



Global warming action of Taiwan's semiconductor/TFT-LCD industries: How does voluntary agreement work in the IT industry?

Shih-Fang Lo*

International Division, Chung-Hua Institution for Economic Research, Taiwan

A B S T R A C T

Keywords:

Global warming
Greenhouse gas emissions
IT industry
Kyoto Protocol
Semiconductor industry
Taiwan
TFT-LCD industry
Voluntary agreements

Voluntary agreements have been widely used in policies and programs seeking to reduce greenhouse gas emissions because they offer greater flexibility than direct regulation. However, this approach is often criticized for being ineffective in developing countries, where government environmental regulatory frameworks may be weak, and local firms' environmental awareness lags behind that of more developed countries. We used Taiwan's semiconductor and TFT-LCD industries as a case study, with the aim of understanding the success factors that make voluntary agreements more effective. Based on their prosperous growth, we found that the two industries proactively set ambitious greenhouse gas reduction goals that are far tighter than those of most other businesses. We also found that the primary forces driving the Taiwanese IT industry are pressure from environmental trade barriers and international industrial associations, and customers' green procurement policies.

© 2010 Elsevier Ltd. All rights reserved.

1. Introduction

Emissions of greenhouse gases with high global warming potential (GWP), such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF₆), have received greater attention from policy makers after they were incorporated into the commitments of the Kyoto Protocol. These gases have a more powerful greenhouse effect than CO₂ emissions. For example, a ton of HFCs can be equivalent to thousands of tons of CO₂ over a 100-year period, as shown in Table 1. Growth in the use of these high GWP gases is affected by developments taking place within the industry. Initially, PFC emissions were largely a byproduct of primary aluminum production. Since the early 1980s, however, special solvent applications in semiconductor manufacturing began for an increasingly large share of global PFC emissions, followed by the booming thin film transistor/liquid crystal display (TFT-

LCD) industries [1]. In terms of reduced emissions of non-CO₂ gases, greenhouse gases (GHG) with high GWP also contribute tremendously to climate change.

Since direct regulation of GHG emissions is difficult, voluntary agreements have been used extensively in climate change policies [2,3]. The popularity of voluntary agreements stems principally from the perception that they allow flexible and inexpensive management of environmental problems. Voluntary agreements also can improve society generally by generating more private-sector investment in pollution controls before the public sector establishes stricter regulations. In industrialized countries, this approach has become quite popular over the past two decades [4,5].

Little is known, however, about whether voluntary agreements would be effective in developing and transitioning countries where local and federal environmental regulations typically are weak. A voluntary agreement policy is worthy of additional investigation in developing countries because their GHG emissions have increased dramatically in recent years.

* Tel: +886 2 2735 6006x531; fax: +886 2 2739 0610.

E-mail address: shihfang.lo@cier.edu.tw.

Table 1

Global warming potential (GWP) values.

Greenhouse gas	Chemical formula	IPCC	GWP
Carbon dioxide	CO ₂	1	
Methane	CH ₄	21	
Nitrous oxide	N ₂ O	310	
Hydrofluorocarbons	HFCs	150–11,700	
Perfluorocarbons	PFCs	6500–9200	
Sulphur hexafluoride	SF ₆	23,900	

Note: GWP values are based on the effects of greenhouse gases over a 100-year time horizon. Source: Intergovernmental Panel on Climate Change. See: <<http://www.ipcc.ch/>>

As a developing country with non-Party status vis-à-vis the Kyoto agreement, Taiwan responds voluntarily with efforts to mitigate global warming and to implement “no-regret” policies. Taiwan is a major manufacturer and exporter of information technology (IT) products, the fourth-largest in the semiconductor industry and the largest in the TFT–LCD industry. But the dramatic growth of these two industries has been accompanied by the growth of gases with high GWP. These industries use a number of gases classified as PFCs for both silicon etching and for cleaning the chambers of fabrication equipment.

