

THE IMPACT OF TECHNOLOGY CHANGES ON
PRODUCTIVITY IN PULP AND PAPER INDUSTRY

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ABSTRACT

In pulp and paper industry, technological changes are critical factors to improve productivity and increase production capacity. The aim for this study is to identify the impacts of technology changes on productivity in pulp and paper industry. Pascorp Paper Industry Sdn Bhd which is the field of study for this research has gone through several technology changes and improvement in their company. New paper machine (PM3) was installed in 2011 to increase production capacity and expand market. The impacts and factors of technology changes can be identified through the data obtained from the interview at the company. Results from the interview shows that new technology or technology upgrades do increase Pascorp Paper's productivity in term of production and production capacity. Factors affecting decision to add new technology or to upgrades existing technology such as increasing demands are discussed in this study.

Keywords: Pulp and paper industry, technology changes, productivity, paper machine.

ABSTRAK

Di dalam industri pulpa dan kertas, perubahan teknologi merupakan faktor kritikal untuk mempertingkatkan produktiviti dan meningkatkan kapasiti pengeluaran. Matlamat kajian ini adalah untuk mengenalpasti kesan perubahan teknologi kepada produktiviti di industri palpa dan kertas. Pascorp Paper Industry Sdn Bhd yang merupakan kawasan kajian untuk kajian ini telah melalui beberapa perubahan dan peningkatan teknologi di dalam syarikatnya. Mesin kertas yang baru (PM3) telah dipasang pada tahun 2011 untuk meningkatkan kapasiti pengeluaran dan meluaskan pasaran. Kesan dan faktor perubahan teknologi boleh dikenalpasti melalui data yang diperoleh melalui temuduga di syarikat ini. Hasil dari temuduga menunjukkan bahawa teknologi baru atau peningkatan teknologi telah meningkatkan produktiviti syarikat Pascorp Paper dari segi jumlah pengeluaran dan kapasiti pengeluaran. Faktor yang membawa kepada keputusan untuk menambah teknologi baru and naik taraf teknologi sedia ada seperti peningkatan permintaan dari pelanggan turut dibincang di dalam kajian ini.

Kata kunci: Industri palpa dan kertas, perubahan teknologi, produktiviti, mesin kertas

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LIST OF ABBREVIATIONS

PM Paper Machine

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Over the past centuries after industrial revolution started in year 1760s, technology has been rapidly changing and expanding in every field imaginable. Every industry around the world has to learn to adopt the technology changes in their manufacturing process or management systems to improve their productivity and reduce their waste.

This study attempts to investigate the impact of technology changes on productivity in pulp and paper industry in paper manufacturing company in Bentong, Pahang. Pascorp Paper Industries Berhad is a major Malaysian pulp and paper manufacturer and produces corrugated medium and test liner paper. Pascorp Paper Industries Berhad is the country's third largest pulp and paper industry with current output of 300,000 tonnes. To achieve the company's goals which to get a higher productivity and reducing their waste products, technology changes is highly significant. The managers are responsible to teach or train their subordinates on how to handle the new technology that came in to ensure they know how to fully utilize the technology to ensure the targeted goals are achieved.

In this research, the key to ensure that positive impacts are acquired after the technology changes lies between all layers of employees in the company from executives, managers, and staff workers. In this chapter, I will give an overview of this research, covering the problem background, problem statement, research objective(s), research questions, scope of study, significance of study, operational definition and expected results of the impact of technology changes in Pascorp Paper

Industries Berhad and to determine why the technology changes should be implemented to increase the company's productivity.

Furthermore, the impact of technology changes was examined in its relationship between productivity and employees adoption to new technology. Finally, factors leading to technology changes were investigated to determine how Pascorp Paper Industries Berhad decided to change their technology from old technology to latest technology.

1.2 PROBLEM BACKGROUND

Technology has contributed to the growth of industries or to the process of industrialization. The existing of new technology enables the industries to be more productive and improve their company's growth. Without a better technology, the manufacturing industries will be stuck on their low level of productivity and won't be able to improve more than that. The relationship between technology and productivity has always been discussed on many technology and productivity literatures.

