JOURNAL OF INDUSTRIAL ECOLOGY

中文摘要
《产业生态学报》
第10卷第1-2期

翻译
施涵，王韬

Chinese Abstracts
Journal of Industrial Ecology
Volume 10, Number 1-2

Translated by
Shi Han, Tao Wang

《产业生态学报》

2006 年冬，第 10 卷第 1-2 期，19-42 页

题目：2003 环境与经济帐户体系及物流核算的经济相关性

作者：Ole Gravgård Pedersen, Mark de Haan

关键字：环境会计，投入产出分析，物料流分析(MFA)，包括环境帐户的国民核算矩阵(NAMEA)，物质投入产出表(PIOT)，国民核算体系

摘要：环境与经济总体核算(SEEA-2003)国际手册详细评述了与国民经济核算相匹配的环境核算方法。除自然资源资产存量与环境保护开销之外，SEEA-2003 尤其着重于物质流的核算分析。将国民经济核算扩展到物流领域、建立物流数据体系有助于推动经济与环境方面的系统决策。本文无意于总括宏观物质流核算方法的所有方方面面，而是侧重讨论了基于国民经济核算的物质流帐户的主要特点及所需参数，并阐述了该方法的分析优势。

Journal of Industrial Ecology

2006, Vol. 10, Issue 1-2, pp. 19-42

The System of Environmental and Economic Accounts–2003 and the Economic Relevance of Physical Flow Accounting

Ole Gravgård Pedersen and Mark de Haan

KEYWORDS:
environmental accounting, input-output analysis, materials flows accounting (MFA), National Accounting Matrix including Environmental Accounts (NAMEA), physical input-output tables (PIOT), system of national accounts (SNA)

SUMMARY:
The international handbook on integrated environmental and economic accounting (SEEA-2003) provides a detailed overview of environmental accounting approaches that have been developed in parallel with the system of national (economic) accounts. In addition to natural resource stock accounts and environmental protection expenditure accounts, SEEA-2003 pays considerable attention to physical flow accounting. Expanding the national economic accounts with physical data sets facilitates the joint analysis of environmental and economic policy issues. This article discusses the main characteristics of national accounts-oriented physical flow accounting approaches and provides an overview of the kind of indicators they may put forward. Although this article is not an attempt to provide a comprehensive review of macro-oriented physical flow accounting approaches, the analytical advantages of national accounts-oriented physical flow accounts are illustrated.

《产业生态学报》

2006 年冬，第 10 卷第 1-2 期，43-60 页

题目：物质流信息的数字立方与矩阵处理规范

作者：Erik Löfving, Anders Grimvall, Viveka Palm

关键字：集成，分解，矩阵处理，多维数组，物质流，理论体系

摘要：技术系统与生物系统可细分为相应的组成单元，一定区域内的物质的存在与流通可表述为组成单元上的物质存量向量与流量矩阵。推而广之，多种物料在一个或多个时间段内的存量和流量可归纳为多维数据立方。本文提出了一套处理物质流数据的理论框架，可用于分析评价无限时间尺度上的各类物质与材料流。该框架可处理系统组成单元发生变化的情况：如单元合并时如何重新计算数据矩阵及立方，单元拆分时又需要哪些信息以构建新的矩阵及立方等。本文还进一步阐述了在何种情况下，研究不同基本单元所得的物质流数据能够比较与合并，以及怎样比较与合并的问题。这一套处理规范对物流数据处理软件的开发不无裨益。

Journal of Industrial Ecology

2006, Vol. 10, Issue 1-2, pp. 43-60

Data Cubes and Matrix Formulae for Convenient Handling of Physical Flow Data

Erik Löfving, Anders Grimvall, and Viveka Palm

KEYWORDS:
aggregation, disaggregation, matrix operations, multidimensional data arrays, substance flows, theoretical framework

SUMMARY:
If the technosphere and the biosphere are divided into cells, the presence and turnover of a substance in a study area can be summarized in a vector of stocks and a matrix of flows between different pairs of cells. Likewise the stocks and flows of several substances or materials in one or more time periods can be summarized in multidimensional data cubes. In this article, we provide a theoretical framework for handling physical flow data, and we demonstrate how a set of matrix operations can facilitate exploratory analysis and quality assessment of such data regardless of the number of substances, materials, and time periods considered. In particular, we show how matrices and cubes of flow data can be recalculated when the collection of cells is modified by joining cells, and also what information is required to recalculate flows when cells are split. Furthermore, we illustrate how and under what circumstances substance-flow data originating from different studies with different collections of cells can be compared or merged. The generic character of the given formulae facilitates the development of software for physical flow data.

