



Status of energy conservation in Taiwan's pulp and paper industry



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ABSTRACT

The P&P (pulp and paper) industry in Taiwan is highly energy intensive and there is much product diversification. Taiwan has extremely limited coal and petroleum resources and imports 98% of its energy supply. Increased energy utilization efficiency to reduce energy consumption is necessary for industry in order to implement energy audit recommendations. This work summarizes the energy-saving potential of 118 firms from 2009 to 2013 as determined by on-site energy audits, as well as the energy savings implemented in 2011 by 72 firms in Taiwan's P&P industry, according to data from the on-line Energy Declaration System. It is found that the total of the energy-saving potential and the implemented energy savings are 168.3 and 762.1 TJ, respectively. The results of this study can serve as a reference for current P&P operations and as a base case for stimulating changes in energy utilization.

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1. Introduction

P&P (pulp and paper) production processes are energy-intensive operations. The P&P industry is the fourth largest industrial energy user in the world and is characterized by the enormous amount of energy consumed, such as the electricity and heat needed for chemical pulping, paper and pulp drying, black liquor evaporation and other operations [1]. There are 120 firms involved in the P&P industry in Taiwan; 91 are members of the Taiwan Paper Industry Association. The firms with an electrical capacity over 800 kW account for 80% of the total members of the Taiwan Paper Industry Association. According to the characteristics of the P&P industry in Taiwan, there is upstream industry (pulp), midstream industry (paper industry, paperboard industry, industrial paper) and downstream industry (paper product processing), as shown in Fig. 1. The pulp and paper industry is a large user of fossil energy in the Taiwanese manufacturing sector, and the concentration of GHG (greenhouse gases) from manufacturing factory activities and vehicle emissions has increased significantly [2]. Energy efficiency is considered a significant option in sustainable development in order to reduce energy resource depletion rates and mitigate GHG [3]. Consequently, numerous analytical studies have been undertaken on energy conservation for energy-intensive

industries, such as the iron and steel industries [4–7], cement industry [8–13], textile industry [14,15], petroleum/chemical industry [16–18] and the pulp and paper industry [1–3,19,20]. Taiwan has extremely limited coal and petroleum resources and imports 98% of its energy supply. Increasing energy efficiency, through energy-conservation techniques or heavy investment in infrastructure, is the most direct means of reducing GHG emissions; it would also assist industry in complying with energy audits [21–23]. Little or no investment is needed to achieve a 10–30% reduction in GHG emissions; if energy users are willing to adopt improved technology, emissions can be even further reduced [24].

Energy users in Taiwan must observe the Energy Management Law and conduct an energy audit and set an energy-conservation target and an action plan. Engin and Ari [25] have demonstrated that energy auditing is an effective energy management program, which can be applied to calculate and evaluate possible ways of reducing the energy demands of each operational unit in the manufacturing process. Clearly, the energy-conservation status, including the energy-saving potential and actual energy conservation, in the P&P industry should be analyzed. In this way, energy-conservation measures, energy-conservation policies and recommendations can be obtained. The aim of this study was to give a synthetic perspective to Taiwan's P&P producers and policy makers on the effectiveness of specific energy-saving measures and energy-conservation potential. In addition, policies which promote energy-conservation policy are recommended.

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Nomenclature

P&P	pulp and paper
GHG	greenhouse gases
GDP	gross domestic product
NT dollar	New Taiwan dollar
GOV	gross output value
VAR	value-added rates
LOE	liter of oil equivalent
IPI	the real production output of manufacturing, mining, and utilities
NG	natural gas
RDF	refuse-derived fuel
SEC	specific energy consumption
IBEMS	Intelligent Building Energy Management System
M&V	measurement & verification
BAT	best available techniques

2. Current status in Taiwan's P&P industry

2.1. Market analysis

The GDP (gross domestic product) of the P&P industry in Taiwan is about 36.1 billion NT dollars, which accounted for 0.24% of the national GDP in 2011. From 2007 to 2011, the GDP growth rate was -3.0% and the GOV (gross output value) growth rate was 4.3%, while the value-added rates (VAR = GDP/GOV) in 2011 decreased 8%, as compared to 2007, as shown in Fig. 2. Table 1 also listed the GOV of various P&P industries. The financial crisis in 2008 and the subsequent recession resulted in the dramatic decrease in the GOV of the P&P industry in 2009. Some economic recovery in the P&P industry was evident in 2010, and the GOV showed an increase of 0.8% in 2011. The GOV of the midstream P&P industry has slightly increased, except for the pulp and paper industry and other industries, as shown in Fig. 3.

