Global Leadership Training Programme in Africa

Final Report

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Research Title

The research on CO2 emission reduction measures in the platinum production process
-Case study of South Africa's largest platinum producer, Anglo American Platinum

Summary

This paper contains the examination of CO2 emissions reduction measures for the platinum industry in South Africa as a resource-dependent emerging country. It is intended to be an empirical study by taking Anglo American Platinum (Amplats) Ltd., the world's largest mining company as a case.
Three approaches were applied as research methods, such as LCA analysis, marginal abatement cost analysis, and hearing surveys.

The research aims to discover process flows of great environmental burdens through the LCA analysis in the platinum production process in order to pick out key measures from the point of view of cost-effectiveness. Extracted key measures include proposals from the perspective in consideration of the whole low-carbon society as a wider boundary in addition to those from the perspective of energy saving to be performed within companies.

While the above description is the major outcome of this research, it should be noted that the research further suggests the needs for building an awareness of environmental burdens that occurs upstream in material flows, providing assistance with environmental technologies, and taking measures to control the consumption of platinum as an approach from consuming countries in Japan as a major resource-consuming country, building on such discussions

Keywords

1. CO2 emission reduction, 2.LCA, 3.Environmental load, 4.Platinum, 5. Emerging country

Title of Research

プラチナ生産過程における CO2 排出削減対策に関する研究

-南アフリカ共和国　世界最大プラチナ鉱山会社（Amplats 社）を事例とする

Summary

本論文は、資源依存型新興国である南アフリカ共和国のプラチナ産業を対象にした CO2 排出削減対策の検討を内容としている。世界最大鉱山会社である Anglo American Platinum (Amplats 社)を事例とした実証的なものである。

研究手法は、LCA 分析、限界削減費用分析、ヒアリング調査の３つを用いている。

内容は、プラチナ生産過程における LCA 分析を通じて、環境負荷の大きな工程を発見し、 費用対効果の視点から重点対策を抽出した。抽出された重点対策は、企業内で実施する省エネの観点からのものに加えて、一層広いバウンダリーとして低炭素社会全体を考慮した視点から提案している。

以上が研究の主な成果であるが、そのような考察の上に立って、さらに資源消費大国である日本として、物質フローにおける上流で起きている環境負荷に対する認識の必要性と、環境技術を通じた支援の必要性、及び消費国からのアプローチとして、プラチナの消費抑制対策の必要性を示唆している。

キーワード

1.　　CO2 排出削減、2. LCA、3. 環境負荷、 4. プラチナ、5. 新興国

1. Introduction

Climate change is already a measurable reality and along with developing countries, South Africa is especially vulnerable to its impacts and South Africa is one of the most energy intensive countries in the world, measured as GHG emission per Gross Domestic Product produced. It is the 11th biggest emitter of GHGs worldwide and has one of the highest CO2 emissions per GDP ratios .On 6 December 2009, the President Zuma announced that South Africa will implement mitigation actions that will collectively result in a 34% and a 42% deviation below its "Business as Usual" emission growth by 2020 and 2025 respectively.

South Africa as the resource-mining industrial country depends largely on the highly energy-consuming large-scale mining industry, and thus affected very seriously by energy problems. According to the Department of Energy, the amount of primary energy consumption in South Africa in 2009 is a total of 6,364PJ, increasing steadily from 4,295PJ in 2000. Looking at energy sources, coal accounts for 70 %, followed by oil (17 %) and renewable energy (7 %). While the proportion of coal fuel has decreased as compared to 79 % in 2000 when, the proportion of natural gas or nuclear power is much lower, and only one nuclear power plant is operated in Cape Town (Figure 1). Furthermore, 93 % of the coal fuel is utilized for power generation.