《产业生态学报》

2006 年冬，第 10 卷第 1-2 期，61-77 页

题目：可持续性作为系统的边界约束：一种将生命周期管理提升到战略高度的方法

作者：Henrik Ny, Jamie P. MacDonald, Göran Broman, Ryoichi Yamamoto, Karl-Henrik Robèrt

关键字：回溯，生命周期评价(LCA)，自然步骤(TNS)，战略生命周期管理，可持续产品开发

摘要：实现物流与产品的可持续管理需要对各种复杂的社会、生态和经济因素做出不断的评价；从而涌现出了许多工具与方法，如生命周期评价(LCA)这一十分严谨的方法。但 LCA 从可持续性的角度来看尚存不足，尤难对问题的特殊性、深入性以及全面性、适用性这对矛盾进行很好的把握。本文由可持续性的基本原则往回溯，提出了一个战略性可持续发展方案(亦称自然步骤方案)，以图催生一种物流与产品管理的新方法，即“战略生命周期管理”。该分析须基于以下基本点：(1)可持续性，及(2)可持续性的实现战略。对物流及行为的有些评估代价高昂且与可持续性或可持续战略关系不大，这类评价应尽量避免。反之，有些评价有助于弥补战略认识的不足并发现潜在的问题，这类评价应予以加强。总得看来，本文所述的方法从可持续性的角度对现存的(如与现阶段产品开发及 LCA 有关的)工具和概念作了有效的补充。

Journal of Industrial Ecology

2006, Vol. 10, Issue 1-2, pp. 61-77

Sustainability Constraints as System Boundaries: An Approach to Making Life-Cycle Management Strategic

Henrik Ny, Jamie P. MacDonald, Göran Broman, Ryoichi Yamamoto, and Karl-Henrik Robèrt

KEYWORDS:
backcasting, life-cycle assessment (LCA), materials management, The Natural Step (TNS), strategic life-cycle management, sustainable product development

SUMMARY:
Sustainable management of materials and products requires continuous evaluation of numerous complex social, ecological, and economic factors. A number of tools and methods are emerging to support this. One of the most rigorous is life-cycle assessment (LCA). But LCAs often lack a sustainability perspective and bring about difficult trade-offs between specificity and depth, on the one hand, and comprehension and applicability, on the other. This article applies a framework for strategic sustainable development (often referred to as The Natural Step (TNS) framework) based on backcasting from basic principles for sustainability. The aim is to foster a new general approach to the management of materials and products, here termed “strategic life-cycle management.” This includes informing the overall analysis with aspects that are relevant to a basic perspective on (1) sustainability, and (2) strategy to arrive at sustainability. The resulting overview is expected to help avoid costly assessments of flows and practices that are not critical from a sustainability and/or strategic perspective and to help identify strategic gaps in knowledge or potential problems that need further assessment. Early experience indicates that the approach can complement some existing tools and concepts by informing them from a sustainability perspective—for example, current product development and LCA tools.

《产业生态学报》
2006 年冬，第 10 卷第 1-2 期，79-88 页

题目：成功及代价：产业生态学的制度化与政治相关性

作者：Maurie J. Cohen, Jeff Howard

关键字：环境政策，生态现代化，高等教育，产业生态学，制度化，知识的社会学

摘要：随着学科理念与方法的日趋完善，学界、产业界乃至政界对产业生态学(IE)也越来越关注。产业生态学者应定期评价该学科的制度化影响，并分析研究领域与外部世界的政治相关性。作者就学科的如下四方面表现展开了分析， 即专业合理性、可能的服务对象、商业洞察力以及职业机会。此外在第五方面，即学科的政治相关性上尚存不小的争议。同自然生态学相比，产业生态学组织制度上的进一步发展可能与该学科作为“可持续性科学与工程学”的初衷相违背。本文总结了此问题的重要性，并指出了学科在诸多方面仍然大有可为的原因所在。

Journal of Industrial Ecology

2006, Vol. 10, Issue 1-2, pp. 79-88

Success and Its Price: The Institutionalization and Political Relevance of Industrial Ecology

Maurie J. Cohen and Jeff Howard

KEYWORDS:
environmental policy, ecological modernization, higher education, industrial ecology, institutionalization, sociology of knowledge

SUMMARY:
As industrial ecology (IE) solidifies conceptually and methodologically, and as it gains visibility and legitimacy in academia, industry, and government, it is important that the IE community periodically evaluate the status of its emerging institutional arrangements. At the same time, industrial ecologists should assess the political relations developing between the field and the larger world. We analyze four institutional criteria, professional legitimacy, viable clientele, entrepreneurial acumen, and occupational opportunities, as well as a more controversial fifth measure—political relevance. Drawing a comparison with the field of ecology, we argue that efforts to foster IE institutionally can, ironically, conflict with the objective of seeing IE become “the science and engineering of sustainability.” The article concludes by reflecting on the importance of this kind of critical appraisal and on why many observers of the field remain hopeful.