Unlike conventional cases of GHG reduction, which required strenuous intense negotiations between the government and the relevant industries, the PFC emissions reduction programs in Taiwan have functioned quite smoothly and effectively. When compared to their prosperous industrial growth, the voluntary reduction goals are far more stringent than typical “business as usual” goals, which are proactively set by the IT industry. Therefore this study aims to identify and characterize the success factors that lead to voluntary agreements in developing countries. The high GWP gases were chosen as an example in order to investigate how Taiwan’s IT industry reacts to the issue of global warming.

2. Taiwan’s semiconductor and TFT–LCD industries

Taiwan is presently the seventeenth-largest economy in the world, and among the top 20 exporters and importers. Its high-tech industries were developed gradually over the past two decades, and today it has the fourth-largest information hardware industry and semiconductor industry in the world. These industries were critical to fueling Taiwan’s economic growth, in 2001 the government announced its national goal: the Two Trillion and Twin Star Industries Development Plan [6]. The goal was to promote the country’s so-called “Twin Star Industries,” namely, semiconductors and flat panel displays (FPDs), to achieve annual sales by 2006 of US\$57 billion–\$45 billion for semiconductors and \$12 billion for FPDs. In this section, we provide a brief overview of Taiwan’s semiconductor and TFT–LCD industries.

2.1. Semiconductor industry

Products associated with computers and integrated circuits (IC), such as PCs, electronic consumer products, notebooks, and their key components, collectively make up

the electronics high-tech industry. Global market demand for IC chips and semiconductors has grown along with the demand for these products.

The semiconductor industry can be roughly categorized into IC design, IC fabrication, IC packaging, and testing. The IC fabrication industry uses large amounts of chemicals because its manufacturing process is complicated, which makes this industry a major source of emissions in the semiconductor industry.

Semiconductor manufacturing is highly competitive, so to compete globally, companies in the industry require large amounts of capital investment either to establish new fabrications or for new designs and processes in current fabrications. Reducing costs and increasing manufacturing productivity are key factors to remaining profitable.

Taiwan is the fourth-largest economy manufacturer of ICs in the world. Fig. 1 shows the growth of Taiwan’s semiconductor industry, with total revenue expected to rise to more than US\$60 billion by 2010. Revenues from IC fabrication accounts for about half of total revenue.

2.2. TFT–LCD industry

By gradually replacing cathode ray tube (CRT) displays, flat panel displays (FPDs) are revolutionizing the way people look at computers. FPDs offer greater brightness, contrast, and environmental benefits such as low emission fields, no magnetic field, and reduced power consumption. One FPD application, the TFT–LCD, is the most promising. TFT–LCDs are widely used in PC applications, such as notebook and desktop monitors; in mobile devices such as PDAs, cellphones, and e-books; in car applications for navigation aids, safe-driving support, and rear-seat entertainment; and in home and office applications, such as TV, internet terminals, and e-newspapers. Like the semiconductor industry, the TFT–LCD industry is highly capital-intensive, requiring large amounts of capital to purchase manufacturing equipment, high levels of technology to ensure the liquid crystal’s stability and yield rate, and an abundant supply of labor for the final module assembly.

Taiwan now produces more than 46% of the world’s TFT–LCDs, the largest supplier in the world. Fig. 2 shows the growth in Taiwan’s TFT–LCD industry. In 2004, total revenue from the industry amounted to more than US\$14 billion. This trend is expected to increase rapidly in response to demand for TFT–LCD-related devices. In

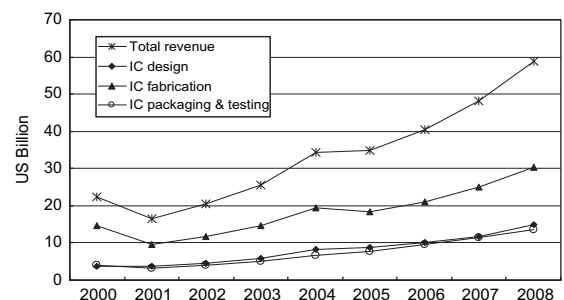


Fig. 1. Product revenue for Taiwan’s semiconductor industry. Note: Data for 2007 and 2008 are forecasts. Sources: refs. [7,8].

Download English Version:

<https://daneshyari.com/en/article/375255>

Download Persian Version:

<https://daneshyari.com/article/375255>

[Daneshyari.com](https://daneshyari.com)