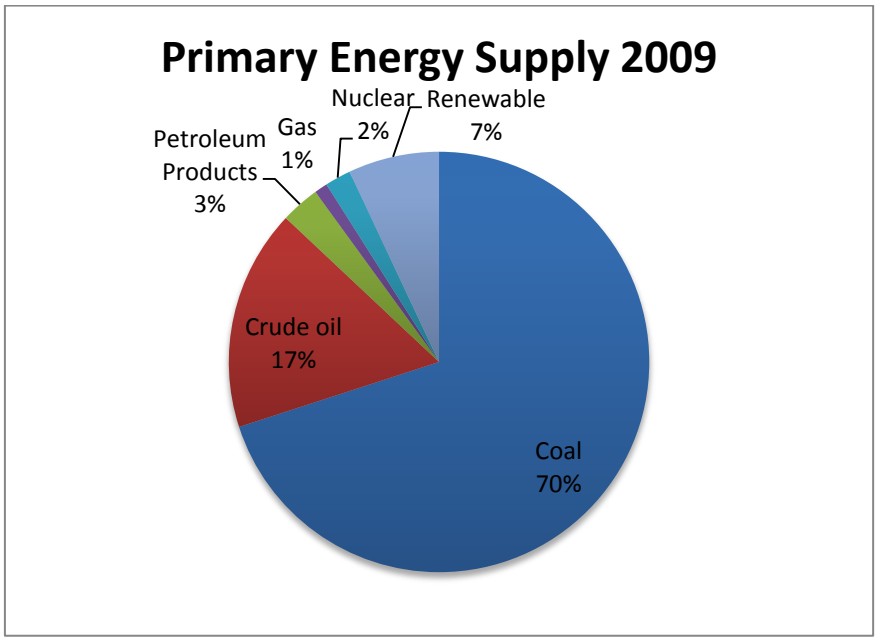

Figure 1 Amount of primary energy supply in South Africa
(Source) Draft Second National Energy Efficiency Strategy Review 2012, DOE

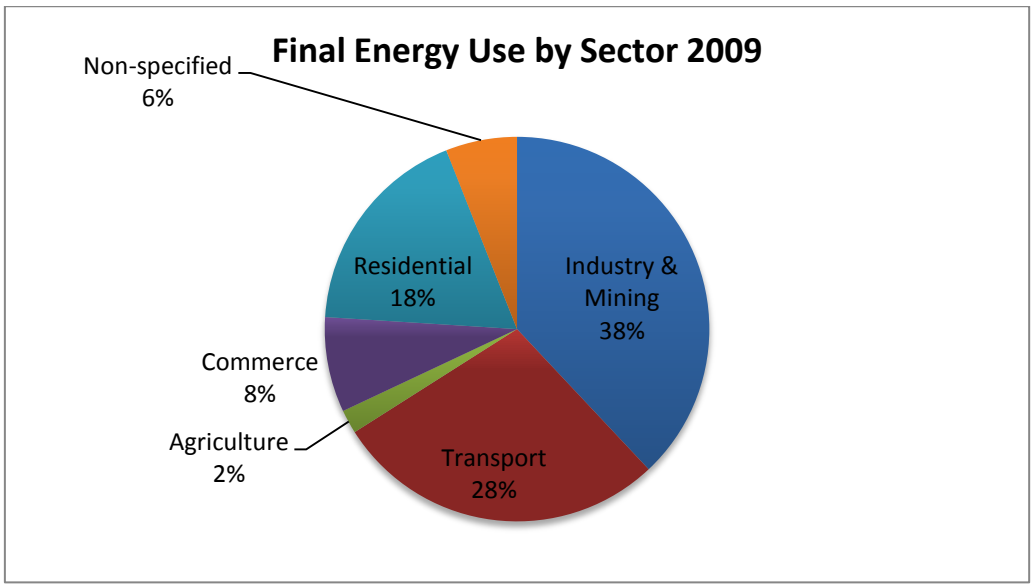

Figure 2 Proportion of energy consumption by sector
(Source) Draft Second National Energy Efficiency Strategy Review 2012, DOE

The amount of energy consumption in each sector that the Department of Energy announced is shown in Figure 2. The government did not present figures only for the mining sector, reporting 38% as a total of the industry and mining sectors. As for the amount of consumption only in the mining sector, the report that was published by SAMMRI (The South African Minerals to Metals Research Institute) in 2009 provided the data that it utilized about 20 % of the total energy.

South Africa accounts for 87.7% of the whole world in the reserves of platinum, ranked at the first in the world. In addition, many of the mines that are currently dug in the Bushveld Mine Zone are minable until approximately 2030 - 2050. Mudd in Australia suggests that mining will be possible in South Africa until 2100, but the stable volume of production volume cannot be expected as grades of ores are getting lower and lower every year.

Given that resources are far from infinite and moreover that environmental loads are generated in the production process for using them, it must be considered necessary to take measures from the consumer side. Also with respect to the amount of supply, South Africa accounts for 54.8% of the whole world, ranked at the first in the world, followed by Russia. Because the facilities for processing up to the refining are insufficient in Zimbabwe, moreover, the proportion of performing it in South Africa is also high.

Japan relies on South Africa for many of the mineral resources, not only platinum, including the importation of 104 tons out of the total 146 tons (71.2% share) of the overall import platinum group metal, 633 thousand tons out of the 1,102,000 tons (57.4 % share) of manganese ores, and 2,690 tons out of the 4,586 tons of ferrovanadium (58.6 % share) from South Africa.

2. Study area

This study was conducted by the author interested strongly in environmental issues in resource-rich countries that continue economic growth regarding current situations of CO2 emissions reduction measures in the mining sector and the viability of improving them with the case of Anglo American Platinum (hereinafter referred to as "Amplats") that is the world' largest mining company in South Africa.