《产业生态学报》
2006 年冬，第 10 卷第 1-2 期，89-110 页

题目：社会系统多级铜循环与锌循环之统计比较

作者：Barbara Reck, Marlen Bertram, Daniel B. Müller, T. E. Graedel

关键字：探索型数据分析，存量增量，金属，资源使用，物质流分析(SFA)，废物管理

摘要：本文应用探索型数据分析法同时研究了当代社会的铜循环与锌循环。研究在国家级(包括 52 个国家，囊括了两种金属的绝大部分社会存量与流量)、区域级(总揽世界 8 大区域)和全球级三个空间尺度上展开，从总量和人均量两方面构建 1994 年左右的一年期金属循环体系。就作者所知，此项工作为多级、多尺度、全生命周期的资源社会循环研究之首创。研究发现：(1)铜与锌两种金属在国家级上的加工率、使用率、社会存量净增率、废弃率及填埋率高度相关；(2)区域级上两种金属的关联度与国家级上的结果相似；(3)国家级上铜的存量增量比锌约高 50%；(4)两种金属全球级上主要废弃物流的类型存在很大差异，不同过程的散失率随着区域与国家的不同而各异，为此制定资源回收政策时必须充分考虑材料差异性与区域差异性；(5)就铜、锌的总物流而言，从国家级上升为区域级时，数据的标准偏差有所下降，但对人均物流则未必。可见两种金属在不同空间尺度上的统计特性相互独立，这为进一步预测人均金属物流情况奠定了基础。

Journal of Industrial Ecology

2006, Vol. 10, Issue 1-2, pp. 89-110

Multilevel Anthropogenic Cycles of Copper and Zinc: A Comparative Statistical Analysis

Barbara Reck, Marlen Bertram, Daniel B. Müller, and T. E. Graedel

KEYWORDS:
exploratory data analysis, addition to stock, metals, resource use, substance flow analysis (SFA), waste management

SUMMARY:
Contemporary cycles for copper and zinc are coanalyzed with the tools of exploratory data analysis. One-year analyses (circa 1994) are performed at three discrete spatial levels—country (52 countries that comprise essentially all anthropogenic stocks and flows of the two metals), eight world regions, and the planet as a whole—and are completed both in absolute magnitude and in per capita terms. This work constitutes, to our knowledge, the first multiscale, multilevel analysis of anthropogenic resources throughout their life cycles. The results demonstrate that (1) A high degree of correlation exists between country-level copper and country-level zinc rates of fabrication and manufacturing, entry into use, net addition to in-use stocks, discard, and landfilling; (2) Regional-level rates for copper and zinc cycle parameters show the same correlations as exist at country level; (3) On a per capita basis, countries add to in-use stock almost 50% more copper than zinc; (4) The predominant discard streams for copper and zinc at the global level are different for the two metals, and relative rates of different loss processes differ geographically, so that resource recovery policies must be designed from metal-specific and location-specific perspectives; (5)When absolute magnitudes of life-cycle flows are considered, the standard deviations of the data sets decrease from country level to regional level for both copper and zinc, which is not the case for the per capita data sets, where the statistical properties of the data sets for both metals approach being independent of spatial level, thus providing a basis for predicting unmeasured per capita metal flow behavior.

《产业生态学报》
2006 年冬，第 10 卷第 1-2 期，111-132 页

题目：关于人均铜、锌金属存量及流量的解释变量的统计对比研究

作者：Claudia R. Binder, T. E. Graedel, Barbara Reck

关键字：探索型数据分析，国内生产总值(GDP)，人类发展指数(HDI)，私人消费，资源使用，物质流分析(SFA)

摘要：应用探索型数据分析法，本文研究了当代技术社会的铜、锌金属存量及流量的可能解释变量。基于世上 50 个国家 1994 年左右的一年期金属社会循环数据，研究发现：(1)解释金属用量的关键变量是(以购买力平价法计算的)人均国内生产总值(GDP)，它可说明人均铜用量和锌用量的三分之一乃至一半的变化情况。其它与铜、锌使用较为相关的变量包括两类私人消费变量(每千人小汽车占有率及电视拥有量)、两类基础设施变量(人均电话总线数量及城市人口比率)以及制造业的相对增加值。研究结果并不支持有关金属使用的库兹涅茨曲线假设。(2)金属人均用量可通过多变量回归方程加以估测。如铜的人均用量的自然对数为人均 GDP(购买力平价值)、制造业增加值的百分比及城市人口比率的线性函数。该模型可解释约 80%的国家样本(回归方程的决定系数为 0.79)。锌的人均用量的自然对数则与人均 GDP(购买力平价值)和制造业增加值的百分比密切相关，模型的解释率可达 75%（决定系数为 0.75)。(3)低收入和高收入国家两种金属的加工率、使用率、存量增量及废弃率迥然不同，对这些变量亦可根据已有数据，开发相应的预测模型。本文所作的统计分析工作为这一类型的研究奠定了良好的基础。

Journal of Industrial Ecology

2006, Vol. 10, Issue 1-2, pp. 111-132

Explanatory Variables for per Capita Stocks and Flows of Copper and Zinc: A Comparative Statistical Analysis

Claudia R. Binder, T. E. Graedel, and Barbara Reck

KEYWORDS:
exploratory data analysis, gross domestic product (GDP), human development index (HDI), private consumption, resource use, substance flow analysis (SFA)

