

Chapter 2

The Role of the Society of Environmental Toxicology and Chemistry (SETAC) in Life Cycle Assessment (LCA) Development and Application

James A. Fava, Andrea Smerek, Almut B. Heinrich and Laura Morrison

Abstract Although there was a demand for environmental health data on chemicals, there was no global scientific organization able to talk about the science behind the regulations being developed. The Society of Environmental Toxicology and Chemistry (SETAC) was founded in 1979. SETAC has three strengths: its global scale, its tripartite membership and governance, and its scientific base. Because SETAC was developed on an international scale, it has been able to address global environmental issues.

The SETAC North American LCA Advisory Group is a formally recognized group within SETAC that has been in existence since June 1991. Similarly, SETAC Europe established an LCA Steering Committee. Both the LCA Advisory and Steering Committee are referred to as the SETAC LCA Groups.

The LCA Groups report to the Board of Directors of both SETAC and SETAC Europe. Specific activities such as workshops, conferences, or educational material development, including ‘position papers’, are approved by the Board of Directors. During the 1990s these SETAC LCA Groups were instrumental in driving the scientific progress to codify the professional practice of LCA. During this time period, several major workshops were successfully organized and over a dozen key publications produced. The SETAC LCA Groups also broadly supported the initial preparation of the ISO 14040 series of voluntary international standards as well as their subsequent revisions.

J. A. Fava (✉)
PE INTERNATIONAL, Inc., 626 Meadow Drive,
19380, West Chester, PA, USA
e-mail: j.fava@pe-international.com

A. Smerek
PE INTERNATIONAL, Inc., Ottawa, ON, Canada

A. B. Heinrich
Heidelberg, Germany

L. Morrison
PE INTERNATIONAL, Inc., Boston, MA, USA

W. Klöpffer (ed.), *Background and Future Prospects in Life Cycle Assessment*,
LCA Compendium – The Complete World of Life Cycle Assessment,
DOI 10.1007/978-94-017-8697-3_2, © Springer Science+Business Media Dordrecht 2014

The general mission of the SETAC LCA Groups is to proactively advance the science and application of LCAs to reduce the resource consumption and environmental burdens associated with products, packaging, processes or activities.

Although life cycle assessment promised to be a valuable tool in evaluating the environmental consequences of a product, process, or activity, the concept was relatively new and required a framework for further development.

The workshop, 'A Technical Framework for Life Cycle Assessments', held August 18–23, 1990, at Smugglers Notch, Vermont, was organized by SETAC to develop a framework and consensus on the current state of LCA and research needs for conducting life cycle assessments. Although life cycle assessments have been used, in one form or another, before the name was coined, this workshop report is the first document which presented the name of the method.

The four SETAC LCA workshops in Smugglers Notch (1990), Leiden (1991), Sandestin (1992) and Wintergreen (1992) formed a tiered process to culminate in the Code of Practice workshop of Sesimbra, Portugal, March 31–April 3, 1993.

Developing international consensus on harmonized methods has been a goal of the SETAC LCA workshops. The 'Code of Practice' completed the harmonization process. Shortly after the workshop, during the autumn of 1993, the ISO standardization process was initiated.

In 1994, as a result of the SETAC LCA workshops, the LCA Advisory Group of SETAC and the LCA Steering Committee of SETAC Europe established individual work groups to address specific LCA issues.

SETAC's working groups and workshops have advanced both the application and reputation of Life Cycle Assessment (LCA) by authoring LCA publications, supporting the development of LCA standardization, partnering with United Nations Environmental Programme (UNEP), and advancing the use of LCA in various sectors. As SETAC grows and expands on its own and with its supporters and partners, it will continue to advance the understanding and use of LCA while ensuring that science is kept at the forefront of LCA development.

