

Proposal on Solid Waste Recycling Promotion Policy in Case of Coal-fired Thermal Power Industry in Vietnam

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Abstract: The waste recycling in general, and the solid waste recycling in particular are the sectors that are encouraged to develop by the Party and State of Vietnam, reflecting upon the legal environmental policies, guidelines and policies, for nearly 15 years. At this moment, Vietnam has 21 coal-fired thermal power plants in operation, the solid waste recycling demand is very high and necessary. In recent time, the coal-fired thermal power plants under Vietnam Electricity Group (EVN) already tried all the bests in re-use of ash, slag, but the result is still limited, urging the State to create a legal corridor by promulgating the policies to push this activity.

In this article, the author wants to assert that in Vietnam, the current policy system to promote the recycling of solid waste from coal-fired thermal power has been issued, but there are still some shortcomings in the development process. Therefore, it is necessary to have a more complete system of State policies to further promote solid waste recycling activities of coal-fired power plants in Vietnam in the coming time.

Key words: waste; coal-fired thermal power; coal-fired thermal power plant; waste recycling; solid waste recycling; adobe building materials

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1. Necessity of the State Policy System to Promote Solid Waste Recycling of Coal-fired Thermal Power Plants in Vietnam

For many years, coal-fired thermal power plants in Vietnam have not been evaluated very positively when it is always considered as a polluting crime. The process of burning coal to operate thermal power plants discharging combustion products include: Bottom ash (bottom slag), also known as slag, is the coarse, large particles collected at the bottom of the furnace; Fly ash (which is the fine fly ash grains collected at the dust filter); Gypsum (a product of SO₂ removal in burning). Typically fly the ash amount accounts for about 80%-90%, while coal slag accounts for about 10%-20%, the remaining small amount is gypsum. Vietnam currently has 21 coal-fired thermal power plants in operation, of which 07 plants apply the circulating fluidized bed technology (CFB) using low quality domestic coal (dust coal 6), 14 factories apply the pulverized coal technology (PC) using better quality domestic coal (dust coal 5), imported bituminous and sub-bituminous coal with a total capacity of about 14,310 MW.

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No.	Name of plants	Capacity (MW)	Type of boiler
1	Mong Duong I	1,080	CFB
2	Mong Duong II (BOT)	1,240	PC
3	Cam Pha I, II	660	CFB
4	Quang Ninh I, II	1,200	PC
5	Uong Bi extension I, II	630	PC
6	Mao Khe	440	CFB
7	Hai Phong I, II	1,200	PC
8	Cao Ngan	100	CFB
9	Son Dong	220	CFB
10	An Khanh I	110	CFB
11	Na Duong I	110	CFB
12	Pha Lai I, II	1,040	PC
13	Ninh Binh	100	PC
14	Nghi Son I	600	PC
15	Vung Ang I	1,200	PC
16	Nong Son	30	CFB
17	Vinh Tan II	1,200	PC
18	Formosa Dong Nai	450	PC
19	Duyen Hai I	1,200	PC
20	Formosa Ha Tinh	300	PC
21	Duyen Hai III	1,200	PC

Fable 1	List of	Coal-fired	Thermal	Power	Plants in	Vietnam

Source: Report at the coal-fired thermal power development seminar and environmental protection solutions in Vietnam.

According to the actual survey data and units' reports, the total amount of consumed ash, slag and gypsum was not large (only about 25-30%) compared to the total annual discharged amount and was unevenly distributed for each factory. There are some factories that sell out the amount of discharged slag, fly ash and gypsum, while some factories have to discharge all ash, slag and gypsum to the dump that are not purchased and processed further.

 Table 2
 Quantity of Thermal Power Ash, Slag in 2018 and Estimated to 2030 of Vietnam

No.	Year	Total annual amount of thermal power discharged ash, slag (ton/year)	Total amount of thermal power ash, slag that are not reused (ton)
1	2018	20,612,500	61,515,750
2	2020	25,441,770	109,983,500
3	2025	29,371,100	248,978,800
4	2030	38,314,500	422,663,000

Source: EVN

Most of this ash and slag amount is transported to the dump, not used for long-term, this will adversely affect the soil, water and air environment.

1.1 Impact on Soil Environment

With the on-going significant amount of ash and slag discharged from coal-fired thermal power plants, hundreds of hectares of land are designated to be used as dump yards. Coal-fired thermal power projects are

planning ash and slag with dump-site's sizes and areas depending on the area from 4 to 40 hectares. This proves that the amount of ash and slag increases more and more. Currently, the total land area of coal slag and ash dumpsites accounts for nearly 709 hectares, expected after 2020 when the plants come into operation, the total designed dumpsite areas will be 1,895 hectares.