SUMMARY:
A number of potential explanatory variables for the stocks and flows of copper and zinc in contemporary technological societies are co-analyzed with the tools of exploratory data analysis. A one-year analysis (circa 1994) is performed for 50 countries that comprise essentially all anthropogenic stocks and flows of the two metals. The results show that (1) The key explanatory variable for metal use is gross domestic product (GDP) per capita (purchasing power parity, PPP). By itself, GDP explains between one-third and one-half of the variance of per capita copper and zinc use. Other variables that were significantly correlated with copper and zinc use included two private consumption variables, stock of passenger cars and television sets (per 1,000 people); two infrastructure variables, telephone mainlines per capita and percent of urban population; and percent of value added in manufacturing. The results do not provide evidence supporting the Kuznets curve hypothesis for these metals. (2) Metal use per capita can be estimated using multiple regression equations. For copper, the natural logarithm of consumption per capita is related to the explanatory variables GDP per capita (PPP), percentage of value added in manufacturing, and percent urban population. This model explains 80% of the variance among the different countries (r^2 = 0.79). The natural logarithm of zinc use per capita is related to the explanatory variables GDP per capita (PPP) and percentage of value added in manufacturing. This model explains about 75% of the variance among the different countries (r^2 = 0.75); (3) For both metals, rates of metal fabrication, use, net addition to stock, and discard in low- and high-income countries differ significantly, and predictive equations can also be developed for these flow parameters. Our statistical analyses thus provide a basis for estimating the potential development of metal use, net addition to stock, and discard, using data on explanatory variables that are available at the international level.

《产业生态学报》
2006 年冬，第 10 卷第 1-2 期，133-147 页

题目：生命周期清单数据库用于大豆生产的案例研究

作者：Shelie A. Miller, Thomas L. Theis

关键字：农业，空气排放，系统边界定义，经济投入产出，交通耗能(GREET)模型，生命周期评价

摘要：本文根据已有的三种生命周期清单数据库——交通部门温室气体、规定污染物与耗能(GREET)模型，经济投入产出生命周期评价(EIO-LCA)模型以及配备了 Franklin 数据库的 SimaPro 生命周期评价软件——分析了大豆生产过程的空气污染情况。针对美国大豆业生产与加工案例，文章比较了不同边界定义下运用 EIO-LCA 与 GREET 数据所衍生的不同分析结果。EIO 模型包括了 GREET 模型所不包括的由于风蚀作用所产生的直径 10 微米以下可吸入颗粒物(PM_{10})，但忽略了使用化肥而间接产生的一氧化二氮(N_2O)及氮氧化物(NO_x)。此外，EIO 模型所假设的大豆加工能耗及大豆粉碎和豆油提炼过程的挥发性有机物(VOC)排放都很低。GREET 和 SimaPro 模型基于相同的边界条件及初始假设，但二者在能量清单设定上存在根本的差异：基本能源生产与燃烧过程的关键污染物排放参数可能相差几个数量级。相对于 GREET 模型，Franklin 数据库所假设的 VOC 及硫氧化物(SO_x)排放量要高一个数量级以上，同时 N_2O 及甲烷(CH_4)的排放则低得多。这会极大影响能量密集型过程的生命周期清单分析结果。

Journal of Industrial Ecology

2006, Vol. 10, Issue 1-2, pp. 133-147

Comparison of Life-Cycle Inventory Databases: A Case Study Using Soybean Production

Shelie A. Miller and Thomas L. Theis

KEYWORDS:
agriculture, air emissions, boundary definition, economic input-output, energy use in transportation (GREET) model, life-cycle assessment

SUMMARY:
Three established life-cycle inventories of agricultural operations were used to generate air emissions data for soybean production: the greenhouse gases, regulated emissions, and energy use in transportation (GREET) model; the economic input-output life-cycle assessment (EIO-LCA) model; and SimaPro software equipped with the Franklin database. EIO-LCA and GREET baseline data were compared to evaluate differences in boundary definitions that apply specifically to U.S. soybean agriculture and processing, which resulted in several major findings. The EIO model estimated for emissions of particulate matter less than 10 micrograms (PM_{10}) resulting from wind erosion that were not included in GREET, but neglected indirect nitrous oxide (N_2O) and nitrogen oxides (NO_x) emissions from fertilizer application. EIO also assumed significantly lower process energy requirements and lower volatile organic compounds (VOC) for soybean crushing and oil extraction. The GREET and SimaPro models were compared using identical boundary and assumption data, to reveal major discrepancies in fundamental assumptions of energy inventories. Key emission factors varied by several orders of magnitude for basic energy generation and combustion processes, potentially impacting results for any inventory analysis that contains significant energy consumption. The Franklin database assumed VOC and sulfur oxides (SO_x) emissions more than an order of magnitude higher than GREET for all categories investigated, with significantly lower N_2O and methane (CH_4) emission factors.

《产业生态学报》
2006 年冬，第 10 卷第 1-2 期，149-167 页

题目：美国小麦生产过程能耗的再评价

作者：Gerhard Piringer, Laura J. Steinberg

关键字：农业，载能比，能量平衡，谷物，投入产出模型，过程分析

摘要：本文开发了一种描述产品生产效率的方法并将其用于中小型企业的污染预防项目。农业生产的能量预算可作为农产品的生命周期评价的基础，亦可服务于农产品生产过程的效益优化。文章论述了美国农业部门能量效率的改进趋势，将 70 到 80 年代有关小麦培育的从摇篮到坟墓的分析向前推进了一步。能量输入数据来自美国的官方统计，在辅以其它来源的基础上又乘以了新近发表的能量系数。生产每千克美国小麦的平均能量需求在 3.1 至 4.9 兆焦/千克之间，最可能值为 3.9 兆焦/千克。其中约 47%的能量集中到氮肥上，25%的能量表现为柴油燃料，此外还有少量的能量集包括到种子、汽油、电力及磷肥中。载能比方面天然气约占 57%，接下来为柴油(30%)。对比早期的类似研究，美国小麦生产的总能量效率有所改善。但不同方面的效率参数差异较大，因此这一改善并不那么一目了然。文章对几个输入过程基于投入产出模型进行了估算，估算结果与过程分析所得的结果吻合得很好。但模型的使用仍存在局限，如一般谷物生产的总能量投入低于单独生产小麦用化肥所需的能量，这可能是计算谷物部门的总能耗时，除小麦之外还包括了多类农产品所致。

