

THE PRIME MINISTER

**Decision No. 1546/QĐ-TTg of September 3, 2013,
approving the master plan on zoning of areas for
exploration, mining, processing and use of titanium ore
through 2020, with a vision toward 2030**

Pursuant to the December 25, 2001 Law on Organization of the Government;

Pursuant to November 17, 2010 Law No. 60/2010/QH12 on Minerals;

Pursuant to the Government's Decree No. 92/2006/ND-CP of September 7, 2006, on the elaboration, approval and management of socio-economic development master plans; and Decree No. 04/2008/ND-CP of January 11, 2008, amending and supplementing a number of articles of Decree No. 92/2006/ND-CP of September 7, 2006;

Pursuant to the Prime Minister's Decision No. 2427/QĐ-TTg of December 22, 2011, approving the Mineral Strategy through 2020, with a vision toward 2030;

At the proposal of the Minister of Industry and Trade in Report No. 2702/TTr-BCT of March 29, 2012, and Official Letter No. 6083/BCT-CNNg of July 10, 2013,

DECIDES:

Article 1. To approve the master plan on zoning of areas for exploration, mining, processing and use of titanium ore through 2020, with a vision toward 2030, with the following principal contents:

1. Development viewpoints

- The country has a large natural resource of titanium ore, which serves as a prerequisite and an important condition for building a modern titanium ore mining and processing industry to support the national socio-economic development along the line of industrialization and modernization and international integration.
- To build and develop a complete and sustainable industry of titanium ore mining and processing toward modernity, economical use of natural resources, economic-social-environmental benefits and social order and safety. Products of this industry must be deeply processed to meet domestic use and export demands.
- To develop the titanium ore mining and processing industry with a reasonable roadmap and scale in order to meet to the utmost requirements and objectives of the national economic development in each period; to

apply advanced technologies to ensure maximum recovery of useful elements in titanium ore and save energy; to develop the titanium industry in harmony with the infrastructure-service system (transportation, seaports, electricity and water supply, logistic and technical services, etc.); to step by step form technological complexes for mining, sorting and deep processing of titanium ore in association with support industries to serve the mining and processing industry, first of all in areas with large titanium ore deposits in Binh Thuan and Ninh Thuan provinces.

- To invest in developing the titanium ore mining and processing industry on the basis of mobilizing different resources at home and abroad. The investment cooperation with foreign countries aims mostly at acquiring advanced technologies in the field of deep processing and penetrating into the world market.

2. Development objectives

a/ General objectives

- By 2020: To form the titanium industry with deeply processed products being pigment

and porous titanium; to meet domestic demand for pigment; to export titanium slag, porous titanium and zirconium oxychloride salt products.

- By 2030: To develop the stable and sustainable titanium industry with large hi-tech titanium ore mining and processing centers in Binh Thuan; to concentrate on and prioritize the development of pigment, porous titanium, titanium metal and alloys to meet domestic and export demands.

b/ Specific objectives

-By 2015

- +To complete the exploration and assessment of reserves of titanium mines to be operated in the planning period, assuring reliable reserves for investment in titanium mining and processing projects.

- + To maintain production at a scale suitable to the actual use demand concurrently with reorganizing production at the existing titanium mines and titanium ore processing facilities; to renew and upgrade technologies, improve the recoverability of low-grade ore and ore tailings; to fully meet the domestic demand for zirconium powder and reconstituted ilmenite; to produce titanium slag and artificial rutile for use as materials for production of pigment and export.

- + To build and commission a number of plants processing titanium slag and artificial rutile in the four planning areas; to research technologies and prepare investment in projects to produce porous titanium and titanium metal in Binh Thuan province, produce pigment in Binh Dinh and Binh

Thuan provinces; to prepare investment in a large titanium ore mining and processing complex in Binh Thuan province.

- + To invest in, renovate and upgrade infrastructure (roads, electricity and water supply, etc.) synchronously with development of titanium mining and processing projects.