1.2 Impact on Water Environment

The majority of ash and slag wastes from thermal power plant are still stored, not used for a long time and stored openly so rainwater can dissolve the components in ash, slag and mix into the natural water system of the area around the plants' dumpsites. Coal ash and slag contain mainly components such as Alumina, Silica, Ca and Sulfide and heavy metals. Pollution of surface and groundwater may be caused by extraction (dissolution) of toxic elements and heavy metals such as maintenance, mercury, cadmium, copper and tin in ash and slag, if they are not properly stored. Studies have shown that dissolved lead (washed away) from stored ash and slag may cause a risk to the human health.

Increased use of low NOx combustion technology in coal-fired thermal power plants has led to an increase in the concentration of ammonium in ash and slag. The amount of ammonium leached from the storage of ash and slag will be converted into nitrate that can move into the groundwater, causing water pollution

1.3 Impact on Air Environment

Fly ash is a fine-grained material, normally distributed in particle size from 0.5 to 300 Micrometers. The toxic elements, gathered in fine particles with a particle size of 2 micrometers, can be inhaled and stored in the bronchus of the humans and animals, thereby it increases the risk of health damage. For dry landfills, the amount of released fly ash can contaminate the surrounding air quality. People who live nearby thermal power plants, which have ash and slag storage areas, will be at higher risks of toxic dust contamination in the air.

Facing this situation, the State needs to get involved in overcoming the consequences caused by ash and slag wastes by promulgating and implementing the policies from the collection of wastes for recycling to production and consumption of recycled products.

2. Analysis of Vietnam's Current System of Policies to Promote Solid Waste Recycling in Coal-fired Thermal Power Industry

2.1 System of 1 Uncles Related to the General Sond Waste Recycling Industry Developing	2.1	18	System	of	Policies	s Relate	d to	the	General	l Solid	Waste	Recv	vcling	Industr	v Develo	pmei
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	Items	Outstanding policies
1	Build the criteria for the recycling activity	"National strategy on general management of solid wastes to 2025, with vision to 2050" (2009) and Decision No. 419/QD-TTg of the Prime Minister dated May 7th, 2018 on "Approving the adjusted National strategy on general management of solid wastes to 2025, with vision to 2050". On September 25th, 2012, the Prime Minister promulgated the decision No. 1393/QD-TTg on green growth strategy Decision No. 432/QD-TTg dated April 12th, 2012 approving the subtainable development strategy for 2011-2020 Decision No. 403/QD-TTg dated March 20th, 2014 approving the National action plan on green growth for 2014-2020
2	Create the input material sources to the solid waste recycling industry	
2.1	Regulation on classification of solid wastes	- Law on environmental protection 2005, 2014;

Table 3 List of Policies to Promote the Solid Waste Recycling Activity in Vietnam

Proposal on Solid Waste Recycling Promotion Policy in Case of Coal-fired Thermal Power Industry in Vietnam

	at the source	- Decrees for periods (Decree No. 59/2007/ND-CP; Decree No. 38/2015/ND-CP)
2.2	Regulation on recovery of product packaging (made of carton, glass, metal)	Not clear
2.3	Regulation on recovery, treatment of discarded products	Decision No. 50/2013/QD-TTg and Decision No. 16/2015/QD-TTg (Regulation on recovery, treatment of discarded products).
3	Support policies for the recycling activity	
		- National strategy on general management of solid wastes to 2025, with vision to 2050.
3.1	Preferential policies: production surface, taxes, infrastructures, loan, technology	- Decrees: Decree No. 04/2009/ND-CP on incentives, supports for the environmental protection activity; Decree No. 19/2015/ND-CP dated February 14th, 2015 detailing the implementation of a number of articles of the Law on environmental protection 2014.
		- Circular No. 121/TT-BTC providing the guidelines on incentive mechanism and financial assistance for the SOLID WASTE management investment activity
3.2	Waste recycling quality control policies	Circular No. 41/2013/TT – BTNMT dated December 2nd, 2013 specifying the ecological label certification order, procedures for the environmental friendly products (Circular No. 41/2013/TT-BTNMT)
4	Product consumption support policies	
4.1	Manufacturer support polcies to increase the product competitiveness	- Decrees: Decree No. 04/2009/ND-CP on incentives, supports for the environmental protection activity; Decree No. 19/2015/ND-CP dated February 14th, 2015 detailing the implementation of a number of articles of the Law on environmental protection 2014
4.2	Incentive/compulsory policies for the consumers to use the recycled products	- Decrees: Decree No. 04/2009/ND-CP on incentives, supports for the environmental protection activity; Decree No. 19/2015/ND-CP dated February 14th, 2015 detailing the implementation of a number of articles of the Law on environmental protection 2014

Source: Summary of author and team of research.

