ELSEVIER

Energy Policy 34 (2006) 2662–2676

ENERGY POLICY

www.elsevier.com/locate/enpol

Outcome indicators for the evaluation of energy policy instruments and technical change

Lena Neij[a,*], Kerstin Åstrand[b]

[a]International Institute for Industrial Environmental Economics, Lund University, P.O. Box 196, 221 00 Lund, Sweden
[b]Department of Environmental and Energy System Studies, Lund University, Gerdagatan 13, 223 62 Lund, Sweden

Available online 31 May 2005

Abstract

The aim of this paper is to propose a framework for the evaluation of policy instruments designed to affect development and dissemination of new energy technologies. The evaluation approach is based on the analysis of selected *outcome indicators* describing the process of technical change, i.e. the development and dissemination of new energy technologies, on the basis of a socio-technical systems approach. The outcome indicators are used to analyse the *effect,* in terms of *outcome,* and *outcome scope* of the policy instruments as well as the extent to which the policy instruments support diversity, learning and institutional change. The analysis of two cases of evaluations, of energy efficiency policy and wind energy policy in Sweden, shows that the approach has several advantages, allowing continuous evaluation and providing important information for the redesign of policy instruments. There are also disadvantages associated with the approach, such as complexity, possible high cost and the requirement of qualified evaluators. Nevertheless, it is concluded that the information on the continuous performance of different policy instruments and their effects on the introduction and dissemination of new energy technologies, provided by this evaluation approach, is essential for an improved adaptation and implementation of energy and climate policy.

Keywords: Evaluation; Outcome indicators; Energy policy instruments

1. Introduction

Climate change has become a major political concern for governments all over the world. Many governments have signed the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC) and hence committed themselves to reduce greenhouse-gas emissions. The commitment includes the adoption of policies and policy instruments for short-term emission reductions and long-term transition from existing energy systems towards energy systems that do not create "dangerous anthropogenic interference with the climate system" (UNFCCC, 1992). A core issue for climate policy is the design, implementation and evaluation of policy instruments that have an effect on *technical change* in the energy field; i.e. development and dissemination of new energy technologies for the supply of renewable energy and more efficient energy conversion and use.

The governmental commitments to reduce emissions and the employment of policy instruments and programmes to reach climate and energy policy targets have raised issues concerning *evaluation*. Public policy evaluations are essential for the *verification* of results and impacts of policy instruments on greenhouse-gas emission reduction and development of energy systems. Evaluations are also essential for an *enhanced understanding* of ongoing policy processes, including the process of technical change. Improved understanding and learning of technical change are vital for the modification and improvement of policy and, not least, for future policy decisions. At present, several countries

*Corresponding author. Tel.: +46 46 222 0268; fax: +46 46 222 02 30.
E-mail address: Lena.Neij@iiiee.lu.se (L. Neij).

0301-4215/$ - see front matter © 2005 Elsevier Ltd. All rights reserved.
doi:10.1016/j.enpol.2005.03.012

are starting to set up guidelines and strategies for the monitoring and assessment of policy instruments for climate change. A key question is which methods should be used for the evaluation.

Effectiveness is one important evaluation criteria. Evaluations of energy policy instruments have usually measured effectiveness through analysis of *impact* of the policy instruments, in terms of e.g. saved energy, installed capacity and reduced emissions. The issue of impact assessment of climate and energy polices has been explored and indicators of impact have been developed, on both the EU level as well as on national level. Such indicators have been referred to as, for example, environmental indicators, sustainability indicators, energy indicators and socio-ecological indicators (see, for example, OECD 1998, 2001, 2002; European Environment Agency 2001a; Azar and Holmberg 1996; The European Commission 2004). Nonetheless, the conventional impact assessments only provide limited information on the performance of different policy instruments. The evaluation of impact is focused on the results of policy implementation and does not provide information on *how* policy instruments did, or did not, affect the process of technical change. To capture the process of technical change in energy systems, traditional evaluation methods need to be improved and developed further.

The aim of this paper is to propose a framework for the evaluation of energy policy instruments; a framework that improves and complements conventional evaluation approaches of policy instrument effectiveness. This suggested approach focuses on the *outcome* of policy instruments, i.e. changes in the system caused by the policy instruments, rather than the final impact achieved. The changes, here referred to as outcome, could be e.g. improved technologies, changes in knowledge, changes in actors' behaviour, changes in authorities' routines, etc. The suggested evaluation approach is based on the use of *outcome indicators*. The outcome indicators can be applied to analyse changes, or non-changes in a socio-technical system as a whole. Furthermore, the outcome indicators can be used to evaluate the performance of policy instruments on a regular basis.

Although the focus of earlier evaluations of energy policy instruments has to a great extent been on the instrument impacts, as described above, there are also evaluations which have considered policy instrument outcome and changes in, for example, technology development and in different actors' involvement and behaviour. The use of parameters that can be regarded as "outcome indicators" was introduced in the 1990s in the publications of, for example, Prahl and Schlegel (1993), Feldman (1994–1996), Rosenberg (1995) and Neij (2001). In contrast to these previous studies, the work presented in this paper does not only stress the importance of evaluating the outcome of policy instruments and to use outcome indicators—this paper also stresses the importance of applying an *outcome scope*. The outcome indicators need to reflect changes in the socio-technical system as a whole and should not be limited to analyses of isolated effects. Evaluations of the outcome scope, using outcome indicators, will tell us where changes have been observed, what type of changes that occur and about non-changes in a socio-technical system. Such an evaluation approach will not only improve our understanding of how policy instruments affect technical change, it will also provide information on how to redesign an ongoing policy programme and how to design future policy instruments for technical change. This evaluation framework can also be used to analyse the extent to which policy instruments support diversity, learning and institutional change—three important aspects of successful policy interventions supporting the introduction and dissemination of new energy technologies.

This paper discusses advantages and disadvantages of the use of outcome indicators and outcome scope. First, however, a theoretical introduction to evaluation of policy instruments and evaluation of technical change based on outcome indicators is presented in Section 2. In Section 3, a framework for evaluation using outcome indicators is developed. This Section is followed by two cases of evaluations, illustrating the empirical use of outcome indicators. The first case is the evaluation of energy efficiency and the Technology procurement programme in Sweden (see Section 4). For this case, parameters identified as outcome indicators were used for evaluation already in the 1990s (see also Neij, 2001). The second case is the evaluation of wind energy policy in Sweden for the development and dissemination of wind energy and wind turbines (see Section 5). For this case, outcome indicators and an outcome scope have been applied evaluating the programme (see Åstrand and Neij, 2005). The paper is concluded with a discussion of advantages and disadvantages of a system-oriented evaluation framework and the use of outcome indicators.

2. Evaluation of technical change based on outcome indicators

A shift from the energy technologies dominating at present to new energy technologies for efficient energy use and for the utilisation of renewable energy resources is a complex process that is not limited to changes in technology. Technology cannot be separated from its social context; there is a "seamless web" that keeps technology and society together, to use a metaphor by Bijker et al. (1987). Hence, technical change involves changes in the entire *socio-technical system*, including