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《产业生态学报》

2000年冬, 第4卷第3期, 11-33页

题目: 在生命周期评价中避免共生产品分配

作者: Bo Weidema

关键词: 分配, ISO14041, 联合生产, 生命周期评价(LCA), 再循环, 系统扩展

摘要: 当对某生产过程不同产品中的某一个产品开展 LCA 时, 这个生产过程的资源消耗和污染排放如何在这些共生产品之间分配呢? 这是共生产品分配的核心问题, 由于如何分配将对评估结果产生相当大甚至决定性的影响, 因此这一直是 LCA 方法发展过程中一个最有争议的问题。本文阐述, LCA 可以通过扩展系统的边界来避免共生产品的分配问题。本文通过一系列的具体案例来说明如何开展系统扩展, 特别是下列分配存在争议的活动: 联合生产(比如氯气和氢氧化钠、锌和重金属、热和电)、“类似废弃物”的副产品处理、同时为多个产品系统服务的生产过程、以及材料再循环和降级再循环等。文章指出, 各种不同共生产品情况都可以采用相同的理论模型和实践做法, 并且还可能将传统的共生产品分配做为上述方法的一个特例。本文还讨论了这种分配程序的不确定性, 而且将它与国际标准 ISO14041 “生命周期评价——目标与范围的确定和清单分析”进行了比较。

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Avoiding Co-Product Allocation in Life-Cycle Assessment

Bo Weidema

KEYWORDS:

allocation, ISO 14041, joint production, life-cycle assessment (LCA), recycling, system expansion

SUMMARY:

In a life-cycle assessment (LCA) involving only one of several products from the same process, how are the resource consumption and the emissions associated with this process to be partitioned and distributed over these co-products? This is the central question in co-product allocation, which has been one of the most controversial issues in the development of the methodology for life-cycle assessment, as it may significantly influence or even determine the result of the assessments. In this article, it is shown that in prospective life-cycle assessments, co-product allocation can always be avoided by system expansion. Through a number of examples, it is demonstrated how system expansion is performed, with special emphasis on issues that earlier have been a focus of the allocation debate, such as joint production (e.g., of chlorine and sodium hydroxide, zinc and heavy metals, and electricity and heat), the handling of "near-to-waste" by-products, processes simultaneously supplying services to multiple product systems, and credits for material recycling and downcycling. It is shown that all the different co-product situations can be covered by the same theoretical model and the same practical procedure, and that it is also possible to include the traditional co-product allocation as a special case of the presented procedure. The uncertainty aspects of the presented procedure are discussed. A comparison is made with the procedure of ISO 14041, "Life-cycle assessment -- Goal and scope definition and inventory analysis," the international standard.

《产业生态学报》

2000年冬, 第4卷第3期, 35-51页

题目: 为产业生态学构筑宏观基础**作者:** Clinton J. Andrews**关键词:** 代理, 生物类比, 个体生态学, 微观经济学, 组织行为学, 交易成本

摘要: 产业生态学家研究几个不同尺度上的现象, 并将研究发现加以联系以促进学科的发展。生态学和经济学已经通过构建行为的微观基础开展这种尝试, 并取得一定的成功; 产业生态学也应该这么做。这些学科领域都以自下而上的方式研究不断发展变化的系统, 在这种系统中独立的个体以自我利益为中心开展活动, 展示不同的行为, 并通过自组织形成社区或部门等更高层次的结构。产业生态学家应该明确地尝试整合这些关于代理的经验和理论观点, 并且更仔细地地区分两类不同代理——公司和个人。

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Building a Micro Foundation for Industrial Ecology

Clinton J. Andrews

KEYWORDS:

agency, biological analogy, ethology, microeconomics, organizational behavior, transaction costs

SUMMARY:

Industrial ecologists study phenomena at several distinct scales, and linking the resulting insights could advance the field. The disciplines of ecology and economics have each attempted, with partial success, to accomplish this by building a behavioral micro foundation, and industrial ecology should do the same. These fields all study evolving systems made up of autonomous individuals who operate in a largely self-interested manner, exhibit diverse behaviors, and self-organize many higher-level structures such as communities or sectors in a bottom-up fashion. Industrial ecologists should explicitly attempt to integrate empirical and normative views about agency, and more carefully distinguish between two types of agents—firms and individual humans.