2.1.1 Formation of Criteria

The contents of recycling activities are mostly shown in the Decision No. 419/QD-TTg of the Prime Minister dated May 7th, 2018 on "Approving the adjusted National strategy on general management of solid wastes to 2025, with vision to 2050". The recycling criteria are specified to each type of solid waste, such as volume of recycled, reused domestic solid waste, energy recovered or used to manufacture organic fertilizer from 60% in 2015, 85% in 2020 and 90% in 2025 of collected solid wastes. It can be seen that these are very high indicators, showing the manager's wishes for the solid waste recycling.

However, the reality shows that these indicators are not feasible. According to Vietnamese environmental status report, in urban areas, the recycling rate is only at 12-20% of the collected solid waste amount and it is mainly spontaneous recycling activities, for the economic purpose of a part of the population concentrated mainly in craft villages. Besides, in recent years, many provinces have invested in building organic fertilizer factories from solid wastes such as Hanoi, Hai Phong, Nam Dinh, Ha Tinh, Ho Chi Minh... but so far the operation efficiency of some of these factories is not high, they still maintain a moderate operation such as Cau Dien organic fertilizer factory, Hanoi.

2.1.2 Creation of Input Material Source for the Recycling Activity

Regulation on solid wastes assortment at the source: The solid waste assortment is an important activity to create a stable source of raw materials for the solid waste recycling industry. Vietnam has soon issued the policy on implementation of this task, reflected in the Law on Environmental Protection 2005 and 2014. The regulation on classification of specific solid wastes and responsibilities of dischargers, state management agencies in charge of solid waste classification at the source are all specifically guided in the Decree 59/2007/ND-CP issued in 2007

and Decree No. 38/2015/ND-CP. However, according to the Vietnamese Environmental Status Report (2011), in practice, the classification is only done relatively well for medical wastes (especially in large hospitals), wastes from industrial activities (in industrial zones). Particularly for the domestic solid wastes, accounting for the largest proportion of total solid wastes, no locality has officially implemented this activity. In addition, the sanctions to limit the solid waste non-classification at the source have not been issued, this is an important solution for this successful activity and has been implemented by many countries around the world.

Regulation on recovery, treatment of waste products: In 2013, the Decision No. 50/2013/QD-TTg was issued by the Prime Minister regulating the recovery and treatment of some waste products, of which the recovery shall be implemented from January 2015. The decision has clearly stated the name of product to be recovered, but some issues are still unclear such as: provisions on shelf life for each type of products; recovery methods for used products as well as sanctions for implemented and the process has been delayed to July 2016 according to the Decision No. 16/2015/QD-TTg. According to this Decision, the recovery method of products has been stipulated more clearly and flexibly with the participation of all manufacturers, service providers and service users. However, an important issue is that the financial policies to implement this activity such as: sanctions for manufacturers, financial incentives for users... have not been mentioned. The experiences from the world show that it is necessary to develop these policies, so the used product recovery plan can be feasible.

2.1.3 Recycling Activity Support

The policies on recycling activity support including: land, tax, loan policies... are stipulated quite specifically in the National strategy on general management of solid wastes to 2025, with vision to 2050; Decrees No.: 04/2009/ND-CP; 17/2015/ND-CP and concretized in the Circular No. 121/TT-BTC guiding preferential mechanisms and financial support for investment activities for solid waste management. It is interested to note that recycling activity is not as much encouraged as waste treatment activities, including: burning (without energy recovery) and burying. These differences are reflected in the site clearance and compensation, investment capital mobilization and in fact in localities such as Hanoi, the solid waste burying activities are being paid entirely by the state budget, but the recycling activities are not entitled to this incentive (except for the production of organic fertilizer from solid waste)

2.1.4 Recycled Product Support

The recycled product price and consumption support is two issues that were reflected very early in the Decree 04/2009/ND-CP and continue to be mentioned in the Decree 19/2015/ND-CP.