Journal of Industrial Ecology

2006, Vol. 10, Issue 1-2, pp. 149-167

Reevaluation of Energy Use in Wheat Production in the United States

Gerhard Piringer and Laura J. Steinberg

KEYWORDS:
agriculture, carrier mix, energy balance, grain, input-output model, process analysis

SUMMARY:
Energy budgets for agricultural production can be used as building blocks for life-cycle assessments that include agricultural products, and can also serve as a first step toward identifying crop production processes that benefit most from increased efficiency. A general trend toward increased energy efficiency in U.S. agriculture has been reported. For wheat cultivation, in particular, this study updates cradle-to-gate process analyses produced in the seventies and eighties. Input quantities were obtained from official U.S. statistics and other sources and multiplied by calculated or recently published energy coefficients. The total energy input into the production of a kilogram of average U.S. wheat grain is estimated to range from 3.1 to 4.9 MJ/kg, with a best estimate at 3.9 MJ/kg. The dominant contribution is energy embodied in nitrogen fertilizer at 47% of the total energy input, followed by diesel fuel (25%), and smaller contributions such as energy embodied in seed grain, gasoline, electricity, and phosphorus fertilizer. This distribution is reflected in the energy carrier mix, with natural gas dominating (57%), followed by diesel fuel (30%). High variability in energy coefficients masks potential gains in total energy efficiency as compared to earlier, similar U.S. studies. Estimates from an input-output model for several input processes agree well with process analysis results, but the model's application can be limited by aggregation issues: Total energy inputs for generic food grain production were lower than wheat fertilizer inputs alone, possibly due to aggregation of diverse products into the food grain sector.

《产业生态学报》
2006 年冬，第 10 卷第 1-2 期，169-184 页

题目：美国居住用水的生命周期分析

作者：Angela Arpke, Neil Hutzler

关键字：建筑，能源消耗，环境评价，环境影响，污水处理，水资源处理

摘要：水与能源是建筑住户的两大主要资源需求。本文通过生命周期评价(LCA)分析了四类建筑水管系统及设备系统的运行情况。整个生命周期过程如下：水资源提取自大自然，经过处理之后送往各类建筑以资利用，用后污水经净化后又重新返回环境。文章从定量及定性两方面，系统分析了美国居住用水的环境影响、水加热及处理系统的电力及天然气等能耗、以及净水过程所需化学品的生产与消费等方面。

与新鲜水生产与废水处理等过程不同，建筑内用水的资源影响大得多。在公寓住宅、大学宿舍、汽车旅馆及办公楼四类建筑中，以公寓单位用水的(用于水处理及加热)能耗为高，而办公楼用水的能耗则最低。公寓用水的 LCA 影响分数也比其它三类建筑来得大。

Journal of Industrial Ecology

2006, Vol. 10, Issue 1-2, pp. 169-184

Domestic Water Use in the United States: A Life-Cycle Approach

Angela Arpke and Neil Hutzler

KEYWORDS:
buildings, energy consumption, environmental assessment, environmental impact, wastewater treatment, water treatment

SUMMARY:
Water and energy are two primary natural resources used by building occupants. A life-cycle assessment (LCA) is performed for water-consuming plumbing fixtures and water-consuming appliances during their operational life for four different building types. Within the cycle studied, water is extracted from the natural environment, subjected to water treatment, pumped to buildings for use, collected for wastewater treatment, and discharged back to the natural environment. Specifically, the impacts of water use, electricity and natural gas generation, energy consumption (for water and wastewater treatment, and for water heating), and the manufacture of water and wastewater treatment chemicals are evaluated both quantitatively and qualitatively on a generalized national level in the United States of America.

It is concluded that water use and consumption within buildings have a much larger impact on resource consumption than the water and wastewater treatment stages of the life cycle. To study this more specifically, the resource consumption of four different building types—an apartment building, a college dormitory, a motel, and an office building—is considered. Of these four building types, the apartment has the highest energy consumption (for water and wastewater treatment, and for water heating) per volume of water used, whereas the office building has the lowest. Similarly, the calculated LCA score for the apartment building is typically greater than those of the other three building types.