Keywords Global coordinating group (GCG) • International organization for standardization (ISO) • LCA in developing countries • LCA in the building sector • Life cycle assessment (LCA) • Pellston workshops • SETAC Europe LCA steering committee • SETAC LCA groups • SETAC North American LCA advisory group • UNEP/SETAC Life cycle initiative • Work groups life cycle impact assessment • Work groups simplified/Streamlined LCA • Workshop Leiden • Workshop Sandestin • Workshop Sesimbra • Workshop Smugglers Notch • Workshop Wintergreen

1 Introduction—SETAC and Life Cycle Assessment

Google labs' Books Ngram Viewer allows any user to graph the frequency of occurrence of words or phrases in Google's database of 500 billion words from digitized books. That technology enticed the senior author to investigate the relationships of

a number of Life Cycle Assessment (LCA)-related words over time. One combination, 'SETAC' (Society of Environmental Toxicology and Chemistry) and 'life cycle assessment,' yielded a very interesting observation for the years 1980–2008.

The 'SETAC' acronym first appeared in books in the 1980s. The frequency of appearance grew steadily from 1990 through 2004, showing a tenfold increase. In 1990, SETAC sponsored an international workshop where the term 'life cycle assessment' was coined. SETAC subsequently established the accepted name (and framework) for life cycle assessment (Fava et al. 1991). Previously, a few practitioners in the United States and Europe used different terms such as 'Resource and Environmental Profile Analysis' (REPA) (Hunt and Franklin 1996).

The occurrence of the phrase 'life cycle assessment' in books grew very similarly to the occurrence of 'SETAC' from 1990 through 2004. Was this a coincidence or were there activities within SETAC that contributed to this parallel growth? As growing interest in green buildings and sustainable products (to name a few drivers) increased the use of LCA, a review of the recent history behind SETAC's role was required. Klöpffer (2006) provides an excellent summary of the role of SETAC in the development of LCA; and Ekvall (2005) outlines the further advancement of LCA by SETAC's LCA working groups.

2 Life Before SETAC's Involvement with LCA

2.1 *Focus on Pollution Reduction*

In 1969, the Cuyahoga River in the United States became infamous for being 'the river that caught fire'. This event helped spur the environmental movement. The river burned because of pollution dumped in it by nearby industrial and waste water operations. At the time, there were few environmental laws providing direction or restriction of environmental releases for companies. The river that caught fire became a national symbol of the fundamental flaws in the way society treated the environment.

Laws and regulations were instituted in the early 1970s that placed new and/or additional controls on point-source releases of waste from treatment facilities and industrial operations. As a result, the water quality of the rivers improved. There is still much to learn about the risks of ingredients and emissions from our products and processes that enter our rivers and waterways, but significant progress has been made.

These governmental and regulatory expectations, placed on companies and government behavior, primarily related to the management of emissions and waste from manufacturing operations (and later the cleanup of abandoned or contaminated land). They were instrumental in creating a change for improved environmental management.

In the 1980s, many regulatory approaches to environmental protection continued to be based on ‘end-of-pipe’ solutions that focused on a single medium (e.g., air, water, or soil), a single stage in the product’s life cycle (e.g., production, use, or disposal), or a single issue (e.g., individual chemical limits). Such strategies did not always lead to a net environmental benefit. Environmental laws and regulations that have a single focus often force the use of pollution control resources in ways that are not optimal for reducing overall impacts.

The attempt was made to solve a single environmental problem without considering the interconnectivity of natural systems. Designed legislation, although intended for a specific purpose, has regularly created additional, unexpected environmental problems. Single-issue approaches are often not designed with a systematic understanding of the tradeoffs and their implications. Thus, they frequently diminish opportunities for achieving net environmental improvements.

One of the rapidly evolving landscapes in business today is adaptability to the changing nature of environmental impact management. This occurs as scope expands from a single site and/or issue to a full understanding of the impacts of our products over their entire life cycles. Many advertisements pitch ‘green’ product traits, but all products have environmental impacts. Materials and crude oil are extracted from the earth, processed, combined with other materials to make parts, assembled into finished products, shipped to customers, and ultimately delivered to final consumers who use the products and dispose of them. Along that value chain, energy is used, waste is generated, and more natural resources are consumed. Sustainability will require us to continue creating value for society while reducing environmental and social impacts.