- For price support: If the Decree No. 04/2009/ND-CP stipulates that the recycled products are supported by the State for the price in the principle of ensuring the revenue source to compensate fully the cost plus reasonable interest rate, and the Decree 19/2015/ND-CP stipulates more strictly, if the products meet the criteria for the public products and services, they will be supported for the price as specified by the law on production and supply of public products and services. With the new regulation, the number of supported recycled products will be decreased in comparison to the last time.
- For product consumption support: According to the Decree No. 04/2009/ND-CP, the State encourages the state agencies to use the products if they meet standards and are subject to their procurement. This "incentive" is not mandatory, so it is not feasible if the State agencies are not really interested in promoting the environmental protection activities. This content has been mentioned more clearly in the Decree 19/2015/ND-CP. According to this Decree, the heads of agencies and units using the state budget

shall prioritize the public procurement of products from recycling activities in purchasing such types of products and the organizations and individuals are priority to buy the eco-friendly products under the guidance of the Ministry of Natural Resources and Environment.

On the other hand, although the Decree also clearly states that the Ministry of Finance is assigned to lead and coordinate with the Ministry of Natural Resources and Environment to provide the specific guidances on conditions of price support, price support level and price support time for the products from the environmental protection activities, including recycled products. However, until the end of 2018, there have been no specific instructions on price support of the ministries and this policy has not been implemented in practice. In fact, the product consumption activity has not been effective.

	Items	Implementation results
1	Build the criteria for the recycling activity	Such criteria havent' been implemented in accordance with the routemap identified in the strategies
2	Create the input material source for the solid waste recycling industry	
2.1	Regulation on classification of solid wastes at the source	Only the classifition of medical solid wastes and a part of industrial solid wastes is carried out; the classification of domestic solid wastes hasn't been officially made, only at the pilot in some wards, communes of provinces, cities such as Hanoi, Ho Chi Minh City.
2.2	Regulation on recovery of product packaging (made of carton, glass, metal)	It hasn't been implemented
2.3	Regulation on recovery, treatment of discarded products	According to the Decision No. 50/2013/QD-TTg, some products are specified to be recovered from January 2015, and this was delayed to July 2016 according to the Decision No. 16/2015/QD-TTg. In reality, the recovery of discarded products hasn't been carried out in almost sectors, fields
3	Support policies for the recycling activity	
3.1	Preferential policies: production surface, taxes, infrastructures, loan, technology.	At present, organic fertilizer factories that were established in many provinces, cities are entitled to incentives, supports on clean land, capital, technology. Such factories are subject the the state management. Some enterprises have obtained the preferential loan from the local environmental fund.
3.2	Waste recycling quality control policies	It hasn't been carried out
4	Product consumption support policies	
4.1	Manufacturer support polcies to increase the product competitiveness	It hasn't been carried out
4.2	Incentive/compulsory policies for the consumers to use the recycled products	It hasn't been carried out

Table 4 Result on Implementing the Policies for the Solid Waste Recycling Industry Development

Source: Summary of author and team of research.

2.2 Policy System Related to the Coal-fired Thermal Power Solid Waste Recycling

No.	Document form	Document name
1	Law	Law on economic and effective energy use issued in 2010: As specified in Point 6, Article 15, it is mentioned "Use energy-saving building materials, adobe materials, installation of equipment using solar energy, biogas in construction works." Law on Science and Technology 2013: According to Articles 64 and 65, it is specified to enjoy the preferential policies on tax and credit;
		Investment Law 2014: Entitled to the preferential investment policies as specified in clause 1 Article 15 and obtain the investment support as specified in clause 1 Article 19;