3. Methods and materials

-Institutional survey on measures to reduce CO2 emissions

Literature surveys were conducted on major energy policies in the mining sector of the Republic of South Africa mainly using materials published by the government, and information was obtained locally at the library of the University of Cape Town for what cannot be seen on the Internet.

-Life Cycle Analysis of the platinum production process

Data were extracted and aggregated on the amount of energy consumption for each type of fuel by mining, concentration, smelting and refining from the Sustainable Development Report (hereinafter referred to as the "SD Report") for the period of nine years from 2005 to 2013, which is published by Amplats Ltd. as the target of the study. Then the aggregated data were summarized in a graph for each process for considering mainly effects of energy-saving measures.

-The marginal abatement cost analysis in CO2 emissions reduction measures

Interview surveys were conducted on energy-saving measures that have been implemented so far as have been reported in the SD Report of 2005 - 2013 published by Amplats Ltd. every year and costs of measures planned to be implemented from now on to calculate reduction effects and costs for technologies that can be introduced in the future.

-Interview surveys on obstructive factors

The author could hear from the person responsible for energy, visiting the Johannesburg headquarters of Amplats Ltd. as the target of this study in order to clarify obstructive factors and issues on CO2 emissions reduction measures (energy-saving measures). In addition, she actually visited the Bathlope Mine in the Bushveld mining region and its adjacent converter.

4. Results & Discussion

(Not mentioned about the result of marginal abatement cost analysis in CO2 emissions reduction measures because it is still working and waiting the data from Amplats.)

-Discussed institutions related to the measures to reduce CO2 emissions, and the status of achievement of the Energy Efficiency Agreement where targets are set is as follows:Amplats Ltd. signed the Energy Efficiency Agreement with the Department of Energy for which it will reduce the energy consumption per production volume by 15 % and the CO2 emissions per production volume by 10 % before 2015 relevant to the 2005 level. Looking at the situation in 2013, energy consumption per production volume is 6.16 gigajoules (GJ) per ounce, as compared to 5.38 GJ as the reference value of 2005, meaning a 12.6 % increase. It is also shown that the CO2 emissions per production volume in fiscal 2013 is 1.42 t - CO2, a 15 % increase as compared to 1.20 t - CO2 in 2005 as the reference value. In addition, the reference value of CO2 emissions in 2005 is 5,842 kt in terms of the absolute value, but the actual value in 2013 is 5,936 kt, meaning a 1.6 % increase. The target value of the total energy consumption is 24.3PJ, while the actual value of 2013 is 24.9 PJ, showing the condition of the 2.6 % increase.
From these situations, the achievement of targets before 2015 would be difficult if the present conditions remain unchanged. It is believed that outcomes would come out if the utilization of waste heat planned for this year and solar power generation starts in the energy-saving measures under the process of smelting the described in the next section, but further measures would be required to achieving the targets.

-Regarding Analisis of platinum production process (mining-concentrating-smelting-refining),the amount of CO2 consumption is indicated in the order of mining > smelting > concentration > refining.
The mining process is divided into underground mines and ground mines, out of which the former group consumes moreCO2. Due to the recent rise in energy costs, small mining companies are inclined to operate by limiting themselves to ground mines alone.
Based on these results, the priority measure is taken for cooling machines that uses the most energy in t he mining process. When considering the introduction of the energy-saving technology from Japan forth cooling machine, the most adequate would be the eco (ecological)-cooling machine that uses a heat pump; it was said that the heat pump might be explosive under the condition of high temperature, a nd so that it would be necessary to replace its cooling mediumwith that for mines during the interviewww ith a Japanese company related to heat pumps. A response was received from them: “Since it is said that the temperatures of the underground mine at the depth of 1,000 m and the gold mine at the depth of 4,0 00 m category would be approximately 35 °C and 55 °C, respectively,their heat pump would be technic ally applicable if the cooling medium is replaced with that for these
temperature classes and thus that they would like to know what kinds of cooling media are currently used at sites.”

As for heat pumps, it was found that though their technologies themselves have become widespread as t heir introduction into all dressing rooms for mine workers and the introduction of heat pump technologi es at miners' villages are progressing separately, different technologies would be required for utilizing them in underground mines.

5. Conclusion

-Amplats is taking the issue of energy efficiency seriously due to the increasing cost of electricity and the issues around energy security.

-Need more energy efficiency against the barriers for achieving the target of energy efficiency accord.

-Understand environmental load especially CO2 emission in platinum production process through LCA.

-Support for Heat Pump technologyof mining process and improvement for source of electrical energy are high potencial from Japan.

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