《产业生态学报》

2000 年冬, 第 4 卷第 3 期, 53-73 页

题目: 日本石化行业 CO₂ 减排策略的评估

作者: Dolf J. Gielen 和 Hiroshi Yagita

关键词: CO₂, 全球变暖, 生命周期评价 (LCA), 线性规划, 最优化, 石化工业

摘要: 本文分析了日本石化行业在整个生命周期中减排 CO₂ 的可能性, 重点放在化石燃料的非能源用途。为此, 我们开发了一个叫做 CHEAP (化学工业环境策略分析程序) 的线性规划模型。研究结果显示, 如果石化行业没有采用新技术, 而且产品需求每年增长 1%, 石化行业的 CO₂ 排放在 2000 至 2020 年期间上升 5%。然而, 如果目前的技术开发成功的话, 2020 年 CO₂ 排放将比 2000 年减少 5% (相对于不采用新技术的情况, CO₂ 减排 10%)。这对于减排 CO₂ 是一个巨大贡献。根据该模型, 到 2020 年, 在上述基础进一步减少 10% 的 CO₂ 排放是有可能的, 但费用昂贵, 每减排 1 吨 CO₂ 需要近 10,000 日元的投入 (相当于 100 美元/吨)。使用生物质原料、废物再循环、从废物中回收能源和使用天然气开展热电联供是减排 CO₂ 的主要策略。

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Assessment of CO₂ Emission Reduction Strategies for the Japanese Petrochemical Industry

Dolf J. Gielen and Hiroshi Yagita

KEYWORDS:

carbon dioxide, global warming, life-cycle assessment (LCA), linear programming, optimization, petrochemicals

SUMMARY:

This article analyzes the possibilities for reducing carbon dioxide (CO₂) emissions in the life cycle of Japanese petrochemicals, focusing primarily on the nonenergy use of fossil fuels. For this purpose a linear programming model called CHEAP (Chemical industry Environmental strategy Analysis Program) has been developed. The results show a moderate autonomous growth of emissions by 5% in the period 2000 to 2020, if it is assumed that no new technology is introduced and demand (measured in physical units) increases 1% per year, on average. However, if it is assumed that ongoing technology development succeeds, emissions in 2020 may decrease by 5% from 2000 levels (a decrease of 10% compared to the case that assumes no new technology). This is a significant contribution to emission reduction. According to this model, a further emission reduction by 10% in 2020 is possible but costly as it requires emission reduction incentives of up to 10,000 yen per ton CO₂ (approximately 100 US\$/ton). The use of biomass feed-stocks, waste recycling, energy recovery from waste and gas-based co-generation are the main strategies for achieving this emission reduction.

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题目: 生命周期评价中与空间位置相关的造成酸化和富营养化的空气污染特征化

作者: Mark A. J. Huijbregts, Wolfgang Schöpp, Evert Verkuijlen, Reinout Heijungs 和 Lucas Reijnders

关键词: 酸化, 空气污染, 富营养化, 影响评价, 生命周期评价(LCA), 地点相关性

摘要: 产品在其生命周期中排放的致酸化和富营养化物质的潜在环境影响经常用一些简单模型来评估。由于背景累积和生态系统敏感性一般都不包含在这类模型中, 所以产品的环境 LCA 可能对这类影响作出不正确的评价。本文介绍了空间相关的地区空气污染信息和模拟模型(RAINS-LCA), 主要用来在考虑背景污染的前提下, 计算欧洲地区氨气(NH₃)和氮氧化物(NO_x)导致酸化和富营养化的可能性, 以及 SO₂ 排放造成酸化的可能性。模型计算探讨了两种影响的定义: (1) 欧洲所有生态系统危害指数的边际变化, (2) 超过临界负荷的欧洲地区的生态系统危害指数的边际变化。与简单模型比较, 新模型包括背景累积和生态系统敏感性方面, 并对不同的物质进行不同的排序。就酸化而言, 氮氧化物的排放不到硫化物的一半。相对于简单模型来说, RAINS-LCA 模型在地表富营养化和酸化潜力两方面的地区差别分别达到 1.5 倍和 3.5 倍。应用情景分析, 模型显示在富营养化和酸化从 1995 年到 2010 年超过临界负荷的地区分别增加 0.6 和 1 倍。上述结果表明, 如果我们期望致酸化和富营养化空气污染物在某个时间局限仅在欧洲少数地区超标, 那么使用空间相关、时间序列的酸化和富营养化模型十分重要。为了进一步改进 RAINS-LCA, 增加北半球的资源接受矩阵, 以及使用物种出现概率作为影响评估的基础是非常重要的。