 Table 5
 List of Coal-fired Thermal Power Solid Waste Recycling Policies

		Construction Law 2014: At Article 110: Requirement on use of building materials; Item 4, Article 111; Point e, Item 2, Article 113; Point b, Item 2, Article 120 specifying the use of building materials including adobe building materials.
		Decree No. 118/2015/ND-CP dated November 12th, 2014 of the Government detailing and guiding the implementation of a number of articles of the Investment Law No. 67/2014/QH13 dated November 26th, 2014, of which in Clause 1, Article 16, it is specified: "Beneficiaries of investment incentives as stipulated in Clause 2 Article 15 and Article 16 of the Investment Law;
2	D	Decree No. 46/2014/ND-CP dated May 15th, 2014 specifying the law on land, surface water rental. Whereby, the land rental exemption incentive is for the investment projects
2	Decree	Decree No. 218/2013/ND-CP dated December 26th, 2013 of the Government detailing and guiding the implementation of the Law on corporate income tax
		Decree No. 91/2014/ND-CP dated October 1st, 2014 of the Government amending, supplementing a number of articles in the decrees specifying taxes;
		Decree No. 24a/2016/ND-CP dated April 05 th , 2016 of the Government on management of building materials. Of which the Chapter V gives the policies to encourage developing the new environmental friendly materials including adobe building materials
		Decision No. 1696/QD-TTg dated September 23rd, 2014 on several solutions for treatment of ash, slga, gypsum of thermal power plants, fertilizer chemical plants as raw materials to make building materials:
3	Decision and Directive	Decision No. 1469/QD-TTg dated August 22nd, 2014 approving the master building materials development planning to 2020 and with orientation to 2030;
		Decision No. 452/QD-TTg dated April 12th, 2017 approving the project on treatment promotion of ash, slag, gypsum in thermal power, chemical plants as raw materials to make building materials and construction works
		Directive No. 10/CT-TTg dated April 16th, 2012 increasing the use of adobe building materials, limiting the production and use of burnt clay bricks
		 Ministry of Construction Circular No. 13/2017-TT-BXD dated December 8th, 2017 of the Ministry of Construction specifying the use of adobe building materials in construction works instead of the Circular No. 09; Circular No. 10/2017/TT-BXD dated September 29th, 2017 promulgating the National technical regulation on products, goods of building materials and guidelines for certificate of conformity and declaration of conformity. The draft Decision on promulgation of construction rate using adobe building materials is completed, separately in one volume to supplement 156 rates in the list of issued 163 rates for all adobe building materials that have been launched to the market at this time.
		Ministry of Industry and Trade - Circular No. 46/2012/TT-BCT dated December 28th, 2012 promulgating the regulation on non-use of annual industrial promotion capital for training, deploying the model in burnt clay brick factories, instead, it will support the development of adobe building materials.
4		 Ministry of Finance Circular No. 78/2014/TT-BTC dated June 18th, 2014 of the Ministry of Finance guiding the implementation of the Decree No. 218/2013/ND-CP dated December 26th, 2013 of the Government specifying and guiding the implementation of the Law on corporate income tax; Circular No. 83/2016/TT-BTC dated June 17th, 2016 of the Ministry of Finance guiding the implementation of investment incentives as specified by the Investment Law and Decree No. 118/2015/ND-CP dated November 12th, 2015 of the Government detailing and guiding the implementation of a number of articles of the Investment Law; For order, procedures to enjoy the investment incentives on land rental: Follow the Circular No. 77/2014/TT-BTC dated June 16th, 2014 of the Ministry of Finance guiding a number of articles of the Decree No. 46/2014/ND-CP dated May 15th, 2014 of the Government specifying the collection of land rental, surface water rental. Ministry of Natural Resources and Environment
		- Circular No. 36/2015/TT-BTNMT dated June 30th, 2015 of the Minister of Natural Resources and Environment

Source: Summary of author and team of research.

Referring to the specific policies on solid waste recycle in the coal-fired thermal power industry, there are two decisions of the Prime Minister: Decision No. 1696/QD-TTg dated September 23rd, 2014 of the Prime

Minister on a number of solutions to treat and use ash, slag and gypsum of thermal power plants, fertilizer chemical factories as raw materials for production of building materials mentioned with the contents of waste treatment of thermal power plants and the Decision No. 452/QD-TTg dated April 12th, 2017, approving the "Scheme on promoting the treatment and use of ash, slag and gypsum of thermal power plants and chemical, fertilizer factories as raw materials for building materials production and used in construction works". It can be seen clearly that, the Decision No. 452/QD-TTg dated April 12th, 2017 is a more specific step and supports the Decision No. 1696/QD-TTg dated September 23rd, 2014.

2.2.1 For Support on Creation of Input Material Source

In both such decisions, all elements that create the input materials for the coal-fire waste recycling industry are fully addressed through the following goals: "For the thermal power plants, chemical factories that are in operation or have an investment decision, must have a plan for construction investment (or investment cooperation) for the ash, slag and gypsum treatment equipment line ensuring the standards and technical regulations as raw materials for the production of building materials and put into operation before 2020"; "For newly invested, expanded or renovated thermal power and fertilizer chemical plants, in approving the project, it must include complete ash, slag and gypsum treatment equipment line ensuring the technical standards and regulations as building materials". These goals open to the waste recycling industry of thermal power plants a huge source of high quality materials

In addition, in the Decision 452/QD-TTg, it also specifies the detailed targets for coal-fired thermal power waste treatment as follows: "By 2020, the treatment and use of ash, slag, FGD gypsum, PG gypsum as raw materials for production of building materials and used in construction works is about 52% of total cumulative amount (about 75 million tons, including: 56 million tons of thermal power ash, slag, 2.5 million tons of FGD gypsum, 16.5 million tons of PG gypsum PG)", besides, there are specific goals: "For thermal power ash, slag: as additives for cement production of about 14 million tons, replacing a part of clay to produce cement clinker about 8 million tons; partially replace clay to produce baked clay bricks of around 7 million tons; as mineral additives for the production of adobe concrete and bricks of around 2 million tons; to make materials for leveling works of mine rehabilitation and construction of traffic roads of 25 million tons".

