Renewable Energy 36 (2011) 2694–2702

Contents lists available at ScienceDirect

Renewable Energy

journal homepage: www.elsevier.com/locate/renene

An analytical framework for energy policy evaluation

Chung-Chiang Chen*

Graduate Institute of Environmental Management, Nanhua University, 55, Nanhua Road, Section 2, Dalin, Chiayi 622, Taiwan

ARTICLE INFO

Article history:
Received 10 December 2010
Accepted 28 February 2011
Available online 31 March 2011

Keywords:
Energy intensity
Carbon intensity
Energy structure

ABSTRACT

This paper presents a framework to evaluate the effectiveness of energy policies and provides a contextual view of measures on energy polices in linking with the objective of a sustainable economy. Firstly, Taiwan's energy policy is overviewed by analyzing the energy-related data to examine its deficit according to the framework presented. This paper finds that the energy policy adopted fails to attain the objective of a sustainable economy because energy consumption and CO_2 emissions still keep upward trends. It also concludes that an energy policy should focus on (1) improving energy efficiency, (2) reshaping industry structure and (3) improving energy structure. In other words, the energy policy maker should create an environment that can motivate the development of clean energy supply and utilization for the achievement of energy policy objectives.

1. Introduction

Energy consumption and electricity generation not only bring about the exhaustion of natural resources, but also are accompanied with a variety of air pollution as well as carbon emissions even though a great amount of effort is devoted to improve environmental pollution via abatement investments. For example, a thermal oil powered plant may release a variety of pollutants like SO_x, NO_x and other chemicals in addition to CO_2 emissions in its operating phase. Conventionally, environmental or energy policies concentrate more on the abatement of conventional pollutants, but recently, especially after the signature of Kyoto Protocol, environmental concern has extended to the mitigation of greenhouse gas (GHG) emissions. Several international meetings were held in an attempt to reduce the greenhouse gases emissions and eventually the Kyoto Protocol was concluded in 1997 as a common agreement that asked industrial countries to cut their greenhouse gas (GHG) emissions by averagely 5.2% at the level of 1990 emissions.

Among the 6 GHGs, the CO_2 emission is seen as a seriously global problem. It has received increasing attention and become an important role in affecting energy policies. In general, the energy policy adopted by each country reflects the degree of each government's attempts and supports to attain a low carbon economy of sustainable development.

In the past, many researchers have presented different types of models such as energy planning models, energy supply–demand models, forecasting models, renewable energy models, emission-reduction models, and optimization models to discuss the relevant issues in association with energy consumption or the development of renewable energy source. For example, Rijal et al. [24] had presented a linear multiple regression energy demand forecasting model to forecast the energy demand in developing countries. Borges and Pereira [27] present a two stage model for energy demand in Portuguese manufacturing sector. Labys [14] presented an econometric method to provide an approach for modeling supply processes where time delays, lags and capital formation are incorporated into the model.

It is generally accepted that the development and promotion of renewable energy play a key role for the goal of CO_2 mitigation. To analyze the important role of energy policies in affecting the development of renewable energy, many authors present a variety of frameworks (e.g. [1] and [18]). Mitchell et al. [20] employ the framework presented by Foxon et al. [9] to evaluate the effectiveness of the renewable electricity policies introduced in England and Germany. They argue that risk reduction is an important criterion in evaluating the effectiveness of policies in supporting renewable electricity. MacKenzie [28] proposes an analytical approach based on a universal logistic growth curve to establishing the minimum fraction of each country's CO_2 emissions that can arise from non-fossil sources. In his paper, a universal logistic curve relating this fraction to time with complete penetration of non-fossil sources by the end of this century was proposed. He argues that the thrust of his proposal is that "every country would follow the same requirements curve and would have to arrange its energy supply and demand so that the minimum percentage indicated would come from non-fossil sources such as solar, photovoltaic, wind, geothermal, biomass, and nuclear." (p. 1184).

* Tel.: +886 5 2427112; fax: +886 5 2427113.
E-mail address: ccchen@mail.nhu.edu.tw.