Normally, company with higher productivity will have a better technology that can process and manufacture their products much faster. To increase the company's productivity, it is important to improve the company's manufacturing process in term of the technology being used for processes such as machines, or the system's technology the company use. A higher production means a higher production of waste products, all industries need to improve or change the current technology for waste management in order to reduce the waste products.

Buying new technology is very costly and training for employees are essentials to ensure that they can get familiar with the new technology that came in. Untrained employees may damage equipment, inefficient and liabilities of not knowing how to handle new technology. The technology changes may happens through many different ways such as by purchasing, research and development (R&D), acquisition and diffusion of technology. The impact of technology changes for industries or companies are varies and depending on type technology implemented.

Technology changes are positives changes for most of the industries or companies for improvement and growth. However, some of the companies refuse to accept the changes and stays with the old technology. Therefore, if the company want to be more productive and earn higher profits, accepting and changing their current technology is a better solution.

1.3 PROBLEM STATEMENT

Rapid state of technological change is influencing many manufacturing industries especially in pulp and paper industry in Malaysia to keep up with the technology changes in order to gain competitive advantage. There are a lot of challenges the company need to face to be able to change to new technology. The impact of technology changes needs to be consider and predicted before changing the technology to ensure the company are ready for it.

Cost for new technology is the main challenges for the company to change their technology. New technology is very expensive and the company needs to decide whether it is worthwhile to change the existing the old technology to new technology. Their main concern is, that the technology changes did not give positive impact to the company in term of productivity and profits.

When new technology is implemented, it increased skill demand and required new work practices. It means the company need to recruit new worker that knows how to operate the technology or give training to existing workers to teach them how to use operate the technology. All this demand and requirement involves a lot of cost and requires the company to spend more money to pay salary to the new expert workers or for training of existing workers. New work practices means, new rules and standard operating procedures will be implemented to suit the new technology.

Previous case studies also have documented the proof that new technology will change the way how work is done and organization's function. Furthermore, measuring the impact of technology changes is difficult. To measure the impacts on productivity, it

is generally approached through metrics such as Total Factor Productivity (TFP), Gross Domestic Product (GDP) and GDP per capita.

1.4 RESEARCH OBJECTIVES

Generally, there are three objectives to be examined for this research which are:

- i. To explore the existence of technology change in pulp and paper manufacturing industry.
- ii. To identify the influencing factors that contributes to technology changes in pulp and paper manufacturing industry.
- iii. To investigate the impact of technology changes on productivity in pulp and paper manufacturing industry.

1.5 RESEARCH QUESTIONS

Based on the research objectives above, research questions are formulated as follows:

Q1: What are the technology changes in pulp and paper manufacturing industry.

Q2: What are the influencing factors that contribute to technology changes in pulp and paper manufacturing industry.

Q3: What are the impact of technology changes on productivity in pulp and paper manufacturing industry.

1.6 SCOPE OF STUDY

This study was conducted to determine the impact of technology changes on productivity in pulp and paper industry. This study will be emphasizing the technological changes on local company in paper and pulp industry in Bentong, Pahang. This study will be conducted among the employees of Pascorp Paper's pulp and paper

industry for data collection and to identify the impact of technology changes to their productivity or manufacturing processes. Method used for this study to evaluate data is comparative analysis. Any individual employees that involved directly with the technological changes will be interviewed.

1.7 SIGNIFICANCE OF STUDY

We are aware that Pascorp Paper Industries Berhad is Malaysia's third largest pulp and paper company. The results of this study will give useful information to other researchers and will be beneficial in both theoretically and practically. In theoretical perspective, this research will provide a better understanding and ideas about the impact of technology changes on productivity to other researchers. This research will help to strengthen the literature review of another researcher's research. For practically beneficial, this study will help to guide any company in making decision for adopting or changing to new technology. It will give the company the positive and negative impact of technology changes in industry.