The forecast total processing output by 2015: 60,000 tons of reconstituted ilmenite per year; 945,000 tons of titanium slag per year; 60,000 tons of artificial rutile per year; and 152,000 tons of fine and superfine zirconium powder per year.

- During 2016-2020

- + To form the titanium ore mining and processing industry with main products of titanium slag, pigment, porous titanium/ titanium metal and a number of products from zirconium on the basis of maintaining the production and expanding existing processing facilities in combination with building deep- processing facilities to meet domestic and export demands.

- + To build and develop in Binh Thuan a large titanium ore mining and processing industry center with advanced technologies and main products being pigment and porous titanium to meet domestic and export demands.

The forecast total processing output by 2020: 60,000 tons of reconstituted ilmenite per year; 989,000 tons of titanium slag per year; 120,000 tons of artificial rutile per year; 194,000

tons of superfine zirconium powder per year; 240,000 tons of pigment per year; 20,000 tons of ferrous titanium per year; and 20,000 tons of porous titanium per year.

- During 2021-2030

- + To stably and sustainably develop the titanium industry, strengthening its position as a supplier of titanium products, pigment and porous titanium for the world market; to complete the building of a complete titanium ore mining and processing industry.

- + To fully meet the domestic demand for pigment, zirconium compounds, porous titanium and titanium metal and concurrently expand export markets.

The forecast total processing output by 2030: 60,000 tons of reconstituted ilmenite per year; 1,001,000 tons of titanium slag per year; 120,000 tons of artificial rutile per year; and 208,000 tons of superfine zirconium powder per year; 300,000 tons of pigment per year; 30,000 tons of ferrous titanium per year; and 20,000 tons of porous titanium per year.

3. Development planning

a/ Titanium ore resource

The estimated titanium ore deposit and resource is around 650 million tons of heavy minerals (including around 78 million tons of zirconium); the estimated deposit and resource in Binh Thuan area is around 599 million tons, accounting for around 92% of the total titanium ore deposit and resource in Vietnam, of which:

- The deposit and resource in areas where mineral activities are banned or restricted is around 210 million tons (including around 26 million tons of zirconium).
- The titanium ore deposit and resource which may be mobilized for mining is around 440 million tons (including around 52 million tons of zirconium).

In the planning period, it is expected to mine around 150 million tons of heavy minerals (including around 17 million tons of zirconium), the remaining deposit and resource will be included in the national reserves.

The detailed titanium deposit and resource volumes are provided in Appendix I to this Circular.

b/ Forecast domestic and export demands

- Forecast processing output

No.	Name of product	Forecast processing output (thousand tons)		
		2015	2020	2030
1	Titanium slag	945	989	1,001
2	Pig iron (Recovered from the stage of production of titanium slag)	535	561	569
3	Superfine zirconium powder and zirconium compounds	152	194	208
4	Artificial rutile	60	120	120
5	Reconstituted ilmenite	60	60	60
6	Pigment	0	240	300
7	Porous titanium/ titanium metal	0	20	20
8	Ferrous titanium	0	20	30

- Forecast domestic demand

No.	Name of product	Forecast domestic demand (thousand tons)		
		2015	2020	2030
1	Ilmenite pure ore	1,882	2,081	2,103
2	Titanium slag	120	312	390
3	Artificial rutile	20	30	60
4	Reconstituted ilmenite	20	30	60
5	Fine and superfine zirconium	20	30	40
6	Pigment TiO ₂	90	150	200

Note: The demand for ilmenite pure ore is determined according to the demand for materials for production of titanium slag, reconstituted ilmenite and artificial rutile. Other products (pig iron, zirconium, rutile, monazite, etc.) are byproducts obtained in the processes of sorting titanium ores and producing titanium slag.