2.2 Moving Beyond Pollution Control to Pollution Prevention

With the improvement in the treatment of air and water emissions and waste from manufacturing operations, there was recognition that end of pipe treatment can only go so far. Additional examination of what enters the end-of-pipe treatment was needed. This led to the development of pollution prevention and pre-treatment programs. These programs were not as influenced by explicit government regulations. It did become clear, at least in some groups, that preventing pollution from entering the environment could save the organization money and protect the environment. 3M’s Pollution Prevention Pays (3P) program, was a landmark program initiated in the 1980s which has saved 3M 1.2 billion dollars worldwide. As well, it has prevented 2.9 billion pounds of pollutants from entering the environment.

In the 1970s and 1980s, there were a number of studies and situations that created the demand for additional information on environmental impacts of products. These were primarily driven by solid waste management issues. Three in particular are relevant to this conversation¹: (1) duelling diaper debates; (2) mercury in fluorescent light bulbs; and (3) Coco-Cola demanding supply chain improvements.

¹ These were presented in Fava (2012) Life cycle knowledge informs greener products, Chap. 25, in: Curran MA (ed) LCA Handbook—a guide for environmentally sustainable products.

2.2.1 Duelling Diaper Debates

Many of us remember the garbage barge that went up and down the east coast of the United States in the late 1980s looking for a disposal site. In this period, there were concerns about the significant amount of solid waste that society was generating. Today that concern remains, but society has realized that there is a broad and growing array of environmental issues. A study by the cloth diaper industry revealed that the use of cloth diapers did not create as much solid waste as the use of disposable diapers (now called single-use diapers). Subsequently, there was a push to use more cloth diapers and reduce the number of single-use diapers sent to landfills. However, additional studies, using methods including life cycle assessment, showed that cloth diapers also have meaningful environmental impacts during use (e.g., heating water for washing). It became unclear which product was actually better. The 'Duelling Diaper' LCA studies raised awareness of the diversity of environmental impacts that products can create and the environmental trade-offs between product options.

What did we learn? One of the most significant lessons was the realization that, depending upon the impact in question and where it occurs, different and equally valid interpretations can result. These early studies revealed that all products have impacts on the environment. LCA tools enable decision makers to use new and additional information on multiple metrics to make better-informed decisions. A clear recognition of the importance of continuing to ensure performance of the product is maintained and improved.

2.2.2 Mercury in Fluorescent Light Bulbs

Society and policy makers were faced with demand to reduce mercury levels associated with lighting systems in order to reduce the overall release of mercury into the environment. While incandescent bulbs contain no mercury, mercury is a critical element in fluorescent bulbs that increases efficiency and durability. The resulting reduction in energy consumption causes a corresponding drop in mercury emissions from coal-fired power plants. Due to the concern about mercury entering the environment from landfills, policy makers were wrestling with two options: banning fluorescent lamps from municipal solid waste (MSW) facilities or encouraging greater use of fluorescent lamps over incandescent lamps. If we only consider the amount of mercury that might enter the environment as a result of bulb disposal, it is clear that significantly more mercury would come from fluorescent bulbs because incandescent bulbs don't contain any mercury.

However, if we expand the system boundaries to include the use phase of the bulbs in addition to their disposal, what does the data reveal? Surprisingly, we find that the use and disposal of incandescent lights released into the environment, on average, *four to ten times as much mercury* as the use and disposal of fluorescent lights. This is due to the additional power plant emissions created by the inefficient incandescent bulbs during the use phase. The US Environmental Protection Agency

(EPA) estimated, in the early 1990s, that the use of fluorescent lights will also eliminate the following:

- 50 % of aggregate national electricity demand;
- 232 Million t of CO₂ emissions each year;
- 1.7 Million t of SO₂ emissions each year; and
- 0.9 Million t of NO₂ emissions each year.