These are the very great, specific goals in creating a development orientation for the solid waste recycling in the coal-fired thermal power industry in the future.

2.2.2 For Recycling Activity Support

In the Decision No. 1696/QD-TTg dated September 23rd, 2014 of the Prime Minister, there were solutions to support recycling activities such as: "Promotion on research, innovation of science and technique, technology for treating ash, slag and gypsum for thermal power plants, fertilizer chemical factories"; "the ash, slag and gypsum treatment and use of finished products as building materials are supported and given incentives like solid waste treatment (recycling, reuse) as specified by the current regulations on solid waste management". It can be seen that the support solutions in this decision are unclear and there is no specific mechanism for supporting the recycling activities of thermal power plants in Vietnam.

For the Decision No. 452/QD-TTg, this incentive is also mentioned in the section of opinion: "The State creates favorable conditions for the organizations and individuals to take part in treatment; use of ash, slag, FGD gypsum, PG gypsum as raw materials for production of building materials and use in construction works." However, by defining such tasks and solutions to promote this treatment: "Finalize the legal documents, standards and technical regulations", the Decision 452/QD-TTg is right on solving the long-standing problems on specifying

the product quality. This will be a bottleneck to solve the amount of solid wastes in the coal-fired thermal power industry in the future.

However, because coal-fired solid waste recycled products are unburnt building materials, they are more or less entitled to the preferential policies from the related policies as in the Decree 118/2015/ND-CP dated November 12th, 2014 of the Government detailing and guiding the implementation of a number of articles of the Investment Law No. 67/2014/QH13 dated November 26th, 2014, of which in Clause 1, Article 16 it is stated that: "The beneficiaries entitled to the investment incentives are specified in Clause 2, Article 15 and Article 16 of the Investment Law; Decree No. 46/2014/ND-CP dated May 15th, 2014 providing the legal regulations on land rental and water surface rental. Accordingly, the preferential land rental exemption is given to the investment projects... There are many differences between enterprises that produce purely unburnt building materials and enterprises that recycle waste ash and slag in thermal power plants.

2.2.3 For Product Consumption Support

In the Decision 1696/QD-TTg, the consumption of recycled products for the thermal power plants is not mentioned, this is a huge omission. As for the Decision No. 452/QD-TTg, the outputs for products are also mentioned through the viewpoint on treatment; use of ash, slag, gypsum: "Prioritize the use of ash, slag, FGD gypsum, PG gypsum that meet the standards, technical regulations and technical instructions as raw materials for the production of building materials and in construction works (civil, industrial, transportation, agriculture and rural development, mine reconstruction ...)". In the duties and solutions section, this view is not mentioned at all.

However, as the coal and ash slag recycled products of coal plants are also unburnt building materials, they are also mentioned in the Directive No. 10/CT-TTg dated April 16th, 2012 on increasing the use of adobe building materials, limiting the production and use of burnt clay bricks and Circular No. 13/2017-TT-BXD dated December 8th, 2017 of the Ministry of Construction stipulating the use of unburnt building materials in construction works instead of the Circular No. 09, these are the policies to support the creation of markets for the building materials, in such documents, it stipulates the rate of unburnt construction materials in the construction of works with public investment and separate constructions and the adobe building materials from recycling of ash and slag are not mentioned separately to the unburnt building materials from minerals.

No.	Items	Outstanding policy documents	Implementation result
1	Create the input material source for the solid waste recycling industry	Decision No. 1696/QD-TTg dated September 23rd, 2014 of the Prime Minister on several solutions for treatment, use of ash, slag, gypsum of thermal power, fertilizer chemical plants as raw materials for production of building materials. Decision No. 454/QD-TTg dated April 12th, 2017 of the Prime Minister approving "the project on treatment promotion of ash, slag, gypsum in thermal power, chemical, fertilizer plants as raw materials to make building materials and construction works".	The coal-fired thermal power plants were active in investing the technology to separate the solid waste components in creating favorable conditions for the future recycling
2	Support policies for the recycling activity	Decree No. 118/2015/ND-CP dated November 12th, 2014 of the Government detailing and guiding the implementation of a number of articles of the Investment Law No. 67/2014/QH13 dated November 26th, 2014, of which in Clause 1, Article 16 it is specified that: "The beneficiaries entitled to the investment incentives are as stipulated in Clause	In fact, the enterprises that operate in recycling of ash, slag are very difficult to access such incentives in the policies because of very hard procedures.

