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## 《产业生态学报》

2001年冬, 第5卷第1期, 11-34页

题目: 社会系统的能量代谢核算: 概念与实例

作者: Helmut Haberl

**关键字:** 生物质能源核算, 能量分析, 能量统计, 材料流分析, 营养物

**摘要:** 关于工业化国家的物流分析已经形成一定的共识, 本文在此基础上进一步讨论能流分析和能量代谢。同时进行工业社会的物流和能流分析可有效发挥代谢方法的潜力, 深入解决人类的可持续发展问题。类比物流分析的理论体系, 本文引入并经验性的描述了一些能量代谢的基本概念, 如能量输入、能量内部转化、能量利用等等。能量统计可单纯考虑驱动设备的热能、光能和机械能, 但社会能量代谢的研究则需进一步包括在人和生物体内流动的生物化学营养能。此外, 进行能量输入统计时, 必须包括到所有跨越系统边界的富含能量的物质流以及非物质能量流(如电流和光能等), 所有的生物质流在能量代谢中都要作为能流来加以考虑。系列论文的第二部分将应用上述概念对不同的社会组织模式进行分析, 研究社会能量代谢对人类可持续发展意义。文章将特别探讨有关的可再生能源(如生物质能源)政策。

## Journal of Industrial Ecology

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**Accounting for the Energetic Metabolism of Societies: Concepts and Empirical Examples**

Helmut Haberl

**KEYWORDS:**

biomass energy accounting, energy analysis, energy statistics, materials flow analysis, nutrition

**SUMMARY:**

Based upon the currently emerging international consensus on how to account for the materials flows of industrialized countries, this article proposes methods to account for the energetic metabolism of societies. It argues that, to fully exploit the potential of the metabolism approach in the context of sustainable development, both energetic and material aspects of societal metabolism have to be taken into account. The article proposes concepts to empirically describe energy input, internal energy transformations, and energy utilization of societies by extending commonly used notions of energy statistics in a way that is compatible with current methods of materials flow analysis. Whereas energy statistics include only the energy used in technical devices for providing heat, light, mechanical work, and data processing, an accounting system for the energetic metabolism of societies should also consider flows of nutritional energy for both livestock and humans. Moreover, in assessing the energy input of a society, all inputs of energy-rich materials (and immaterial forms of energy such as electricity and light) that cross the boundary into the biophysical structures of society should be taken into consideration, regardless of the purpose for which they are eventually used. As a consequence, an energetic metabolism accounting system treats all biomass as energy input, instead of considering only the biomass used for technical energy generation, as energy statistics do. Part II in this set of articles will apply these concepts to different modes of societal organization and explore the significance of energetic metabolism for sustainable development. In particular, it will explore the significance for policies that aim at increasing the contribution of renewable energy, especially biomass.

## 《产业生态学报》

2001年冬, 第5卷第1期, 35-54页

## 题目: 虚拟东京集成软件系统: 概念与实例

作者: Steven B. Kraines, David R. Wallace, Yumiko Iwafune, Yoshikuni Yoshida, Toshiya Aramaki, Kazuhiko Kato, Keisuke Hanaki, Hisashi Ishitani, Tomonori Matsuo, Hiroshi Takahashi, Koichi Yamada, Yukio Yanagisawa, Hiroshi Komiyama

关键字: 分布式模型, 温室气体(GHGs), 综合模拟, 中间件, 光电, 可持续性

**摘要:** 解决环境问题时, 要有效地评价技术与政策之间的权衡, 就必须对有关对象作出系统的调查评判。对一个复杂的巨系统来说, 适用性问题、系统维护问题、计算效率问题都可能成为建模的障碍。本文开发了一个基于 Internet 的软件原型——分布式对象模拟环境(DOME), 并在此基础上建立了一个“虚拟东京”平台, 可对各种温室气体减排的技术和措施进行全面评价。该系统首先以城市建成区内的土地分布使用信息和商品输入输出信息为准开发了两个模型, 并与东京地区的数据库相结合, 建成了“虚拟东京”模型。利用该平台, 本文对一些特定的技术作了分析: 如使用光伏发电可减少传统的火电消费, 从而减少二氧化碳排放。因此, 在东京的建筑屋顶上安装光电板是值得提倡的, 如果东京的屋顶空间得到充分利用的话, 发电过程的二氧化碳排放量将减少 12%。该软件还可对光电设备的费用、可行性等问题进行了研究。