Clearly, when the system boundaries and the impacts of interest are expanded to include bulb use as well as disposal, the better decision is to encourage greater use of fluorescent bulbs. This was, in fact, the direction taken by policy makers: *use fluorescent bulbs* but challenge lighting companies to *reduce the mercury in those bulbs*. This policy enabled reduction of mercury releases and encouraged innovation to develop lighting systems containing less mercury. Philips' Sustainable Lighting Solutions and its ALTO[®] bulbs² are good examples of environmentally responsible lighting because they contain less mercury, are Toxicity Characteristic Leaching Procedure (TCLP³) compliant, energy efficient and last longer. Responsible lighting solutions result in fewer light bulbs in landfills and further reduce the impact on the environment.

What did we learn? By taking a broader systems approach, we can make better decisions. Using this systems thinking, the lighting sector has produced innovations over the years to develop better products with lower environmental impacts.

2.2.3 Coca-Cola's Supply Chain Improvements

In the early 1970s, the Coca-Cola Company conducted a study of its beverage containers. The results showed that all of their beverage containers had real environmental impact. In response, Coca-Cola decided to challenge the material and container companies to make adjustments to their products and processes that would result in reduced life cycle environmental impacts over previous design options. This was contrary to common practice at the time to simply ban or deselect the poorest-performing material(s)⁴. For Coca-Cola's aluminum cans, the sector worked with local governments to develop a recycling infrastructure for the used beverage containers, resulting in a reduction of more than 90 % in the energy used throughout the life cycle of the aluminum beverage container. Other material groups made similar improvements in a response to Coca-Cola's challenge.

What did we learn? LCA study results should be used to improve product environmental performance. As Coca-Cola chose not to ban any of the high environmental

² <http://www.usa.philips.com/c/fluorescent-tubes/296298/cat/en/>.

³ The Toxicity Characteristic Leaching Procedure (TCLP) is designed to determine the mobility of both organic and inorganic analytes present in liquid, solid, and multiphasic wastes. <http://www.epa.gov/osw/hazard/testmethods/sw846/pdfs/1311.pdf>.

⁴ Information based on personal conversations with Coca-Cola employees.

burden materials, they created an atmosphere that allowed for material innovation such as the development and financing of a recycling infrastructure to recapture the inherent value in the aluminum.

3 The Birth of SETAC

Rachel Carson's 'Silent Spring'⁵ was published in 1962 and the world was awakened to the implications of wide spread chemical and pesticide use on the environment. Federal laws around the world were passed that began to demand additional information on the fate and effects of chemical use on the environment. This information was to inform the determination related to what might be acceptable and safe use and application rates for chemicals and pesticides used in commerce. However, this created a need for internationally acceptable methodologies and risk assessment frameworks. These frameworks could be applied and used to examine and evaluate the safe and acceptable levels of chemical use. Although there was a demand for environmental health data on chemicals, there was no global scientific organization able to talk about the science behind the regulations being developed.

In 1979, The Society of Environmental Toxicology and Chemistry (SETAC) was founded to serve as a non-profit professional society to promote the use of multi-disciplinary approaches in the study of environmental issues. SETAC has three unique strengths: its global scale, its tripartite⁶ membership and governance and its scientific base. Because SETAC was developed on an international scale, it has been able to address global environmental issues. In October 1980, there were 230 Charter Members. Today, there are nearly 6,000 members from more than 100 countries. SETAC's members, from governmental, academic, and business backgrounds, are committed to balancing the scientific interests of the three sectors represented.