Last but not least, this research will benefit other students that are doing a research related to this research. It will help them to understand the concept and the meaning of technology change and the impact of it. This research will definitely become a guideline for other researchers that are studying the impact of technology changes to output and productivity especially in pulp and paper manufacturing industry.

1.8 OPERATIONAL DEFINITION

Operational definition is brief definition or meaning of the terms as used in a particular field of case study.

Technology

Technology is the branch of knowledge that deals with the human creation and use of technical means and their interrelation with life, society, and the environment, drawing

upon such subjects as industrial arts, engineering, applied science, and pure science. It is also the use of specific methods, materials, and devices used to solve practical problems.

Impact

Impacts is an influence of other things that lead to another thing. It is the effect or impression of one thing on another for examples, the impact of automation on the lives of factory workers.

Industry

An industry is a group of manufacturers or businesses that produce a particular kind of goods or services. It is the aggregate of manufacturing or technically productive enterprises in a particular field, often named after its principal product: the automobile industry; the steel industry.

Research and Development (R&D).

Investigative activities that a business chooses to conduct with the intention of making a discovery that can either lead to the development of new products or procedures, or to improvement of existing products or procedures. Research and development is one of the means by which business can experience future growth by developing new products or processes to improve and expand their operations.

Gross Domestic Product (GDP)

Gross domestic product (GDP) is related to national accounts and is the market value of all officially recognized final goods and services produced within a country in a year, or other given period of time. GDP per capita is often considered an indicator of a country's standard of living. GDP per capita is not a measure of personal income Under economic theory, GDP per capita exactly equals the gross domestic income (GDI) per capita (See Gross domestic income).

Total Factor Productivity (TFP).

Total-factor productivity (TFP), also called multi-factor productivity, is a variable which accounts for effects in total output not caused by traditionally measured inputs of labor and capital. If all inputs are accounted for, then total factor productivity (TFP) can be taken as a measure of an economy's long-term technological change or technological dynamism.

1.9 EXPECTED RESULT

Hopefully, this research will be able to identify the impacts of technology changes in Pascorp Paper's pulp and paper industry. This research will prove that productivity of pulp and paper and positively related to technology changes from old technology to new technology. Problems with worker's adaptation with new technology are likely to happen because they are not familiar with the technology and not enough training.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Literature is a written literary work which is a critical summary and an assessment of the current state of knowledge, or current state of the art in a particular field. In this chapter, the previous relevant literatures were reviewed and several definitions for technology changes and impact of technology changes to manufacturing industry were provided. It also gave insights in the different dimensions of analysis on impact of technology changes on productivity in paper industry that have been examined many different researchers. Other than that, examples of technological changes in different industries and background of pulp and paper industries were also be discussed in this chapter.

2.2 TECHNOLOGY CHANGES

Technology is a word that came from the of Greek's word techne, which means the skills or craft needed to make something and loges which means discussion or knowledge of something. Technology is all the knowledge, products, processes, tools, methods and systems employed in the creation of goods or in providing services. The component of technology is hardware that includes any physical product, software which is the knowledge of how to use the hardware in order to carry out the required tasks and brainware which is the reason for using the technology in that particular way.

Technology changes were understood to be an improvement in technology, or technological progress that brings benefits to society and industries. The term of technological change is used to describe the overall process of invention, innovation and diffusion of technology or processes as shown in Figure 2.1. The term is synonymous with technological development, technological achievement, and technological progress. In essence technology changes is the invention of a technology (or a process), the continuous process of improving a technology (in which it often becomes cheaper) and its diffusion throughout industry or society.



Figure 2.1: Model of three phases of the process of Technological Change.

Source: Rip and Kemp (1997).

The invention is the creation of something new that not existed before, or a "breakthrough" technology. Innovation is the process of translating an idea or into a good or service that creates value or for which customers will pay. The idea and the creation of innovation were created and generated through invention. To be called an innovation, an idea must be replicable at an economical cost and must satisfy a specific need. Diffusion is the spreading of technology through industry or society. Technology diffusion generally is an S-shaped curve. The early versions of technology are mainly unsuccessful, followed by a successful period with high adoption levels and finally a dropping point where the technology reaches its maximum potential in a market.