## Journal of Industrial Ecology

2001, Vol. 5, Issue 1, pp. 35-54

## An Integrated Computational Infrastructure for a Virtual Tokyo: Concepts and Examples

Steven B. Kraines, David R. Wallace, Yumiko Iwafune, Yoshikuni Yoshida, Toshiya Aramaki, Kazuhiko Kato, Keisuke Hanaki, Hisashi Ishitani, Tomonori Matsuo, Hiroshi Takahashi, Koichi Yamada, Yukio Yanagisawa and Hiroshi Komiyama

**KEYWORDS:**

distributed modeling, greenhouse gases (GHGs), integrated simulation, middleware, photovoltaics, sustainability

**SUMMARY:**

The evaluation of trade-offs between technologies and policies for mitigation of environmental problems requires a systematic investigation of effects over the entire region under consideration. When attempting to model such large complex systems, issues such as usability, maintenance, and computing efficiency often become major modeling barriers. In this work a software prototype for integrating the services of computational models over the Internet, called DOME (distributed object-based modeling environment) is used to facilitate the construction of virtual Tokyo — a simulation platform for evaluating holistically the trade-offs between various technologies for reducing the emissions of greenhouse gases. In making steps toward this ultimate goal, two models have been developed that use data defining spatial land-use distributions and the flows of goods expressed as an input-output table to provide information on the spatial and temporal characteristics of an urban region. Integrated, these models form a preliminary virtual Tokyo model when applied to Tokyo-specific databases. Given this platform, process models are applied to examine the effectiveness of using photovoltaic (PV) modules on the demand side to reduce conventional electric power generation and, thereby, also reduce carbon dioxide emissions. The results of introducing PV modules on the rooftops of buildings in Tokyo under various installation conditions are presented as a working example of the prototype. For full deployment on usable rooftop space, PV power generation could reduce carbon dioxide emissions from electric power generation by more than 12%. Future work will use the same methods as presented in this paper to examine cost, a critical determinant in the actual feasibility of PV module installation.

## 《产业生态学报》

2001年冬, 第5卷第1期, 55-75页

## 题目: 温室气体减排与绿色包装的关系

作者: Marko P. Hekkert, Dolf J. Gielen, Ernst Worrell, Wim C. Turkenburg

关键字: 二氧化碳排放(CO<sub>2</sub>), 温室气体减排, 一体化产品政策(IPP), 材料管理, 包装, 废物减量化

**摘要:** 包装材料的生产、运输、使用和最终处置都将产生温室气体(GHGs)。如何减少与包装过程相关的温室气体排放? 本文通过一个动态的 MATTER-MARKAL 模型对西欧国家作了建模分析。结果说明, 采取适当措施可使 1995-2030 年间因包装而排放的 GHGs 减少 58%。目前欧洲的包装办法已能减少 10% 的 GHG 排放, 通过采用轻便包装、可重复利用包装等物流管理措施, 将进一步减排 22% 的 GHG。如能对每吨二氧化碳征收 200 欧元的温室气体税, GHG 排放又会减少 13%。总的来说, 当 GHG 排放税率较低(小于 100 欧元/吨二氧化碳当量)时, 材料管理措施将起主要作用。反之, 当税率较高(100 到 500 欧元/吨二氧化碳当量)时, 材料生产和废物处理过程中的 GHG 减排将会得到更大的重视。因此, 在目前技术条件和较低的二氧化碳税率下, 更应从提高包装材料利用率的角度入手来减少 GHG 的排放。

## Journal of Industrial Ecology

2001, Vol. 5, Issue 1, pp. 55-75

### Wrapping Up GHG Emissions: An Assessment of Greenhouse Gas Emission Reduction Related to Efficient Packaging Use

Marko P. Hekkert, Dolf J. Gielen, Ernst Worrell and Wim C. Turkenburg

**KEYWORDS:**

carbon dioxide (CO<sub>2</sub>) emissions, greenhouse gas reduction, integrated product policy (IPP), materials management, packaging, waste reduction

