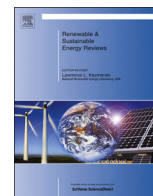




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Evacuated tube collectors: A notable driver behind the solar water heater industry in China

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ABSTRACT

A major reason behind China's dominant position in the solar water heater (SWH) industry in the world over recent years has been its technological choice of evacuated tube instead of flat plate collectors. Through continuous innovations in research and development, manufacturing, and marketing, China has ensured that evacuated tube SWHs satisfy consumer needs with low initial costs and short payback periods. SWH companies have also been able to generate considerable profits even without financial incentives from the government. Preliminary investigations of economic advantages of evacuated tube SWHs mainly resulting from innovations in China, imply that Chinese companies should continue to develop ways to minimize the cost of evacuated tube SWHs and to improve their quality rather than follow developments in industrialized countries where flat plate SWH technologies dominate.

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1. Introduction

Faced with the challenge of rapidly diminishing resources, particularly in the energy sector, and unfolding climate change impacts on energy demand and infrastructures, several countries including China have focused on the development of renewable energy, like hydro, wind, solar, biomass and so on over the past two decades. The solar water heater (SWH) industry in China, especially, witnessed a rapid growth during this period. Total installed capacity of SWHs in operation in China amounted to 180,400 MWth by the end of 2012, which corresponded roughly to an energy savings equivalent to 16 million tons of oil per year and a reduction of 49 million tons of CO₂. The annual growth rates of total installed capacity in operation and total output of SWHs in China were 20.9% and 20.5% respectively during the period 2001–2012 [1]. Total installed capacity in operation in China by 2011 accounted for 65.3% of the installed capacity around the world, increasing from 39.3% by 2003, while newly installed capacity in China in 2011 accounted for 84.0% of the world, increasing from 57.2% in 2000 [2,3]. Undoubtedly, China has become a world leader in SWH production and consumption.

Several researchers have tried to explore the main factors behind the rapid development of the SWH industry in China. Liu and Liu found that several factors may have contributed to China's leadership in the area of SWH production and consumption. These are governmental policies, innovations in technology, high profitability, competitive prices, a large market, new installation, lack of electricity and gas supplies, and cultural acceptance [4]. Li recognized that the main driver behind the rapid development of SWHs in China is the fact that SWHs can satisfy the daily hot water demands of residents reliably and at a reasonable price that competes favorably with electric and gas water heaters. In addition, he found that increasing conventional energy prices, improvement in living standards, the massive construction of new residences, as well as increasing awareness of environmental issues within the Chinese society, will provide impetus for further growth of the industry [5]. Hu et al. suggested that the main driver of the SWH industry in China lies in domestic demand, and pointed out that research and development and industrialization, products meeting the demand of the market, and the policies adopted have been instrumental in pushing forward the industry [6]. While Li et al. argued that SWH popularization has been accepted as a business opportunity in China [7], Luo et al. attributed the rapid development of the SWH industry in China to factors like benefit to people's livelihood, support from governmental policies, rapid economic growth, fast urbanization, residential construction on a large scale, and speedy technological innovations [8,9].

While some of these explanations for the expansion of SWHs seem reasonable, some of these explanations are not necessarily consistent with each other. For example, Li [5] and Hu et al. [6] suggested that the SWH industry has developed in China without incentive policies, while Liu and Liu [4] and Luo et al. [1,8,9] considered governmental policies as one of the factors contributing to the rapid development of the SWH industry in China. Furthermore, most of these studies so far have overlooked the important role that Chinese technological choice of evacuated tube collectors (ETC) instead of flat plate collectors (FPC) has played in pushing the fast development of the SWH industry all the time. SWHs consist of three major components – one or more solar water collectors, a water storage tank, and often an auxiliary heater. Based on the type of solar water collector used, SWHs are mainly classified as evacuated tube (collectors) SWHs and flat plate (collectors) SWHs. This study offers an initial appraisal of the role that ETC has played in helping shape developments of the SWH industry in China. By concentrating on economic performance criteria of alternative SWH technologies, this paper provides a groundwork for future research into the adoption of solar energy-based technology in China and other developing countries.