Technology change has many facets. Technology changes includes, a creation of new products, efficiency and quality improvement for existing products such as lighting, computers, cars, software and the fact that nearly all products have been improving in function and quality while the costs for manufacturing decreases or constant. Technological changes can be described a process involving many actors with different capabilities and interests, which no one are able to control the overall process (Rip and Kemp, 1997). The notion of co-evolution of technology, derived from a consideration of the dynamics of technical change, applies to sociotechnical

transformations as well as to individual technologies, even if the concept cannot then be used in the strict sense.

Technological developments are creating novelty that may create opportunities for new manufacturing industries. According Rip and Kemp (1997), it is argued that thresholds are temporarily low when paradigms change, and windows of opportunity may open for new participants. Times are considered as paradigm change to offer a double technological opportunity by exploiting a certain components of the old paradigm, and to change into the new paradigm.

2.3 THE PRODUCTIVITY

The concept of productivity, generally defined as the relation between output and input, has been available for over two centuries and applied in many different circumstances on various levels of aggregation in the economic system (Tangen, 2002). Inputs include labor and capital, while output is typically measured in revenues and other GDP components such as business inventories.

Productivity measures may be examined collectively (across the whole economy) or viewed industry by industry to examine trends in production growth, labor growth, wage levels and technological improvement. Productivity gains are vital to the economy because they allow us to accomplish more with less. In terms of manufacturing industries, productivity growth helps to expand their business and increase their revenues and profits. In manufacturing industries, both capital and labor are scarce resources, maximizing their impact is always a core concern of modern business.

Productivity enhancements come from technology advances, such as computers and the internet, supply chain and logistics improvements, and increased skill levels within the workforce. Tangen (2002) conclude that people who claim to be discussing productivity are actually looking at the more general issue of performance. While productivity is a fairly specific concept related to the ratio between output and input, performance is a term which includes almost any objective of competition and

manufacturing excellence such as cost, flexibility, speed, dependability and quality. Figure 2.2 shows the relation of productivity to performance objective.

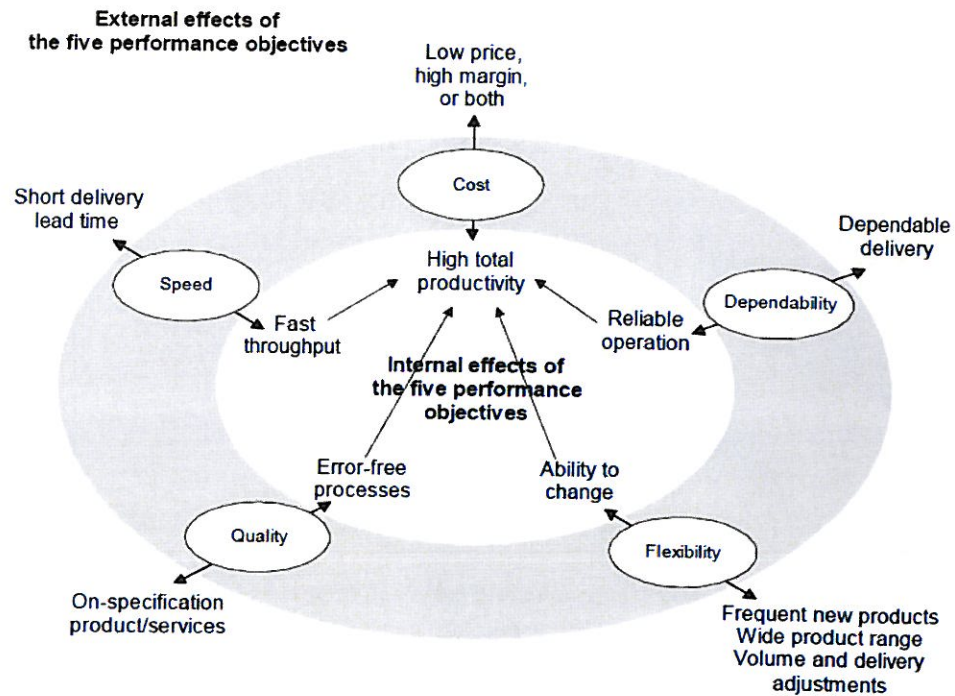


Figure 2.2: Productivity's relation to performance objectives. Source: Tangen (2002).