**SUMMARY:**

The use of packaging materials results in greenhouse gas (GHG) emissions through production and transport of materials and packaging and through end-of-life management. In this article, we investigate the potential reduction of GHGs that are related to packaging. For this purpose, we use the dynamic MATTER-MARKAL model in which the western European energy and materials system is modeled. The results show that GHGs related to packaging can technically be reduced by up to 58% in the period 1995-2030. Current European packaging directives will result in a 10% emission reduction. Cost-effective improved material management 1 that includes lightweighting, reusable packages, material recycling, and related strategies can contribute a 22% GHG emission reduction. An additional 13% reduction becomes cost effective when a GHG emission penalty of 100 euros per metric ton CO<sub>2</sub> (EUR/ton) is introduced (1 EUR 0.9 USD). Generally speaking, improved material management dominates the gains that can be achieved without a penalty or with low GHG emission penalties (up to 100 EUR/ton CO<sub>2</sub> equivalent). By contrast, the reduction of emissions in materials production and waste handling dominate when high GHG penalties are applied (between 100 and 500 EUR/ton CO<sub>2</sub> equivalent). Given the significant technical potential and the low costs, more attention should be paid to material efficiency improvement in GHG emission reduction strategies.

## 《产业生态学报》

2001 年冬, 第 5 卷第 1 期, 77-103 页

## 题目: 氮元素在工业系统中的作用

作者: L. Alejandra Febre Domene, Robert U. Ayres

**关键字:** 氨, 氨衍生物, 物质平衡, 氮元素, 含氮化合物, 排放

**摘要:** 氮元素是生态系统中的关键元素之一, 它在现代工业领域所起的作用也不可小视。氨是合成各种含氮化合物的基础原料。本文分析了 1996 年氨及重要氨衍生物的生产和使用, 研究了关键的生产过程和污染物的排放, 并考察了各部门内的氮元素的损失与释放情况。

## Journal of Industrial Ecology

2001, Vol. 5, Issue 1, pp. 77-103

## Nitrogen's Role in Industrial Systems

L. Alejandra Febre Domene and Robert U. Ayres

**KEYWORDS:**

ammonia, ammonia derivatives, materials balance, nitrogen, nitrogen chemicals, releases

**SUMMARY:**

Nitrogen is one of the key component elements in biological systems, but it also plays an increasingly important part in other areas of a modern industrial system. The starting point for almost all nitrogen-based chemicals is ammonia. This article presents 1996 production and use statistics for ammonia and its most important derivatives. We also characterize the key production processes and emissions. Finally, we summarize losses and emissions of nitrogen within the sector.

## 《产业生态学报》

2001年冬, 第5卷第1期, 105-116页

题目: 追求绿色有经济回报吗? 对企业环境与经济表现的实例分析

作者: Andrew King, Michael Lenox

关键字: 超越环境法规要求, 企业战略, 计量经济分析, 环境表现, Porter 假说, 双赢

摘要: 改善环境表现似乎总能够为一个企业带来经济利益, 事实上环境效益与经济效益间的关系并非那么简单。更好的环境表现真的意味着更好的经济回报吗? 这背后会不会还隐藏着其它的作用因素和作用关系? 花钱买得来清洁吗? 本文分析了1987至1996年间美国652家制造企业的案例, 事实证明尽管低污染往往与高收入相联系, 但这种联系更多的是企业自身特性和企业战略作用的结果。那么再问“何时该加大绿色投入”之前, 也许我们更该认真想一想“企业绿色化能够带来经济回报吗?”

## Journal of Industrial Ecology

2001, Vol. 5, Issue 1, pp. 105-116

Does it Really Pay to be Green? An Empirical Study of Firm Environmental and Financial Performance

Andrew King and Michael Lenox

**KEYWORDS:**

beyond compliance, corporate strategy, econometric analysis, environmental performance, Porter hypothesis, win-win

**SUMMARY:**

Previous empirical work suggests that firms with high environmental performance tend to be profitable, but questions persist about the nature of the relationship. Does stronger environmental performance really lead to better financial performance, or is the observed relationship the outcome of some other underlying firm attribute? Does it pay to have clean-running facilities or to have facilities in relatively clean industries? To explore these questions, we analyze 652 U.S. manufacturing firms over the time period 1987-1996. Although we find evidence of an association between lower pollution and higher financial valuation, we find that a firm's fixed characteristics and strategic position might cause this association. Our findings suggest that "When does it pay to be green?" may be a more important question than "Does it pay to be green?"