0960-1481/$ – see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.renene.2011.02.023

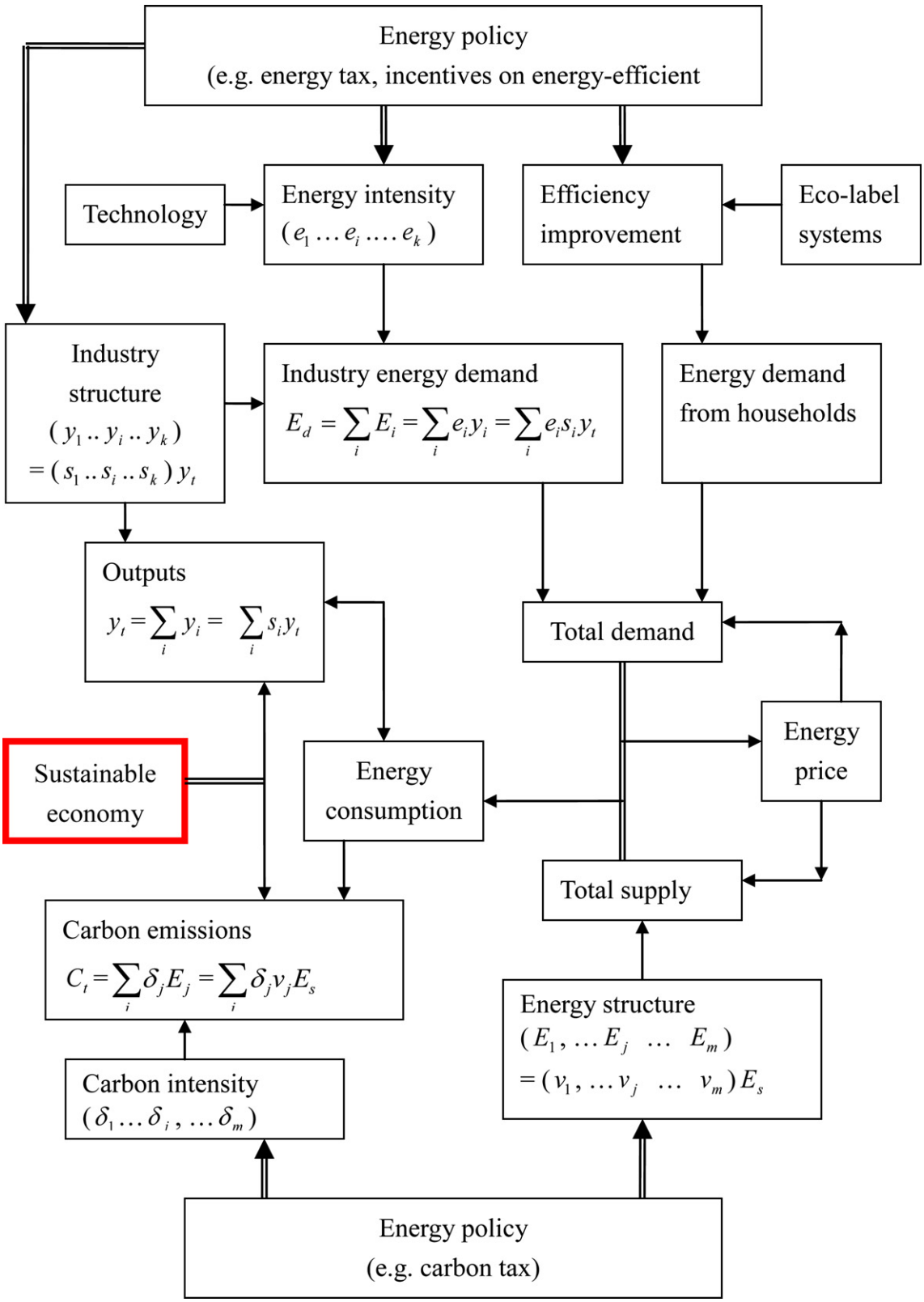

Fig. 1. The analytical framework for the assessment of energy policy.

This paper attempts to assess the appropriateness of energy policies by developing a framework in which it integrates energy demand and supply to link with CO_2 emissions. This framework provides a better understanding on the relationship between energy policies and sustainable economies that consider the integration of energy consumption and CO_2 emissions. Taiwan is employed as a case example and thus first its energy policies adopted are reviewed in Section 3. And then the historical trend of