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Spatially Explicit Characterization of Acidifying and Eutrophying Air Pollution in Life-Cycle Assessment

Mark A. J. Huijbregts, Wolfgang Schöpp, Evert Verkuijlen, Reinout Heijungs and Lucas Reijnders

KEYWORDS:

acidification, air pollution, eutrophication, impact assessment, life-cycle assessment, site-dependency

SUMMARY:

Simple models are often used to assess the potential impact of acidifying and eutrophying substances released during the life cycle of products. As fate, background depositions, and ecosystem sensitivity are not included in these models, environmental life-cycle assessment of products (LCA) may produce incorrect results for these impact categories. This paper outlines the spatially explicit regional air pollution information and simulation model (RAINS-LCA), which was developed for the calculation of acidification and terrestrial eutrophication potentials of ammonia (NH₃) and nitrogen oxide (NO_x) air emissions and acidification potentials for sulfur dioxide (SO₂) air emissions for Europe and a number of European regions, taking fate, background depositions and effects into account. Two impact definitions are explored in the calculations: 1) the marginal change in the hazard index of all ecosystems in Europe and 2) the marginal change in the hazard index of ecosystems in Europe where the critical load is actually exceeded. The inclusion of fate, background depositions, and ecosystem sensitivity results in a different ranking of substances compared to simpler model outcomes. In the context of acidification, emissions of nitrogen compounds are regarded as about a factor 2 less important relative to sulfur compounds. Furthermore, using RAINS-LCA as opposed to simpler models, it was found that region-specific differences in terrestrial eutrophication and acidification potentials range up to 1.5 and 3.5 orders of magnitude, respectively. By means of scenario analysis, it was also shown that "only above critical load" terrestrial eutrophication and acidification potentials for the years 1995 and 2010 differ up to 0.6 order and 1 order of magnitude, respectively. These results imply that it is important to use region-specific and time-specific acidification and terrestrial eutrophication potentials, if it is expected that life-cycle emissions of acidifying and eutrophying air pollutants are predominantly situated in a few (Euro-pean) regions and within a specific year. Further improvements in RAINS-LCA may be established by including source-receptor matrices of the Northern Hemisphere instead of Europe and using the probability of species occurrence as a basis for the effect assessment

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题目: 将生物材料引进电子工业: 使用木质素树脂开发印刷线路板

作者: Laura L. Kosbar, Jeffrey D. Gelorme, Robert M. Japp 和 William T. Fotorny

摘要: 木质素做为在植物细胞壁中形成的一种生物聚合物, 是造纸工业的一种副产品。在 IBM 开展的研究中, 木质素被引入到为微电子工业生产印刷线路板的树脂中。这种新树脂的物理和电子特性与目前使用的片状树脂相似。由木质素树脂生产的印刷线路板满足大部分针对 FR4 级片状树脂的物理、电子和可靠性标准测试。在一项比较木质素树脂和目前使用的树脂的 LCA 中, 生物树脂的能耗比目前的树脂低 40%。大规模生产木质素树脂将只需要廉价的木质素原料, 并产生较少的离子污染。

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Introducing Biobased Materials into the Electronics Industry: Developing a Lignin-based Resin for Printed Wiring Boards

[Laura L. Kosbar, Jeffrey D. Gelorme, Robert M. Japp and William T. Fotorny](#)

SUMMARY:

Lignin, a biopolymer formed in the cell walls of plants, is a by-product of paper manufacturing. In research at IBM, it was incorporated into a resin used in the fabrication of printed wiring boards (PWB) for the microelectronics industry. The resin had physical and electrical properties similar to those of current laminate resins. PWBs fabricated from the lignin-based resin passed most of the standard physical, electrical, and reliability tests for an "FR4"-grade laminate. A comparison of the lignin-based resin and current resins via life-cycle assessment indicated up to 40% lower energy consumption for the biobased resin. Large-scale manufacture of lignin-based resins would require an inexpensive source of lignin with low ionic contamination.