## 《产业生态学报》

2001年冬, 第5卷第1期, 117-126页

题目: 大都市的产业生态系统发展

作者: Judy Kincaid, Michael Overcash

**关键字:** 副产品, 生态产业园区, 地理信息系统(GIS), 产业生态系统, 产业共生, 废物交换

**摘要:** 本文介绍了位于美国北卡罗来纳州的一个大都市圈的副产品交换利用项目。这一为期两年的研究项目得到了美国环保局的资助。该项目收集了当地 182 家企业和公共机构的相关数据: 可用于附近其他企业的副产品, 以及可能由其他工厂提供的副产品输入量。利用这些数据和地理信息系统手段, 可发现潜在的材料、水和能源综合利用的可能。在项目期内, 48% 的参与者都找到了与之相关的副产物配对利用关系。该项目证明在本地促进机构和特定技术对于发现和促进可能的副产物交换。

## Journal of Industrial Ecology

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Industrial Ecosystem Development at the Metropolitan Level

Judy Kincaid and Michael Overcash

**KEYWORDS:**

by-product, eco-industrial park, geographic information system (GIS), industrial ecosystem, industrial symbiosis, waste exchange

**SUMMARY:**

This article presents the result of a two-year project funded by the U.S. Environmental Protection Agency to identify potential by-products partnerships between industries in a six-county metropolitan area in North Carolina, U.S.A. The project gathered data from 182 industries and institutions in the region regarding (1) by-products that might be usable by other, nearby firms, and (2) the inputs they used that might be furnished from another facility's by-products. These data, which were also linked to geographic information system maps, were used to identify potential regional partnerships for the reuse of materials, water, and energy. Of the 182 participating facilities, probable or possible partnerships were found for 48% during the limited project period. This project demonstrated the value of a local facilitator and the value of specific techniques for identifying and promoting potential by-products partnerships.

## 《产业生态学报》

2001 年冬, 第 5 卷第 1 期, 127-146 页

题目: 杜邦高密度聚乙烯合成纸回收时面临的生产、市场与组织机构方面的挑战

作者: Mark Sharfman, Rex T. Ellington, Mark Meo

关键字: 高密度聚乙烯 (HDPE), 房屋包装, 无纺布, 塑料回收, 保护服, 回收量

摘要: 20 世纪 80 年代末, 随着消费者的环境意识日渐增强, 杜邦的高密度聚乙烯合成纸 (TYVEK) 面临着许多挑战。TYVEK 广泛用于从房屋装潢到药品包装的各个领域, 最常见的就是联邦快递和美国邮政用的包装材料。从 1988 年起, 用户就常常抱怨 TYVEK 信封的环境问题。随着问题变得越来越严重, 杜邦不再坐视, 它在 TYVEK 中加入了可回收的聚乙烯。后来, 杜邦又建立了 TYVEK 的回收机构 (TYVEK 主要由高密度聚乙烯组成, 回收起来十分不易)。为此, 杜邦必须解决诸多的技术和组织难题。尽管 TYVEK 中包含了可回收的聚乙烯, 但市场上对这种新产品仍存在着阻力。本文研究了杜邦是如何作出上述决策并克服重重困难的。文章最后还讨论了杜邦案例的经验和启示。

## Journal of Industrial Ecology

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The Introduction of Post-Consumer Recycled Material into Tyvek: Production, Marketing and Organizational Challenges

Mark Sharfman, Rex T. Ellington and Mark Meo

**KEYWORDS:**

high-density polyethylene (HDPE), house wrap, nonwoven textile, plastics recycling, protective clothing, recycled content

**SUMMARY:**

In the late 1980s, with the advent of increased consumer environmental awareness, DuPont faced a challenge with its TYVEK family of nonwoven polyethylene textile products. TYVEK is used in a wide variety of applications ranging from house wrap to medical packaging. One of the most visible portions of the business is envelopes used by FedEx (previously known as Federal Express), the well-known courier and delivery service and by the U.S. Postal Service. As early as 1988, end users began asking questions about the environmental characteristics of TYVEK envelopes. As these questions increased, DuPont began to address the concerns directly. In response to the market's concern and because of the increased availability of postconsumer-recycled (PCR) polyethylene, DuPont decided to put PCR polyethylene into TYVEK, beginning with the envelope business. Further, DuPont developed a recycling infrastructure for TYVEK because, although TYVEK consists entirely of high-density polyethylene, which is highly recyclable, no infrastructure was in place to recycle the material. These decisions produced a wide variety of technical and organizational challenges the firm had to overcome. This case study examines how DuPont made these choices and overcame the difficulties created by implementing needed changes. Whereas the envelope market for TYVEK embraced PCR polyethylene, other product markets resisted the innovation. The article closes with a discussion of the lessons learned from DuPont's experience.