The result of the empirical investigations confirms that there is no consensus in industry of what the term productivity actually means. The absence of definition of productivity within a company was also found to cause problems. However, most managers and employees at the studied companies agree that an established productivity definition would be beneficial to a company's improvement work.

2.4 TECHNOLOGY CHANGES IN DIFFERENT INDUSTRIES

2.4.1 Taiwanese Industries

Taiwan is a fast growth country with increasing number of manufacturing industries with high productivity and quality output. According to Branstetter and Chen (2005), analyses have emphasized the skill of Taiwanese firms in obtaining and successfully

utilizing technology developed abroad. This “absorptive capacity” is believed to be a key element in Taiwan’s export success in increasingly technology-intensive manufacturing industries.

Most of the technology used by Taiwan’s industries are purchased and acquired from foreign country technology. Based on Branstetter and Chen (2005) empirical results, it suggests that the impact of foreign technology imports on productivity growth at the plant level have been positive and significant. This study shows that the technology changes in Taiwan’s manufacturing industries has increased their productivity growth and increase their products export to foreign countries.

Figure 2.3 shows how much Taiwan has spends for R&D in technology changes compared to Japan. Branstetter and Chen (2005) conclude that by the early 1980s, exports of electronics were larger than Taiwan’s exports of textiles and garments, and the electronics industry has continued to grow, not only in absolute economic size, but also in terms of the increasing technological sophistication of domestic producers.⁹ By 1995, the Taiwanese electronics sector accounted for 23 percent of Taiwan’s manufacturing GDP and over 35% of its total exports.

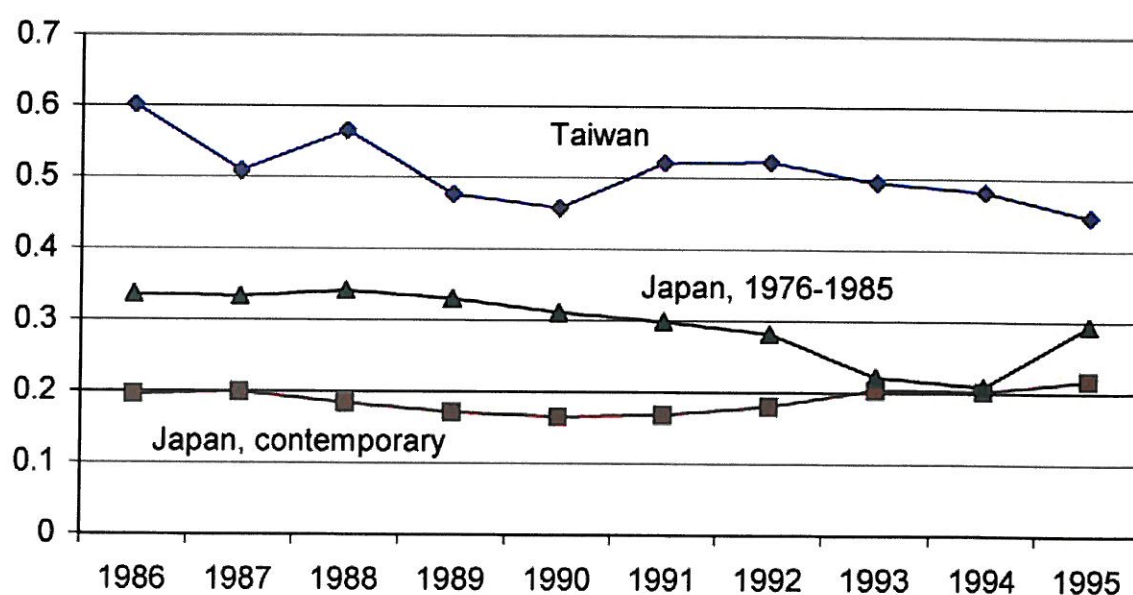


Figure 2.3: Public R & D as fraction of total spending. Source: Branstetter and Chen (2005).