3.1 SETAC Workshops

From the beginning, SETAC has sponsored workshops to bring together scientists, engineers, and managers from government, private business, academia, and public interest groups to consider the state-of-the-art of specific environmental topics. While formats vary, workshops are generally held over the course of 4–5 days with 40–50 individuals in attendance. During the intensive workshops, a combination of formal presentations and informal working sessions are used to examine the status of current information and the knowledge base of the topic and develop recom-

⁵ Carson (2002) [1st Pub. Houghton Mifflin 1962]. *Silent Spring*. Mariner Books. ISBN 0-618-24906-0. *Silent Spring* initially appeared serialized in three parts in the June 16, June 23, and June 30, 1962 issues of *The New Yorker* magazine.

⁶ SETAC has a commitment to balance the scientific interests of government, academia and business.

mendations for enhancing the current state of the science. An expected product of a SETAC workshop is a document that presents a clear description of this knowledge and a description of the recommendations developed.

There are two general categories of SETAC Workshops: Pellston Workshops, named after the location of the first workshops (University of Michigan Field Station, Pellston, MI, USA) and Technical Workshops, including Small Meetings. The distinction between these two categories is primarily a function of the anticipated breadth of interest in the topic across the SETAC membership, the criticality and timeliness of the topic, and the likelihood that the workshop will significantly advance scientific understanding of the issue. The basics of balance and objectivity underlying all SETAC activities apply to all SETAC workshops. This foundation has been the key to the successful workshops for the past 30 years on topics ranging from LCA to improving management of contaminated sediments.

All SETAC workshops must adhere to the following fundamental guidance principles:

- Proposed workshop is consistent with SETAC goals;
- Proposed content is scientifically sound or credible;
- Workshop promotes multi-disciplinary approaches;
- Workshop attendance ensures balance in opinion and representation by involving relevant constituencies (from academia, government, business and non-governmental organizations);
- Workshop has a viable communication plan coordinated with the SETAC Publications Advisory Council (PAC) and the Public Relations and Communication Committee (PRCC) that ensures timely, accurate and cost-effective publication of results to the Society and sponsors as well as to a wider global audience. Web-based communications, such as webinars, podcasts, or blogs, are also encouraged to the extent they increase the base of knowledge of the workshop findings and complement other, more traditional means;
- Proposed workshop does not generate a conflict of interest; and,
- Workshop budget is viable, including publication costs, and financial liability to SETAC is controlled.

3.1.1 Pellston Workshops

The goal of a Pellston Workshop is to promote advancement in the resolution of truly cutting-edge technical and policy issues in environmental science, while enhancing strategies of science and philosophy.

Developing the Workshop Topic Workshop proponents, at least one of whom must be a SETAC member or an individual SETAC member, will identify a pertinent issue or environmental topic to serve as a focal point for the proposed workshop and form a tentative Workshop Steering Committee which includes at least one SETAC Office staff member as an ad-hoc member. The tentative Steering

Committee or individual will develop a pre-proposal (concept paper) that clearly describes the topic to be examined, the workshop objectives, the anticipated range of participants, any potential funding sources, and the benefits to be obtained from the workshop. The SETAC Office should be contacted for example documents, for advice on preliminary workshop organization, for ideas on tentative dates and location, and for funding requirements for the workshop and follow-up activities. If the Board/Council feel that the pre-proposal for the workshop is worthy, it will approve preparation of a complete proposal. This proposal is submitted to the Technical Committee, through the SETAC Office, for technical review.

Technical Committee Review After referral from the Board of Directors/Council, the appropriate national SETAC Technical Committee would review the proposal in reference to the *Criteria for Designation of SETAC Pellston Workshops* and *Criteria for Designation of SETAC Technical Workshops*. Based upon this review, the Technical Committee would provide a recommendation to the Board of Directors/Council on the degree to which the workshop should be sponsored⁷.

Based on the recommendation of the relevant Technical Committee and in light of other demands on the SETAC Office and the probability of obtaining adequate funding for the proposed workshop, the Board, Council, or SETAC World Council (SWC)⁸ would approve or disapprove the workshop/meeting or the SWC would refer back to national level as a technical workshop as relevant. This would take place at any regularly scheduled meeting throughout the year or by ballot.

