Environmental Impact Assessment Review 71 (2018) 1–11

Contents lists available at ScienceDirect

Environmental Impact Assessment Review

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

Analysis of strategic environmental assessment in Taiwan energy policy and potential for integration with life cycle assessment

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ARTICLE INFO

Keywords:
Strategic environmental assessment
Life cycle assessment
Energy policy

ABSTRACT

Strategic environmental assessment (SEA) has been implemented in many policies in the European Union since 2001. In Taiwan, SEA has been implemented for 28 cases since 2001, which includes various types of policies. National energy policy is the most challenging type. There are three most important steps in SEA process: alternative planning, scoping, and impact assessment. However, the current limitation of method application affects the effectiveness of SEA. In this case, life cycle assessment (LCA) is integrated with SEA for clarifying the role of LCA in whole SEA process. The method of combining LCA and SEA has been developed and is applied in a case of Taiwan's energy policy. Benefits from LCA in alternative planning, scoping, and impact assessment steps are explored. Finally, suggestions for enhancing LCA's application, for scoping operation, and for the improvement of SEA are proposed.

1. Introduction

1.1. Strategic environmental assessment in Taiwan

In 2000, the definition of strategic environmental assessment (SEA) was still ambiguous (Brown and Thérivel, 2000). However, in recent years, more and more SEAs have been performed in different areas (e.g., land use policy, waste policy, energy policy, water policy), as well as in different countries (Tetlow and Hanusch, 2012).

In Taiwan, after the environmental impact assessment (EIA) law was enacted in 1994, the Taiwan Environmental Protection Agency (TEPA) began to elaborate on SEA-related regulations, including the SEA report rules (regulation concerning the items that should be included). Two SEA-related regulations in Taiwan are Article 26 of the EIA Act and the governmental strategic environmental assessment report operational rules. The former lists the public policies that must be included in SEA processes. The latter includes the details that must be included in SEA reports, including the content of an SEA report, evaluation categories in the references, the content of former categories, and the presentation of evaluation results. The content of an SEA report includes: 1) the policy planning authority and names of relevant authorities, 2) the purpose of the relevant government policy, 3) the policy content and background, 4) alternative analysis, 5) impact assessment evaluation and prediction, 6) strategies for prevention or minimization of impacts, and 7) conclusions and advice; all of which are common for typical SEA cases.

Currently, the definition and scope of an SEA is in the exploration stage. Some studies have focused on the impact assessment function in SEAs, and have found a suitable impact assessment method that could be used as part of an SEA process. Some studies have broadened SEA applications, like institution-centered SEAs, which need to consider more factors regarding the political context, public participation, communication between stakeholders, or policy planning process. Because the SEA purpose and policy goal are different, there are different types of SEA implementations (Noble and Nwanekezie, 2017; World Bank, 2012).

The context of the development goal determines which approach is most appropriate. The current SEA institution in Taiwan energy policy is an impact-centered SEA, which is the most common type of SEA. The purpose of an impact-centered SEA is to evaluate the impacts of the proposed policy, plan, or program (Noble and Nwanekezie, 2017). Thus, the main function is an “impact assessment”, which is similar to EIA. Because SEA evolved from EIA, most experts and the government will perform impact-centered SEA. The above Taiwan SEA regulation satisfies the requirements of an impact-centered SEA, and the process for this SEA follows the steps described in Section 2.2 and Fig. 1.

1.2. Life cycle assessment contribution to impact assessment

In the impact-oriented SEA process, which includes most current SEA cases, the impact assessment step is the core step for evaluating the environmental impacts of each alternative. As a result, the decision maker may select an alternative based on evaluation results. During the

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https://doi.org/10.1016/j.eiar.2018.03.005
Received 1 January 2017; Received in revised form 28 January 2018; Accepted 20 March 2018