2.4.2 Automotive Emission Control Industry

Automotive emission control industries have been battling since 1970s in competing standards intended to reduce pollutants from cars and fit regulatory emissions standards. There are two different physical designs (dual converter and three-way) and two types of catalysts (pelleted and monolithic) were competing to be the standard for the market until the market settled on the on monolithic three-way converter architecture that has been standard for more than thirty years.

Automotive emissions stabilized on a dominant design in 1981, and in the first twenty years after this dominant design emerged, patenting activity associated with emissions increased significantly. According to Lee and Berente (2012), overall performance of emissions technologies improved by a factor of three, and the digital revolution was leveraged to enable unprecedented emissions control and tuning. As far as the composition of this innovation, there is widespread agreement that after a dominant design emerges, firms will shift their attention from the overall architecture to component innovation.

The evolution of automotive emission control systems (AECS) technology provides an opportunity for changes of technology after the emergence of a dominant design. In this case, the dominant design involves the standardization on a three-way catalyst-based catalytic converter architecture in 1981, and Lee and Berente (2012) mentioned that it was followed by more than a decade of architectural stability until the technological shift resulting from on-board electronic diagnostic control modules in 1994.

As shown in Figure 2.4, the introduction of new technology brought about significant performance improvement over the previous engine-modification-based auto emissions reduction technologies. This proved that technology changes brought a positive improvement in automotive emission control industries to reduce hazardous gas emission from automotive.