《产业生态学报》
2006 年冬，第 10 卷第 1-2 期，185-197 页

题目：中国铅酸电池系统的生态效率

作者：Jiansu MAO, Zhongwu LU, Zhifeng YANG

关键字：元素流分析，环境影响，铅排放，铅回收，社会服务，物质流分析

摘要：提高生态效率有利于可持续发展大业。本文定义了铅酸电池(LAB)系统的社会服务与环境影响，以及生态效率、资源效率及环境效率等变量。作者以财年为世界单位，基于 LAB 系统的实际铅物流，建模分析了生产过程、生产至废物处置的时间间隔、最终产品与社会服务的相关性等因素；由此给出了生态效率的计算公式，并估计了生态效率的变化趋向。

结果表明，提高铅回收减少铅排放无疑会改善生态效率。中国 LAB 系统的资源与环境效率分别为 119 和 131 千瓦时·年/吨，远低于瑞典的 15800 千瓦时·年/吨。这缘于中国的铅回收率低(仅 0.312 吨/吨，约有 70%的废铅根据官方统计未能有效回收)，且铅排放率高(约 0.324 吨/吨，即近 33%投入使用的铅最终排放到了环境当中)。进一步分析发现，问题的根源在于低效的废铅管理系统、低品位的铅矿资源以及大量存在的小规模铅加工厂。文章还对如何改进 LAB 系统的生态效率展开了讨论。

Journal of Industrial Ecology

2006, Vol. 10, Issue 1-2, pp. 185-197

The Eco-efficiency of Lead in China's Lead-Acid Battery System

Jiansu MAO, Zhongwu LU, and Zhifeng YANG

KEYWORDS:
element flow analysis, environmental impact, lead emissions, lead recycling, societal services, substance flow analysis

SUMMARY:
Improving eco-efficiency can contribute to sustainable development. This article defines the societal services and environmental impacts of the lead-acid battery (LAB) system and offers definitions of eco-efficiency, resource efficiency, and environmental efficiency in the context of LAB systems. Based on the actual lead-flow in the LAB system, we develop a model that considers changes in production, the time interval between production and disposal, direct linkages between the final product and the societal service it provides, and the fiscal year as the statistical period. From this model, equations for eco-efficiency are derived and changes in eco-efficiency are predicted.

The results show, not surprisingly, that increased lead recycling and reduced lead emissions will both improve eco-efficiency. The resource and environmental efficiencies for LAB in China are 119 and 131 kilowatt-hour-years per metric tonne (kWh·yr), respectively, versus a value for both of 15,800 kWh · yr in Sweden. The difference results from a lower lead recycling rate (only 0.312 tonne/tonne, which means that nearly 70% of the old lead scrap is not recycled based on official statistics) and higher lead emissions (0.324 tonne/tonne, which means that nearly 33% of the lead inputs used in the LAB system were lost into the environment) in China. Further analysis shows that these problems result from inefficient management of lead scraps, poor quality lead ore, and an abundance of small-scale lead-related plants. Ways to improve eco-efficiency are proposed.

《产业生态学报》
2006 年冬，第 10 卷第 1-2 期，199-216 页

题目：移动电话的生态足迹分析

作者：Sibylle D. Frey, David J. Harrison, Eric H. Billett

关键字：生物生产所需土地面积，电子产品，环境指数，产业生态学，信息与通讯技术(ICT)，自然资产核算

摘要：生态足迹作为地理区域乃至一定产品和行为的可持续性的评价标准已有 15 年以上的历史。它表示为给定时间及特定人口生产某种资源(如农作物或木材)、建设某类基础设施或净化某些废物(多数情况下限定为二氧化碳)所需的土地面积。目前有关移动电话的评价仍以生命周期法为主，侧重于环境毒性、废弃产品管理及能耗等方面，一定程度上忽略了更广义的可持续问题。为此有必要分析电子产品的生态足迹。本文给出了三类移动电话的生态足迹分析结果。基于文献数据、部分基于对有关原矿品位及覆盖岩层的近似估计，文章建立了一个数据库，用于计算生产电子产品所需矿物原料的土地面积。当原始数据缺乏时，原料开采的能耗可根据原料品位和岩土覆盖量进行统计回归计算。通过生命周期评价法，生产及使用移动电话的环境负担可转换为即时的资源消耗。结果显示不同的电子产品具有不同的生态足迹。本文所述的方法足以揭示小型电子产品的生态足迹差异，亦可用于判断不同技术的生态足迹效率。

Journal of Industrial Ecology

2006, Vol. 10, Issue 1-2, pp. 199-216

Ecological Footprint Analysis Applied to Mobile Phones

Sibylle D. Frey, David J. Harrison, and Eric H. Billett

KEYWORDS:
bioproductive area, electronic products, environmental indicator, industrial ecology, information and communications technology (ICT), natural capital accounting

SUMMARY:
Ecological footprints (EF) have been used for more than 15 years as an aggregate measure of sustainability of geographical regions, but also for certain products and activities. EF analysis measures the bioproductive areas required to produce resources such as crops and timber, the directly occupied areas for infrastructure, and areas for absorbing waste flows (mostly limited to carbon dioxide) in a given year for a defined population. The need to extend ecological footprint analysis to electronic products arose because so far, mobile phones have mainly been evaluated using life-cycle assessments with a focus on toxicity, end-of-life management, and energy use, thus ignoring the wider sustainability implications. This article presents the footprint results from three mobile phone case studies. To establish the land areas consumed by the mined materials used in electronic products, a database was developed based on literature data and on approximations from the density and overburden of materials. The relationship between abundance and overburden values was used in a regression analysis to estimate energy requirements in materials extraction where other data were not available. Using a life-cycle assessment approach, environmental burdens for producing and using a mobile phone were calculated and transformed into the instantaneous rate of resource consumption. Key results were that different electronic products have different ecological footprints and that the methodology proved sensitive enough to reveal differences in small electronic products and for monitoring technologies that use bioproductive space efficiently.