Table 6	Result on Implementing the Support Policies For Production and Consumption of Products Recycled From Ash,
	Slags of Coal-fired Thermal Power Plants in Vietnam

		2 Article 15 and Article 16 of the Investment Law; Decree No. 46/2014/ND-CP dated May 15th, 2014 providing the legal regulations on land rental, water surface rental. Accordingly, the land rental exemption incentive is given to the investment projects	
3	Product consumption support policies	Directive No. 10/CT-TTg dated April 16th, 2012 increasing the use of adobe building materials, limiting the production and use of burnt clay bricks and Circular No. 13/2017-TT-BXD dated December 8th, 2017 of the Ministry of Construction specifying the use of adobe building materials in construction works instead of the Circular No. 09.	In the first step, it creates the market for adobe building materials, however it is no bindings to adobe building materials from waste ash, slag.

Source: Summary of author and team of research.

In addition to the support policies, in recent years, ash and slag of thermal power plants have been strictly controlled by a number of state policies, this causes difficulties in consumption, including two main policies, Circular No. 36/2015/TT-BTNMT dated June 30th, 2015 of the Minister of Natural Resources and Environment, in the appendix, it lists the coal-fired industry wastes as a list of hazardous wastes but it is not confirmed that all ash and slag of coal-fired power plants are hazardous, the introduction of "Fly ash and oiled boiler dusts; Fly ash from the use of emulsion hydrocarbon fuel" into the detailed list of hazardous and potentially hazardous wastes also makes many difficulties for the consumption.

Further, in Article 31 of the Decree 38/2015/ND-CP dated April 24th, 2015 on waste and scrap management, it only refers to "Hazardous waste treatment owners who have been issued the hazardous waste treatment licenses are allowed to collect and transport ordinary industrial solid wastes", does not to mention that the ordinary transport units that can participate in transport of ash and slag. This regulation makes the highly increased ash and slag transportation cost from coal-fired thermal power plants to the production units, in leading to the reluctance of manufacturing enterprises to invest in the production of building materials from waste ash and slag.

3. General Assessment of Vietnam's Current Policy System to Promote Recycling of Solid Waste From Coal-fired Thermal Power Industry

3.1 Assessment on Policy System Related to the Recycling Industry Development in General

- The feasibility of some policies is not high;
- Lack of some important policies to provide a comprehensive support for the production steps in the recycling activity;
- The frame policy implementation guiding documents haven't been set up fully and on time.

3.2 Assessment on Policy System Related to the Coal-fired Thermal Power Industry Solid Waste Recycling

- The waste treatment activity is more focused on than recycling, re-use;
- It needs specific policies to support the production and consumption of recycled products from waste ash, slag of thermal power plants.

4. Proposal of Policy Solutions to Promote Solid Waste Recycling in Coal-fired Thermal Power Industry in Vietnam

4.1 Group of Solutions, Policies Oriented to the Recycled Product Manufacturing Development

4.1.1 Policies on Limitation of Using Production Land for the Purpose of Storage of Wastes From Thermal Power Plants

It is required to specify that each factory will have a waste storage area with an area suitable to the scale of power generation capacity. The restriction of land use for the dump will motivate the emission unit to seek partners as well as methods for treatment of ash and slag. Currently, in the Decision 1969/QD-TTg and Decision 452/QD-TTg, it mentions the regulations on limited landfills (ensuring the ash and slag storage capacity of thermal power plants for 2 years), however, in fact, the dumping sites of operating thermal power plants have exceeded the specified capacity. Therefore, it is necessary to develop the sanctions imposed on the units that do not strictly comply with the above regulations, from here, it will press the emission unit to actively seek their waste users

4.1.2 Policies on Supporting the Coal-fired Thermal Power Industry Waste Recycling Technology

The State encourages to place order with independent research units that study the ash, slag, gypsum use, recycling technology according to the criteria: economic, environmental, modern.

Encourage, support to provide the information to the local ash, slag recycling units to seek the technology suppliers in the developed countries.

Assist the local and foreign technology transfer procedures.

In the first time, it needs to issue the tax preferential policies related to investment in technology and equipment for the manufacturers that make the recycled products from ash, slag, gypsum.