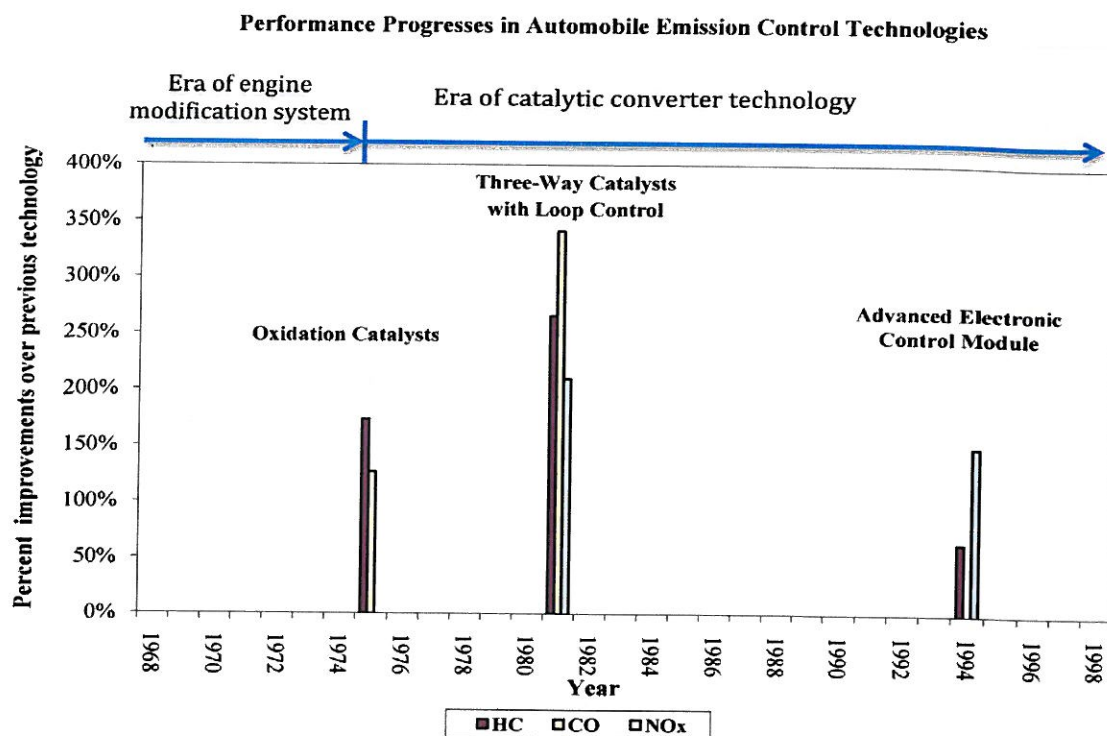


Figure 2.4 Performance progresses in automobile emission control technologies.

Source: Lee and Berente (2012).

2.4.3 United States Iron and Steel Industry

Iron and steel industry is one of the oldest industries that existed in United States (US). High demand for iron and steel in US forced the industries to increase their productivity on iron and steel production. Because of that, energy consumption by this industry increased every year and emissions to air increases.

Ruth (1995) claimed that even modest increases in raw steel production rates require unrealistically high rates of iron and steel recycling to reduce energy use and emissions in the long run, even if the historically observed rates of technological substitution and efficiency improvements can be maintained.

As shown in Figure 2.5, the technology changes in US iron and steel industry have reduced the energy use in mining, beneficiation and agglomeration of iron ores per-unit output. The industries have been using coke oven gas since 1950 and contribute

60% of non-electricity energy inputs into steel furnaces which produced high emissions. In 1992, natural gas accounted for 96.6% of non-electricity energy input, replacing coke oven gas and remaining 3.4% were tar, pitch, blast furnace gas and fuel oil.

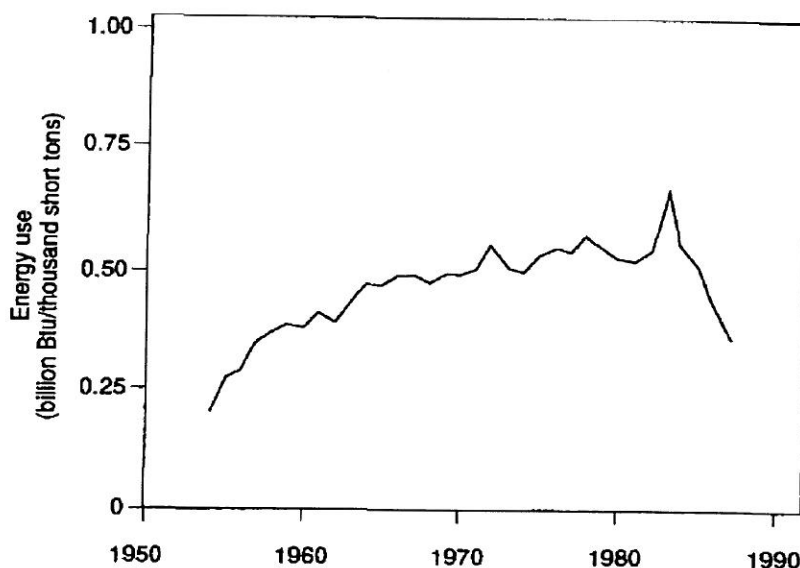


Figure 2.5: Energy use in mining beneficiation and agglomeration of iron ores per-unit output. Source: Ruth (1995).

Technology change in US iron and steel industry gives positive implications for energy use, and CO₂ emissions. With the technology change, the industries manage to reduce the energy consumption in the process of making iron and steel and reduce the output of CO₂ emissions.

2.5 OVERVIEW OF PULP AND PAPER INDUSTRY

The paper and pulp industry is often regarded as a mature industry, where, the products are stable and the main competition between companies is simply a price and cost competition (Ranta et al., 1991). The paper and pulp industry also has experienced dramatic changes during the past few decades with large variations in international market shares of production capacity and consumption (McCarthy and Lei, 2009).