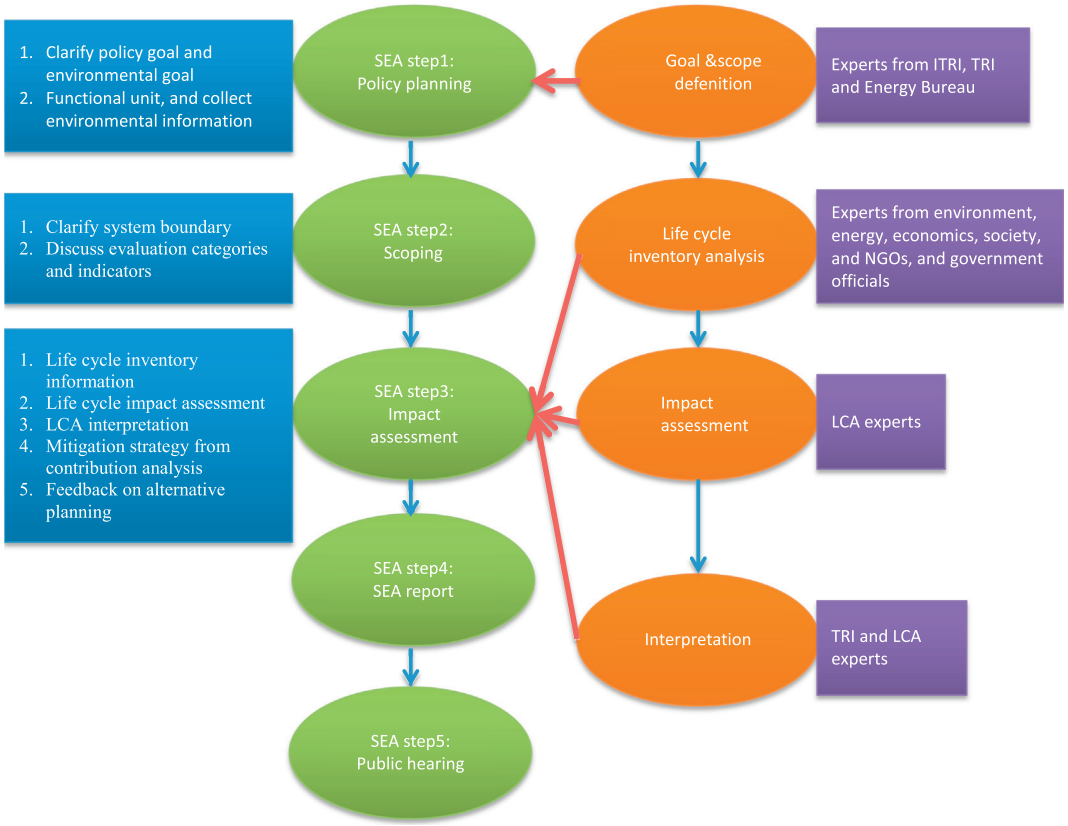

Fig. 1. Flow chart showing the process of integrating LCA into SEA.

early stage of SEA development, qualitative methods were typically applied (i.e., matrix approach or expert judgment), but the limits of subjective judgment and evaluation uncertainty have resulted in the use of more quantitative methods in recent years, such as GIS, multi-criteria decision analysis, or life cycle assessment (LCA).

Integration of different methods to enhance their advantages is required to provide more complete evaluation results (Jeswani et al., 2010; Tajima and Fischer, 2013). LCA has been applied in EIA industrial projects to solve the shortage of site-generic impacts in traditional EIA processes (Cornejo et al., 2005). Comparisons between EIAs and LCAs have been made in previous studies. Morero et al. (2015) focused on the different impact assessment advantages and limitations of each method; LCA provides a complete life cycle evaluation and global system boundary advantages, whereas EIA assesses socio-economic and environmental impacts. Manuilova et al. (2009) indicated that the type and nature of the methods also differs; EIA is a process-based method and LCA is an analytical method.

The above findings describe how LCA can aid in impact assessment when integrated into an EIA. However, LCA can contribute to other EIA processes (Larrey-Lassalle et al., 2017). For example, in the scoping step, key impact issues can be clarified and verified, and the midpoint hot spots that cause damage to endpoint indicators can be found. During the impact assessment step, a contribution analysis should be used to find the difference between foreground and background impact information, as well as local, regional, and global impacts.

In addition to adding value to different steps of the EIA process, LCA can also help propose an improvement strategy for EIA. Impact hot spot analysis could be applied to find the core problem in the product life cycle (Židonienė and Kruopienė, 2015). Therefore, the key impact stage can be improved through developing different scenarios or alternative strategies.

The above studies have shown that LCA is an important analytical method for predicting environmental impacts, no matter the product or policy level. Compared to the EIA process, the SEA process is used to evaluate higher-level environmental impacts of policies, plans, and programs. Therefore, SEA can have higher potential to bring more flexibility to EIA. Compared with EIA, SEA could more flexibly integrate impact assessment methods, and have a greater influence on alternative planning, scoping, or impact assessment step. The transparency and public participation of SEA is better than EIA, which will influence the implementation effectiveness of impact assessment. Moreover, SEA is an iterative process, which has greater potential to integrate different tools (like cost-benefit analysis or LCA) to achieve the policy goal. Liou and Yu (2004) suggested that no single SEA method could be applied to all policy types. In 2000, some authors proposed the integration of LCA with EIA and SEA (Finnveden and Moberg, 2005; Tukker, 2000). Furthermore, Bjorklund (2012) and Bidstrup et al. (2015) integrated LCA and SEA when implementing civil energy planning and land use planning.

Most analytical methods can be easily integrated into procedural methods. In this study, a new impact assessment process is developed to solve some of the challenges mentioned above. LCA can be integrated into the SEA process, providing advantages not only for the impact assessment step but also in the policy planning and scoping steps. The four steps of the LCA method can be seamlessly connected to the SEA steps. Taiwan's energy policy, which is the most challenging SEA type because of the complexities due to energy composition and social expectations, was used in this SEA case study. This energy policy was proposed by ex-president Ma Ying-jeou and represents the direction of the Chinese Nationalist Party's (KMT) energy policy. The LCA integration process is described in the following sections.

1.3. Research goals

In Taiwan, SEA has been employed for 28 cases since 2001, including for various types of policies. National energy policy belongs to