Planning the Workshop After approval by the SETAC Board of Directors, workshop proponents may initiate the planning process, cooperatively with the SETAC/SETAC Foundation Office.

Types of Publications From Workshop Proceedings Publication and dissemination of proceedings from workshops is highly encouraged. The outline and format for the publication is dependent upon the workshop objectives and program. Development of a complete first draft of the proceedings during the workshop is essential. After the workshop is held, it is the responsibility of the Workshop Steering Committee to ensure that the proceedings are completed.

Success of Pellston Workshop While SETAC was founded to promote the use of multi-disciplinary approaches for the study of environmental issues, the format of the Pellston Workshop laid the foundation necessary to address life cycle assessment (LCA).

⁷ The following recommendations are possible: Recommend SETAC sponsorship as a Pellston Workshop and submission to the SWC Technical Committee for consideration; Recommend SETAC sponsorship as a Technical Workshop at a national level; Recommend SETAC sponsorship as a Small Meeting at national level; Recommend SETAC sponsorship contingent upon securing funding; Recommend SETAC sponsorship contingent upon incorporation of mandatory changes; Recommend SETAC sponsorship with minor changes suggested; or, Recommend against SETAC sponsorship.

⁸ The SWC facilitates worldwide outreach to environmental scientists, engineers, and managers and encourages development of additional SETAC member groups.

3.1.2 Technical Workshops

SETAC supports the convening of technical workshops to bring together experts to discuss and resolve timely technical, scientific or policy issues related to environmental science. SETAC's level of support can range from simply providing an endorsement (e.g., non-exclusive license to use SETAC name or logo for promotional purposes) to providing full technical and scientific support, as long as basic principles are met. Recognizing the diversity of possible workshop formats and varying levels of potential logistic and financial involvement, SETAC's approval and sponsorship criteria are generally flexible and determined primarily by the level of support sought by the applicant. The governing principle: the greater support that is requested from SETAC (in terms of support and financial commitment), the more detail and oversight will be required from the applicant.

Among the flexible workshop formats, there are three general levels of SETAC involvement:

- *Level 1—SETAC-hosted technical workshop or meeting:* Major workshop, hosted by SETAC, of global, regional or national relevance on an important, but not necessarily urgent environmental scientific or policy issue (i.e. non-Pellston), organized and advertised by a SETAC-assembled Steering Committee, with all-invited attendance, significant scientific input, major SETAC financial and logistical support and a substantive high-quality publication.
- *Level 2—SETAC-co-organized technical workshop:* Workshop of global, regional or national relevance, co-organized by SETAC (in partnership with other organizers), with significant scientific input, some SETAC financial and logistical support, but limited financial liability and less comprehensive publication effort.
- *Level 3—SETAC sponsored technical workshop or meeting:* Workshop is organized by a different organization, but endorsed, co-sponsored or advertised by SETAC, with a certain degree of scientific input, but minor or no financial and logistical support.

The goal of a SETAC-hosted or co-organized technical workshop (Level 1 or 2) is to promote advancement of the resolution of important technical and policy issues in environmental science while enhancing strategies of science and philosophy.

To that end, the following criteria have been developed as guidance for the designation of SETAC Technical workshops (in addition to the general guidance principles listed above):

- The proposed workshop topic does not merit a Pellston workshop designation;
- Potential sources and estimated amounts of funding are clearly identified;
- SETAC member participation in balanced Steering/Organizing Committee is required;
- Steering Committee Chair or Co-Chair is a strong champion for the proposed workshop. Members of the steering committee must include recognized subject matter experts germane to the workshop topic;

Background and Future Prospects in Life Cycle
Assessment

Klöpper, W. (Ed.)

2014, XII, 262 p. 25 illus., 5 illus. in color., Hardcover

ISBN: 978-94-017-8696-6