2.2. Production analysis

The production of Taiwan's P&P industry accounts for about 1% of the world's supply per year, as most of the production is used to meet domestic demand. The IPI (Industrial Production Index) of the P&P industry in 2011 was 95.67 (Base: 2006 = 100), which was a

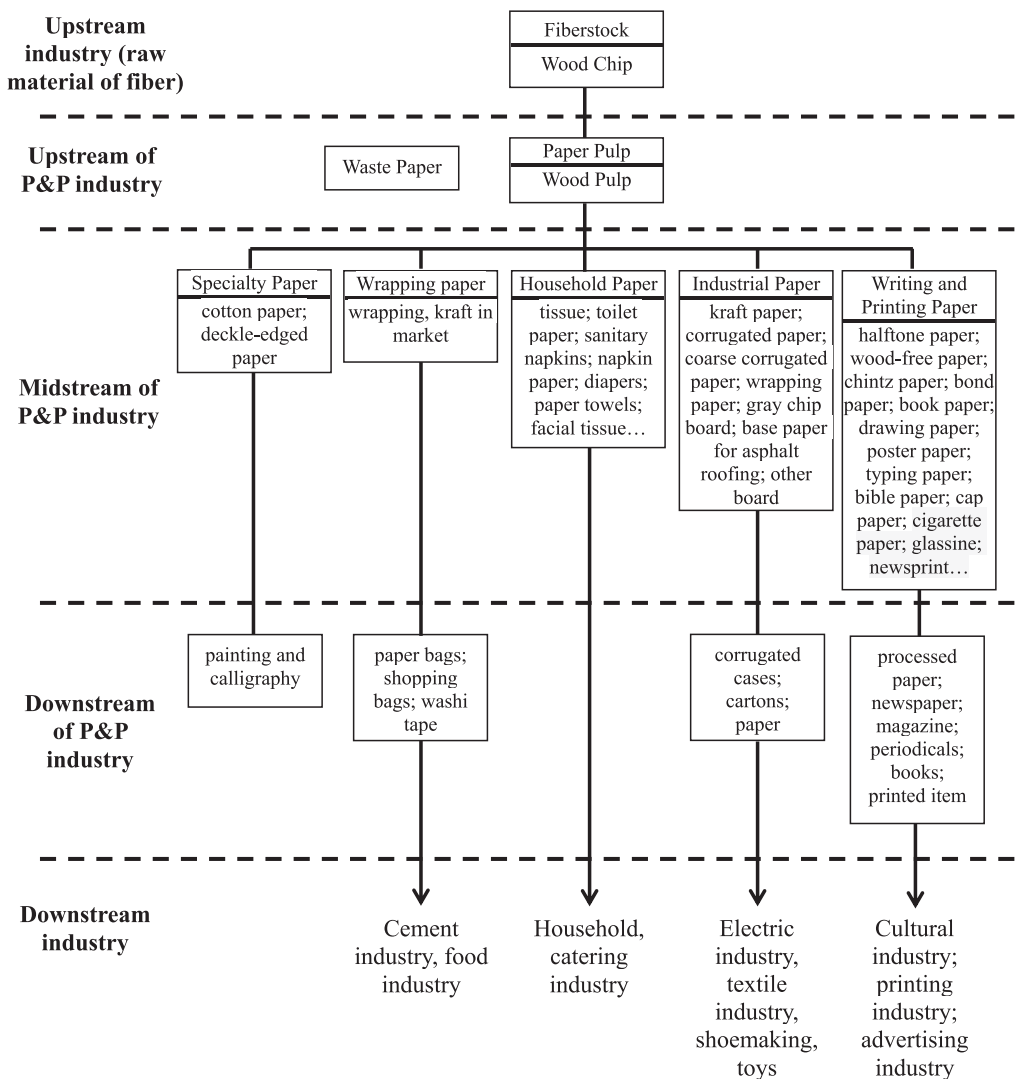


Fig. 1. Structure of Taiwan's pulp and paper industry (Source: Taiwan Paper Industry Association website-<http://www.paper.org.tw/TPA/>).

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