applying the principles of shared responsibility, the polluter pays principle, and the principle of expanded liability. Which is an environmental principle to determine the duties and responsibilities of each party. It is a way to create a society of circular use, promoting the reuse of solar cell waste and parts. It can be said that it is a creation of a recycling system. It is different and new because Thailand lacks a model to promote the recycling of solar cell waste and parts for reuse in a tangible way and is different from other EU member countries that promote the reuse of solar cell waste and parts by defining the roles, duties, and joint responsibilities of all parties involved until successful. The study found that Thailand still lacks measures related to promoting the recycling of solar cell waste and parts after use to recycle and reuse for tangible and practical results. In order to have a

relationship with the increasing amount of solar cells, it should promote the recycling process of solar cell waste and parts after use to recycle and reuse them. It should also use the registration model of entrepreneurs and those involved in recycling (Recycle) to determine the responsibilities of each party to support the increasing amount of solar cell waste and parts following the model of EU member countries, which are industrial countries that produce technological products for export abroad and domestic use. Prevent the increase in solar cell waste and parts as a source of pollution to be eliminated or reduced.

Summary

In order to improve the law and control the increase in waste and parts of solar cells after the end of their use, the following recommendations are made:

5.1) By virtue of the power under Section 69 of the National Environmental Quality Promotion and Conservation Act B.E. 2535, the Minister of Natural Resources and Environment, with the advice of the Pollution Control Board and with the approval of the National Environment Board, shall issue an announcement specifying sources of pollution that are controlled to be removed from their locations or released into the environment by requiring the owners or possessors of sources of pollution as specified in the announcement to comply with the law, along with promoting the recycling process. This method opens the way for new laws to be enacted.

5.2) Increase the penalties for owners or possessors of sources of pollution that have been declared as controlled sources of pollution and fail to comply or avoid complying with the law. In civil law, fines should be increased at a higher rate. In criminal law, imprisonment should be imposed on those who fail to comply with the law, preventing owners or possessors of sources of pollution from avoiding compliance with the law and preventing the expansion of pollution sources.

5.3) Strictly enforce the law by government agencies related to the production and import of solar cells, sales of waste and parts of solar cells after the end of their use. Since these businesses create significant sources of pollution, the duties of producers, consumers and government agencies are as follows:

5.3.1) Producers

(1) are required to accept back solar cell waste and parts that are their products sold or imported for recycling (Recycle) to be reused. For parts that cannot be recycled (Recycle), they must be destroyed.

(2) Producers must set up a center to accept back solar cell waste and parts after use.

(3) Producers set recycling fees (Recycle) and keep a list of solar cell waste and parts after use in their possession, informing relevant government agencies.

5.3.2) Consumers

(1) are responsible for the disposal fee of solar cell waste and parts after use.

(2) Return solar cell waste and parts after use to the return center or specified location.

5.3.3) Government sector

(1) Consider and issue licenses to businesses that recycle solar cell waste and parts after use.

(2) Determine the procedures, formats and methods for issuing licenses to recycling operators.

5.4) There should be a law to control solar cell waste and parts after use (including batteries). and electric batteries) when the expiration date has passed, they must not be used and must be sent to a collection center for recycling.

5 . 5) There should be a law that only authorized operators can operate a recycling business. Authorized operators are not allowed to operate. Authorized operators have the following duties:

(1) Create a record of the collection and disposal of solar cell waste and parts after use.

(2) Create a tax system for the recycling of solar cell waste and parts after use.

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