《产业生态学报》
2006 年冬，第 10 卷第 1-2 期，217-237 页

题目：生产者延伸责任制无益吗？挪威塑料包装及电子产业的技术革新研究

作者：Kjetil Røine, Chin-Yu Lee

关键字： 电子电气设备，电子废料，生产者延伸责任制(EPR)，塑料包装，产品照管，技术革新

摘要： 本文讨论了挪威生产者延伸责任制(EPR)与技术革新(TCI)之间的关系。问题的关键在于 EPR 政策是否对技术革新有影响？如果答案是肯定的，那么不同的 EPR 政策又能产生何种不同效果？文章比较研究了挪威的塑料包装及电子电器产业，认为 EPR 与技术革新之间存在着一定的联系，但二者的相关性并不强。EPR 通过鼓励循环利用对下游过程产生一定的影响，进而间接推动了制度学习与革新。但多数 EPR 政策都侧重于参与者的财政方面，相互之间差异不大，对技术革新的影响也并不显著。对上游过程的革新，挪威 EPR 政策的作用也十分有限。其它因素，如欧盟基于 EPR 的有害物限制(RoHS)指令以及塑料包装产业的竞争力要求等则相对而言重要得多。为使 EPR 更有力的服务于技术革新，决策者必须考虑采取其它直接影响产品核心业务的措施。

Journal of Industrial Ecology

2006, Vol. 10, Issue 1-2, pp. 217-237

With a Little Help from EPR? Technological Change and Innovation in the Norwegian Plastic Packaging and Electronics Sectors

Kjetil Røine and Chin-Yu Lee

KEYWORDS:
electrical and electronic equipment, e-scrap, extended producer responsibility (EPR), plastic packaging, product stewardship, technological change and innovation

SUMMARY:
In this article we discuss the interplay between extended producer responsibility (EPR) and technological change and innovation (TCI) in Norway. We ask whether Norwegian EPR policy has an effect on TCI and, if so, whether it makes any difference how the EPR policies are designed. By carrying out a comparative study between the plastic packaging (PP) sector and electrical and electronic (EE) sector in Norway, we conclude that there is a correlation between Norwegian EPR policy and TCI, but the causality is rather weak. EPR has an effect on downstream activities through increased recycling and indirectly through institutional innovation and learning. It does not, however, make a significant difference how the policies are designed, because they are considered similar by a majority of actors contributing financially to the EPR schemes. As for technological change and innovation upstream, the role of Norwegian EPR policies in the observed trends is not significant. Other factors such as the EPR-based Restriction on Hazardous Substances (RoHS) Directive promulgated by the European Union (EE sector) and the need for competitiveness (PP sector) seem far more important. In order to make EPR policies more powerful in inducing technological change and innovation, decision-makers should consider more specific measures that directly address the core businesses of the producers.

《产业生态学报》
2006 年冬，第 10 卷第 1-2 期，239-255 页

题目：丹麦卡伦堡产业共生的经济与环境定量评价

作者：Noel Brings Jacobsen

关键字：副产品集成，分级利用，联合发电，产业生态系统，再循环，水的再利用

摘要：产业共生作为产业生态学的一个重要研究课题，侧重于企业集群的资源优化。丹麦卡伦堡产业共生系统是产业生态学文献中的一个基本案例。但对这一案例的深入量化分析乃至对其经济与环境表现的系统认识仍有待完善。本文基于详细的经济与环境数据，分析了卡伦堡系统的关键物质与能量交换。研究发现，这些交换共生的环境效益有大有小；其经济初衷往往在于上下游的具体过程经济表现，与交换的副产物或废物本身价值的高低没有直接的联系。可见，企业眼中的产业共生不但应实现系统总体的可持续发展，同时也必须改进企业个体的经济与环境表现。

Journal of Industrial Ecology

2006, Vol. 10, Issue 1-2, pp. 239-255

Industrial Symbiosis in Kalundborg, Denmark: A Quantitative Assessment of Economic and Environmental Aspects

Noel Brings Jacobsen

KEYWORDS:
by-product synergy, cascading, cogeneration, industrial ecosystem, recycling, water reuse

SUMMARY:
As a subdiscipline of industrial ecology, industrial symbiosis is concerned with resource optimization among collocated companies. The industrial symbiosis complex in Kalundborg, Denmark is the seminal example of industrial symbiosis in the industrial ecology literature. In spite of this, there has been no in-depth quantitative analysis enabling more comprehensive understanding of economic and environmental performances connected to this case. In this article some of the central industrial symbiotic exchanges in Kalundborg are analyzed, using detailed economic and environmental data. It is found that both substantial and minor environmental benefits accrue from these industrial symbiosis exchanges and that economic motivation often is connected to upstream or downstream operational performance and not directly associated with the value of the exchanged by-product or waste itself. It is concluded that industrial symbiosis, as viewed from a company perspective, has to be understood both in terms of individual economic and environmental performance, and as a more collective approach to industrial sustainability.

