

## SUMMARY OF MASTER'S DISSERTATION

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<p>Title</p> <p style="text-align: center;">Impact study of copper resource constraint on environmentally friendly products</p>			
<p>Abstract</p> <p>Copper has properties such as high electrical conductivity and thermal conductivity. In addition, copper has been widely used in throughout history. Therefore, the demand for copper is always high. It is copper that is more likely than rare metals to have supply constraints in the future. Furthermore, the demand for copper is expected to increase further in the future because it is used for environment friendly products to reduce carbon emission.</p> <p>However, the fact is that current copper supply is limited and the expected supply growth is sufficient only to cover the existing industry demands. The current supply will be, therefore, insufficient to cover the future copper needs for manufacturing environment friendly products.</p> <p>The purpose of this study is to estimate the future copper demand from the viewpoint of environment friendly products industry, and also to suggest measures to meet the gap.</p> <p>Out of 17 highly demanded environment friendly products, we focus in this research on the following ones that use relatively large amount of copper: Electric Vehicle (EV), Plug-in Hybrid Electric Vehicle (PHEV), Fuel Cell Vehicles (FCV), Heat Pumps, Wind Power Generation, Nuclear Power, CIGS solar cells. We evaluated how the future demand for copper will change between 2010 and 2050 according to the existing products will be replaced based on the BLUE Map scenario.</p> <p>Our estimation for the copper demand from environment friendly products in 2050 was as follow: EV-product 1613kt, PHEV759kt, FCV107kt, heat pumps 74kt, Wind 86kt, nuclear-3kt, CIGS solar cells-25kt.</p> <p>To cover this future copper demand, we use a what-if analysis based on using copper stock from electric wires and resource saving in environment friendly products manufacturing. As a result, we found that the demand for copper in 2050 could be secured by replacing copper with the aluminum in electric wires at a 29% level. However, the replacement rate from using aluminum wire is thought to have limitations. According to the data from France, 22% appears to be the maximum limit for aluminum wire replacement, which will be only enough to cover the demands until 2045. The shortage starting in 2045 is expected to cause copper prices estimated previously to increase 160% or more. Therefore, I found that resources savings and/or the development of alternative technologies should be promoted by the year 2045. If we achieve a 2% yearly resource savings in the amount of copper used for each one of the 3 car models previously mentioned –while keeping the overall demand,- the copper demand in 2050 becomes 1,200kt which is nearly half of the values before the resource savings. In this case, we found that demand can be met by copper wire replacement.</p>			
<p>Key Word(5 words)</p> <p>Environmentally friendly products, copper resource constraint, BLUE Map scenario, Copper wire stock, Resource-saving</p>			