- Forecast export volume

No.	Name of product	Forecast export volume (thousand tons)		
		2015	2020	2030
1	Titanium slag	825	677	611
2	Artificial rutile	40	90	60
3	Reconstituted ilmenite	40	30	0
4	Fine and superfine zirconium	132	164	168
5	Pigment	0	90	100
6	Porous titanium/ titanium metal	0	20	20
7	Ferrous titanium	0	20	30

c/ Planned zoning

Four titanium ore areas are zoned off to supply materials for processing facilities in conformity with technological characteristics of the ore, processing scale and output, specifically as follows:

- Region I: In Thai Nguyen area (original ore and ore placer).
- Region II: In Ha Tinh - Thua Thien Hue (ore placer in the grey sand layer).
- Region III: Quang Nam - Binh Dinh - Phu Yen (ore placer in the grey sand layer).
- Region IV: Ninh Thuan - Binh Thuan (ore placer in the grey and red sand layers).

d/ Planned exploration

-By 2015

+ To complete the exploration in the areas as unanimously agreed in Thai Nguyen, Quang Binh, Quang Tri, Binh Dinh, Ninh Thuan and Binh Thuan provinces in order to obtain a reliable deposit to meet the demand for materials for processing facilities.

+ To complete the exploration of titanium ore in the red sand layer in Luong Son in northern Binh Thuan province to serve large- scale mining and processing.

- During 2016 - 2020

Depending on the possible implementation of projects on mining combined with deep processing, to expand exploration in the vicinity of Luong Son (in northern Binh Thuan province) and areas having titanium in the red sand layer in Ninh Thuan province.

- After 2020

To explore remaining areas with titanium in the red sand layer.

Exploration schemes may be carried out when there are technically and economically feasible projects on mining and deep processing.

The forecast total deposit which is available or currently or already explored for mining in the planning period is around 150 million tons of heavy minerals (around 120 million tons of ilmenite pure ore).

The list of exploration projects in the planning period is provided in Appendix II to this Decision.

dd/ Planned titanium ore mining and processing

- Planned ore mining and sorting

+ By 2015: To mine largely titanium original ore (in Thai Nguyen area) and titanium placer in the grey sand layer (in all four areas). To concentrate on renovating, improving and upgrading sorting technology in order to raise the percentage of recovery of useful minerals and reduce the wastage of

water and electricity. To research technologies and proceed with preparations for mining titanium ore in Luong Son area (northern Binh Thuan).

- + During 2016-2020: To continue mining activities in the existing mines and start mining in mines already explored during the period from now through 2015 in Thai Nguyen, Ninh Thuan and Binh Thuan provinces. To invest in large-scale ore mining and sorting in Luong Son (northern Binh Thuan) with modern technologies.

- + After 2020: To maintain mining in mines which still have ore deposits. Depending on specific conditions (market, deep processing capability, capital raising capability, infrastructure conditions, etc.), to develop new projects.

- Ore mining and sorting technologies:

- + Titanium original ore in Thai Nguyen area: To be mined according to the following technological diagram: Drilling- blasting -> loading -> transportation -> crude ore sorting -> pure ore sorting (ilmenite and rutile pure ores).

- + Coastal titanium ore placer (in the grey and red sand layers): To be mined according to the following diagram: Breaking -> pumping - sucking -> crude ore sorting -> pure ore sorting (ilmenite, rutile, zirconium and monazite pure ores).

The list of titanium ore mining projects is provided in Appendix III to this Decision.

- Planned titanium processing

Planned region-based product processing is as follows:

- + Region I: To process largely titanium slag.

- + Region II: To process largely titanium slag and superfine zirconium.

- + Region III: To process largely titanium slag, reconstituted ilmenite, superfine zirconium and pigment.

- + Region IV: To build and develop a titanium industry center, to mine and process titanium on a large scale and with advanced technologies; processed products are planned to include titanium slag, superfine zirconium powder, zirconium oxychloride, pigment, porous titanium/titanium mineral and compounds.

New investment projects must adhere to the principle of investment in concentrated processing to assure scale and capacity economy and convenience for the application of advanced technologies and

environmental treatment. A processing facility may use materials from titanium mines both inside or outside the region.