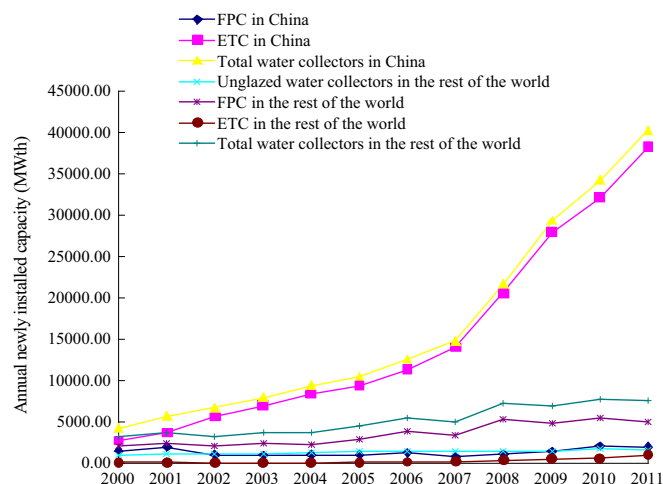


Fig. 1. Newly installed capacity of solar water collectors in China and the rest of the world, 2000–2011. Source: Ref. [2].

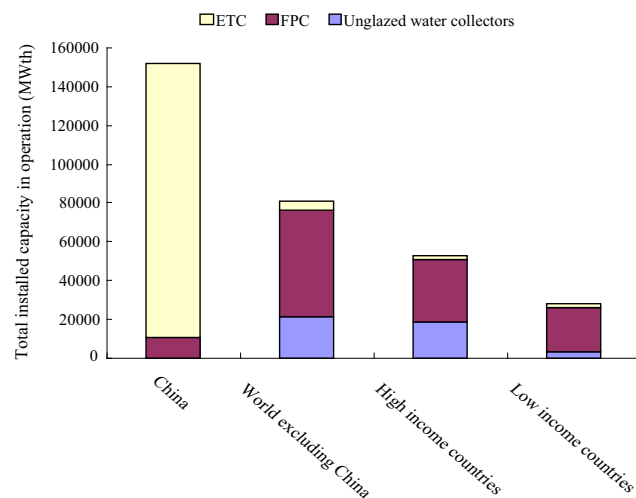


Fig. 2. Total installed capacity of water collectors in operation in China and the rest of the world, high income countries and low income countries by the end of 2011. High and low income countries refer to those countries with per capita GNI above and below US\$25,000 (PPP) respectively. Source: Ref. [2]; World Bank, <http://data.worldbank.org/indicator/NY.GNP.PCAP.PP.CD>, accessed on 10/10/2013.

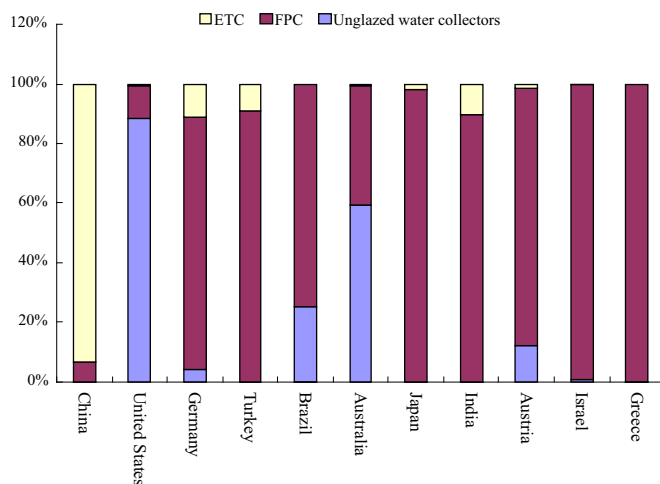


Fig. 3. Distribution by type of SWH for the installed water collector capacity in operation in China and the other 10 leading countries by the end of 2011. Source: Ref. [2].

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