《产业生态学报》
2006 年冬，第 10 卷第 1-2 期，257-278 页

题目：大企业环境标准对子公司及供应商的影响：摩托罗拉槟城公司之案例

作者：Michael T. Rock, David P. Angel, Pao Li Lim

关键字：全球生产网络(GPNs)，跨国公司(MNCs)，新制度经济学(NIE)，“竞次”现象，供应链管理，交易费用

摘要：跨国公司往往具有严格规范的环境标准，但如何将这些标准扩展到公司的全球生产网络，尤其是位于发展中国家的子公司及供应商中去呢？本文就此问题以摩托罗拉为例展开了研究。作为一家生产网络遍及全球的大型跨国电子企业，摩托罗拉为满足欧盟新近推出的环境指令而制定了一系列严格的企业环境标准。研究显示这一标准已经应用于摩托罗拉位于马来西亚槟城的一个重要子公司及其供应商，以便降低生产过程的环境强度。可见，拥有全球生产网络的跨国公司通过提高其子公司及供应商的环境标准，可避免仅限于满足最低环保要求的“竞次”行为的发生，从而在贸易、投资和科技交流自由的气氛下，实现企业技术与环境表现的持续改进。

Journal of Industrial Ecology

2006, Vol. 10, Issue 1-2, pp. 257-278

Impact of Firm-Based Environmental Standards on Subsidiaries and Their Suppliers: Evidence from Motorola-Penang

Michael T. Rock, David P. Angel, and Pao Li Lim

KEYWORDS:
global production networks (GPNs), multinational corporations (MNCs), new institutional economics (NIE), race to the bottom, supply chain management, transaction cost

SUMMARY:
How successful are multinational corporations in extending their firm-based environmental standards to their subsidiaries and those subsidiaries' local suppliers in their global production networks in developing countries? We address this question through an in-depth case study of how Motorola, a prominent multinational electronics firm with an extensive global production network, is using a set of firm-based standards to meet several new stringent European Union environmental directives. The case study demonstrates that these firm-based standards appear to be enabling a major subsidiary and its suppliers in one developing economy to reduce the environmental intensities of their production activities. This finding suggests that the firm-based environmental standards of multinationals with extensive global production networks might contribute to a leveling up of environmental standards in subsidiaries and their local suppliers, rather than a "race to the bottom," thus reinforcing the technique or intensity effects associated with open trade, investment, and technology policies.

《产业生态学报》
2006 年冬，第 10 卷第 1-2 期，279-292 页

题目：瑞典与欧洲化学品管理服务的经验教训

作者：Oksana Mont, Pranshu Singhal, Zinaida Fadeeva

关键字：化学品释放，利益分配，外购，服务化，产品与服务体系(PSSs)，供应链管理

摘要：现代社会生产与使用的化学品花样繁多，但有关这些化学品生命周期过程的环境风险也不能忽视。化学品管理服务(CMS)旨在通过签署长期的战略性合同，由服务提供方承担化学品管理的责任，从而减少相应的费用与风险，并进而降低化学品的环境影响。本文得到了对 CMS 感兴趣的产业专家的指导，通过采访欧洲的化学品生产商与 CMS 关联单位，分析了欧洲 CMS 供求双方现存的一些机遇、挑战与利益冲突，阐述了 CMS 在化学品管理市场中所起的作用以及可以为鉴的经验教训。文章认为只有在一系列重要条件具备的情况下方能确保 CMS 的经济与环境效益，实现 CMS 供求双方的互利互惠。文章最后还对 CMS 在欧洲的进一步发展提出了建议。

Journal of Industrial Ecology

2006, Vol. 10, Issue 1-2, pp. 279-292

Chemical Management Services in Sweden and Europe: Lessons for the Future

Oksana Mont, Pranshu Singhal, and Zinaida Fadeeva

KEYWORDS:
chemical leasing, gain sharing, outsourcing, servicizing, product-service systems (PSSs), supply chain management

SUMMARY:
The number and diversity of chemicals produced and used in society today are growing in conjunction with the both evident and uncertain environmental impacts associated with the life cycles of these chemicals. Chemical management services (CMS) is a business strategy based on a strategic, long-term contract, according to which the supplier of chemical management services accepts the responsibility for managing chemicals and strives to reduce the associated costs and risks. This strategy also has the potential for reducing the environmental impacts of chemicals. This article provides an overview of the existing advantages and barriers for CMS providers and customers in the European context, identifies conflicts of interest between them, and highlights important lessons regarding the role of CMS in shaping these markets. It reports on findings from interviews with European chemical producers and other stakeholders of chemical management services and is directed toward industry professionals interested in chemical management services. It concludes that economic and environmental advantages of CMS are not automatically guaranteed and lists factors that are critical for developing a win-win CMS for both providers and customers. Finally, ways of fostering CMS dissemination in Europe are suggested.