Planned product processing is as follows:

- + By 2015: To produce largely titanium slag, reconstituted ilmenite and a number of by- products from zirconium (superfine zirconium, zirconium oxychloride), artificial rutile and welding powder, etc., to meet domestic and export demands. To research technologies and prepare investment in projects to produce pigment with a minimum capacity of 30,000 tons/year/plant, plans to produce ferrous titanium and porous titanium/titanium metal of up to 20,000 tons/year.
- + During 2016-2020: To increase the capacity of processing titanium for export and other products to meet the consumption demand. To invest in and commission 2-3 pigment plants (planned to be built in Binh Thuan, Binh Dinh and Ninh Thuan) and a porous titanium/titanium metal plant (to be built in Binh Thuan), and projects to produce alloys containing titanium, first of all ferrous titanium (in titanium slag, mechanical, metallurgical plants or plants built to produce ferrous titanium only).
- + After 2020: To maintain the production of porous titanium/titanium metal, titanium slag and reconstituted ilmenite. To increase pigment production capacity to meet domestic and export demands. Depending on specific conditions, by 2030, to raise the output of ferrous titanium to 30,000 tons/year.

The list of titanium processing projects in the planning period is provided in Appendix IV to this Decision.

e/ Conditions for titanium ore processing projects (new projects)

- Standards of processed products

Table 4

No	Name of processed product	Content						Granular size
		TiO ₂ (%)	FeO (%)	Fe (%)	ReO (%)	ZrO (%)	Ti (%)	(µm)
1	Titanium slag							
	- Grade 1	≥ 85	≤ 10					
	- Grade 2	≥ 70 < 85	≤ 10					
2	Reconstituted	≥ 56	≤ 9	≤ 27				

	ilmenite							
3	Artificial rutile or synthetic rutile	≥ 83						
4	Monazite pure ore				≥ 57			
5	Zirconium powder							
	- Grade 1 superfine					≥ 65		≤ 10
	- Grade 2 fine					≥ 65		$> 10 \leq 75$
6	Pigment TiO ₂							
	- Rutile	≥ 92.5						
	- Anatase	≥ 98						
7	Porous titanium, titanium metal						≥ 99	

- Processing capacity and technologies

+ Titanium slag:

- The minimum capacity of a plant must be 20,000 tons/year.
- The minimum capacity of a kiln must be 6,300 KVA, for semi-closed kilns with automatic capacity adjustment and dust control (for projects to renovate and increase capacity to at least 3,200 KVA).

+ Reconstituted ilmenite: The minimum capacity of a plant must be 20,000 tons/year.

+ Grinding superfine zirconium:

- The minimum capacity of a plant must be 5,000 tons/year.
- For new investment projects: The output of superfine zirconium (granular size $< 10 \mu\text{m}$) must account for at least 50% of the total output of the plant.

+ Artificial rutile: The minimum output of a plant must be 10,000 tons/year.

+ Pigment: To use chloride or sulfate technology determined during the formulation of investment projects, aiming to assure efficiency, satisfy the environmental standards and suite the characteristics of input materials. The minimum capacity of a plant must be 30,000 tons/year.

+ Porous titanium and titanium metal: The minimum capacity of a plant must be 10,000 tons/year.

g/ Planned transportation

Most titanium ore mining and processing areas lie along the coast (except region I - Thai Nguyen), so the existing technical infrastructure network in the regions may be used for transportation. For the transportation and export of processed titanium products in Binh Thuan area, it is planned to build a general seaport in Binh Thuan (for transportation of titanium products, processed bauxite ore and coal transshipment, etc.).

4. Investment capital

The total investment capital demand estimated for the planning period through 2030 is VND 43,956 billion (approximately USD 2,144 million), of which capital for exploration is VND 1,373 billion (approximately USD 67 million), capital for mining and processing is VND 40,634 billion (approximately 1,982 million), and capital for infrastructure is VND 1,948 billion (approximately 95 million).