4.1.3 Policies on Certifying the Product Quality, Policies on Recognizing the Green Product Standard

Currently, recycled products are also received carefully by the consumers for the safety, so the government needs to establish the standards and regulations related to recycled products. That will be the basis for recognition of eco-green labeled products, from which to have appropriate support policies. It is necessary to give the separate quality assessment guidelines for the recycled products

4.1.4 Consideration to Remove Ash, Slag, Gypsum of Coal-Fired Thermal Power Plants From the List of Hazardous Wastes

By many studies and practical results, it can now be confirmed that the ash and slag of coal-fired thermal power plants are not a source of hazardous waste, but also a valuable source of raw materials for the production of building materials. Therefore, it is necessary to conduct the thorough studies to consider removing ash, slag and gypsum of coal-fired thermal power plants from the list of hazardous wastes in the the appendix of the Circular No. 36/2015/TT- BTNMT dated June 30the, 2015 of the Minister of Natural Resources and Environment

4.2 Group of Solutions, Policies Oriented to the Support, Promotion of Recycled Product Consumption

4.2.1 Policies on Support for Propaganda, Supply of Information About the Meaning of Using Recycled Products

Firstly: People tend to trust the government agencies. So the Government agencies should promulgate the regulations on developing and implementing a broad, effective and meaningful propaganda program for the use of recycled products. Have the strict regulations on quality control, official legal framework set-up for recycled

products, protection of the consumer's rights. Only when the Government propagates and ensures the quality of recycled products, then the consumers have a safe mentality in consuming recycled products. This is also a policy that meets the needs of ensuring safety in consumption of products.

Secondly: Raise the people's awareness through mass media, packaging, websites, using positive images from famous persons. Launch the movements, action months, special days such as program on the use of recycled products and improvement of the way to identify recycled products with products using traditional materials so that the consumption of recycled products becomes closer to the consumers. Encourage people to use recycled products, save and protect resources, etc... Create favorable conditions for the enterprises that make recyclable products to organize the community connection events, thereby provide many useful information and bring the ways to approach largely the recycled products for the consumers

4.2.2 Policies on Recycled Product Market Development

In order to create a market for the recycled products, the policy on using recycled products through public procurement is also a policy that contributes to bring the recycled products closer to the consumers. For recycled products from wastes of the coal-fired thermal power industry, the application of consumption solutions through public procurement is very appropriate. Currently, the urbanization process takes place in most localities across the country, just the policies require that the construction of public works in urban areas must use unburnt building materials made from recycled products that meet the requirements, this will also create an enough large market to attract the investors involved in the production of recycled products

Even the Directive No. 10/CT-TTg dated April 16th, 2012 specifies "increasing the use of unburnt building materials, limiting the production and use of burnt clay bricks", however, it is necessary to promulgate the sanctions imposed on the units that fail to comply with this, thereby it improves the effectiveness of policies

4.2.3 Preferential Policies for the Products Entering the Market

The Government needs to issue the specific policies and programs to support the enterprises with recycled products to ensure the quality contact with the market. These programs and policies can be developed through exemption/support for recycled products in participating in relevant exhibitions (specifically, exemption for building materials produced from ash, slag of thermal power plants in participating in exhibitions for building products such as Vietbuild...). Besides, it is necessary to develop the policies that State functional units ensure the quality and safety of products after the quality test. This program can be implemented in a certain period of time when the enterprises bring their products to the market.

4.2.4 Policies on Limitation of Products of the Same Type Made of Natural Materials

The use of recycled products not only focuses on economic efficiency but is also concerned by the social benefits that it brings. For that reason, it is not possible to treat the recycled products under the purely market mechanism, but in order to develop it, it is necessary to have the policies to restrict the products of the same type made from natural materials appropriately. The restriction on products of the same type made from natural materials can be easily done by imposing the environmental tax on such products as well as providing the specific technical requirements

5. Conclusion

Vietnam's energy demand, especially for coal-fired thermal power, will keep on growing significantly in the coming period. According to the 7th revised electricity plan, by 2030, total coal-fired thermal power capacity will

be 55,252 MW, producing about 304 billion kWh, accounting for about 53.2% of the electricity produced, consuming about 129 million tons of coal and the estimated amount of coal ash and slag discharged from coal-fired power plants will be about 38,314,500 tons/year by 2030 and it will increase total amount of stored thermal power ash and slag (if not recycled) to 422,663,000 tons. Therefore, proposing the policy solutions to promote solid waste recycling in coal-fired thermal power industry in Vietnam is really necessary and meaningful, which not only creates motivation for the production but also contributes to promoting comprehensively the industry and economy towards the more sustainable orientation.

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