Expected capital sources:

- Capital for ore exploration and infrastructure investment: From capital sources acquired by enterprises themselves.
- Capital for mining and processing: From capital sources acquired by enterprises themselves, domestic and foreign commercial loans, capital raised through the securities market, issuance of project bonds and other lawful capital sources.

The detailed investment capital demand is provided in Appendix V to this Decision.

5. Solutions, mechanisms and policies

a/ Solutions

- Regarding management of natural resources
 - + Developing a complete database using digital technology to serve the management of titanium ore sources nationwide.
 - + Stepping up the exploration in order to take the initiative in assessing reliable deposits for projects expected to be commissioned in each period, first of all in the period through 2020.
 - + Auctioning the mining right for the remaining titanium mines, largely those in the red sand layer.
- Regarding titanium ore mining and processing
 - + Mining titanium ore only to supply % materials for deep processing projects, suitable to their implementation progress, processing capacity and

capability to sell processed products. All titanium ore mining projects must restore the original terrain conditions under regulations.

- + For Coastal overlapping areas (mainly in Ninh Thuan and Binh Thuan provinces): Stepping up the early mining of titanium ore in order to clear the ground for construction of industrial, tourist and civil works. Other overlapping areas which fail to meet the conditions for mining may be treated as national natural resource reserve areas.

- + Project on investment, expanded investment or renovation of titanium ore mining or sorting, production of titanium slag or pigment must use advanced technologies which save electricity, water and conform to environmental standards.

- Regarding science, technology and international cooperation

- + Stepping up international cooperation, first of all in the fields of research, transfer of advanced technologies, environmental treatment and training of human resources for titanium ore mining and processing.

- + Elaborating a roadmap for step-by-step termination of operation and elimination of mining and processing facilities using obsolete technologies, consuming large volumes of energy, having low percentage of natural resource recovery and causing environmental pollution.

- + Researching and experimenting the use of seawater in the mining and sorting of crude titanium ore in coastal mines.

- Regarding infrastructure

Building a complete technical infrastructure network outside the fence of large-scale and concentrated titanium ore mining and deep processing areas in Binh Dinh, Ninh Thuan and Binh Thuan provinces.

b/ Mechanisms and policies

- Regarding titanium ore mining and processing

Encouraging enterprises to cooperate or join investment in building concentrated titanium ore processing establishments in each area in order to save investment capital, assure scale economy and convenient application of advanced technologies and environmental treatment.

- + Promoting cooperation with the global leading companies in titanium ore processing, with eminent technological and market advantages and capability to raise capital for investment in large-scale pigment, titanium metal/alloy processing projects.

- + Promoting the production of processed titanium ore products of high commercial value for export.

- Regarding finance

+ Revising and promptly adjusting taxes, charges and fees as reasonable, ensuring harmony between the interests of the State, enterprises and people in the localities where minerals are mined.

+ The State provides supports for the research and transfer of technologies for processing porous titanium/titanium metal and alloys under relevant regulations.

- Regarding human resources

Prioritizing the training of managers, technicians and specialists in titanium mining and processing in the master plan on development of human resources for the Central Vietnam key economic region with reasonable preferential, supporting and incentive policies.

- Regarding science and technology

Promoting the research and application of sciences and technologies to the deep processing of titanium ore in order to quickly receive and master technologies, thus proactively enabling the performance of jobs which are currently performed by hired foreign parties.

Article 2. Organization of implementation

1. The Ministry of Industry and Trade shall:

- Assume the prime responsibility for, and coordinate with related ministries and localities in, publicizing the master plan, and guiding, supervising and inspecting the implementation.

- Periodically review and evaluate results of the implementation of the master plan; update information on natural resources, market and impacts of projects on the socio- economic development in project areas, and propose adjustments to the master plan when necessary.

- Propose solutions to strictly control the circulation and sale of titanium pure ore and processed products; coordinate with ministries, localities and the Vietnam Titanium Association in formulating specific mechanisms and policies to promote the processing of pigment, porous titanium and titanium metal.

- Coordinate with related ministries and localities in directing, supervising and inspecting investors in implementing titanium ore mining and processing projects in order to assure application of advanced and environment- friendly technologies and general socio- economic efficiency.

2. The Ministry of Natural Resources and Environment shall:

- Direct the exploration and determination of titanium resource deposits, especially in areas where titanium exists in the red sand layer. Coordinate with related ministries and localities in zoning off and submitting to the Prime Minister for decision natural reserve areas and areas ineligible for auction of the titanium mineral mining right in accordance with the mineral law.
- Assume the prime responsibility for reviewing and examining titanium ore mining projects /then take measures to handle projects unconformable with the master plan or failing to meet technical, technological and environmental requirements.
- Assume the prime responsibility for, and coordinate with ministries, sectors and localities in, directing the land use of titanium projects, thereby minimizing impacts on agricultural, forestry, fishery and tourist activities in localities.
- Assume the prime responsibility for, and coordinating with local administrations in, taking environmental solutions for titanium projects; propose the enhanced state management of the environment in titanium projects.
- Assume the prime responsibility for developing and updating the database on natural resources and titanium ore deposits.

3. The Ministry of Science and Technology shall assume the prime responsibility for, and coordinate with the Ministry of Industry and Trade in, directing and supervising the transfer and application of advanced and environment- friendly technologies for production of pigment, porous titanium/titanium metal and alloys.

4. The Ministry of Transport shall assume the prime responsibility for revising the master plan on the external transport system and seaports to serve the transportation for development of the titanium mining and processing industry.

5. The Ministry of Planning and Investment shall assume the prime responsibility for, and coordinate with related ministries in, mobilizing and calling for ODA capital and allocating capital for the preparation for and implementation of investment in infrastructure facilities to serve the titanium industry.

6. The Ministry of Finance shall assume the prime responsibility for, and coordinate with the Ministry of Industry and Trade and the Ministry of Natural Resources and Environment in, revising tax and charge policies in each period to suit types of processed titanium ore products, with a view to promoting production and sale of deeply processed products.

7. The Ministry of Agriculture and Rural Development shall assume the prime responsibility for, and coordinate with related ministries and localities in, directing the planning of investment in building reservoirs and dams for supply of water for titanium ore mining and processing, especially in Ninh Thuan and Binh Thuan provinces, combined with the supply of water for agriculture and rural development.

8. The People's Committees of the provinces and cities where titanium mineral activities are carried out shall:

- Closely coordinate with the ministries in organizing the implementation and management of the master plan.
- Assume the prime responsibility for, and coordinate with the Ministry of Natural Resources and Environment, the Ministry of Industry and Trade and related ministries in, carefully reviewing boundaries of mine areas expected to be explored and mined in the planning period in their localities, proposing the handling of areas overlapping industrial, tourist, agricultural and forestry projects (if any) in their localities right from the stage of examination and agreement for grant of exploration licenses. Assume the prime responsibility for protecting unexploited local titanium mineral resources.
- Assume the prime responsibility for, and coordinate with investors in, carrying out the payment of compensations for ground clearance and resettlement of local people to serve titanium ore mining and processing projects.
- Formulate policies to support investors in selecting, training and employing local people, providing job training and attracting high- quality workers for the projects.
- Actively propagate and disseminate guidelines, policies and laws on minerals related to the implementation of the master plan in their localities.

9. The Vietnam Titanium Association shall:

- Join the state management agencies in organizing, studying and proposing mechanisms and policies to create favorable conditions for the implementation of the master plan.
- Mobilize its member enterprises to actively cooperate and associate with one another in researching and applying new technologies and investing in large-scale titanium deep processing projects.

Article 3. This Decision takes effect on the date of its signing and replaces the Prime Minister's Decision No. 104/2007/QĐ-TTg of July 13, 2007.

Article 4. Ministers, heads of ministerial- level agencies, heads of government-attached agencies, and chairpersons of provincial-level People's Committees shall implement this Decision.-

Prime Minister

NGUYEN TAN DUNG

** All appendices to this Decision are not translated.*

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