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《产业生态学报》

2003 年冬，第 7 卷第 1 期，17–23 页

题目：超越食物网：关于产业生态系统的深层探索

作者： Jonah Spiegelman

关键字：复杂系统分析，㶲，层次，非平衡系统，自组织系统，热力学

摘要：产业生态学理论在一定程度上建立在产业生态系统与自然生态系统的物流和能流结构的简单类比之上。本文认为产业生态系统和自然生态系统都是远离热力学平衡态的复杂自组织系统，它们在系统约束和动力学特性上有很多共性，这远非以前的简单类比所能涵盖。为了研究系统间的实际上要复杂得多的联系，有必要建立一个适用范围更广的分析框架。在此引入复杂系统分析方法是一个很好的选择，它深化了产业生态学的理论内涵。

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Industrial Ecosystems as FoodWebs

Jonah Spiegelman

KEYWORDS:
complex systems analysis, exergy, hierarchy, non-equilibrium systems, self-organizing systems, thermodynamics

SUMMARY:
Industrial ecology is a school of thought based, in part, upon a simple analogy between industrial systems and ecological systems in terms of their material and energy flows. This article argues for a more sophisticated connection between these diverse systems based on the fact that they are all complex self-organizing systems, operating far from thermodynamic equilibrium. As such, industrial and ecological systems have in common certain constraints and dynamic properties that move beyond the central metaphor of industrial ecology and could align these systems under a more comprehensive analytical framework. If incorporated at a fundamental level, the complex systems framework could add depth and sophistication to the field of industrial ecology.

《产业生态学报》

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题目：美国清洁汽车回收系统的经济分析

作者：Jane E. Boon, Jacqueline A. Isaacs, Surendra M. Gupta

关键字：汽车，拆卸，经济学，目标规划，再循环，切割

摘要：燃料价格日益上涨，环境污染越来越受到关注，使得美国汽车制造商和立法者的目光不约而同的转向了“清洁汽车”技术。燃电混合型汽车（HEVs）已经上路，纯电动汽车也正在接受市场的检验，此外还不时的有高能效微型车涌现出来。可以预见，这些清洁汽车将日趋成熟，大量生产和使用，并最终废弃。美国对传统的内燃机汽车有一套完善的回收机制，包括废旧汽车拆卸厂和切割厂等。现在，这些传统汽车的回收部门，此外还包括废电池回收商，必须准备好回收即将报废的新型清洁汽车。

本文通过一个目标规划模型分析了清洁汽车回收系统中的材料流和回收过程的经济效益，比较了使用铅电池以及镍氢电池的两座电动汽车、四座及两座的 HEV 以及微型汽车，计算了车体内有色金属材料含量对汽车回收处理过程的经济效益的影响。尽管目标规划模型作为一个线性模型有其一定的局限，但它仍然给出了不少有价值的信息。研究表明，清洁汽车的回收可能不像传统汽车回收那样有利可图，但只要二手汽车配件的市场足够大、车体内有色金属材料的含量足够高，其经济性还是能够保证的。

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End-of-Life Infrastructure Economics for “Clean Vehicles” in the United States

Jane E. Boon, Jacqueline A. Isaacs and Surendra M. Gupta

KEYWORDS:
automobile, disassembly, economics, goal programming, recycling, shredding

SUMMARY:
Rising fuel prices and concern over emissions are prompting automakers and legislators to introduce and evaluate "clean vehicles" throughout the United States. Hybrid electric vehicles (HEVs) are now on the roads, electric vehicles (EVs) have been test marketed, and niche vehicles such as high-fuel-economy microcars are being considered for introduction. As these vehicles proliferate and mature, they will eventually reach their end of life (EOL). In the United States, an extensive recycling infrastructure exists for conventional, internal combustion engine (ICE) vehicles. Its primary constituents are the disassembler and the shredder. These industries, as well as battery recyclers, are expected to play integral roles in the EOL processing of clean vehicles.

A model of the automobile-recycling infrastructure and goal programming techniques are used to assess the materials streams and process profitabilities for several different clean vehicles. Two-seat EVs with lead-acid or NiMH batteries are compared with two- and four-seat HEVs and microcars. Changes to the nonferrous content in the vehicle bodies are explored and compared for the effect on processing profitability. Despite limitations associated with the linearity of goal programming techniques, application of this tool can still provide informative first-order results. Results indicate that although these clean vehicles may not garner the same profit levels as conventional ICE vehicles, they are profitable to process if there are markets for parts and if there are sufficient quantities of nonferrous materials.

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题目：全球及区域食物系统的生物质代谢研究

作者：Stefan Wirsenius

关键字：农业，生物质，食物生产，材料流分析(MFA)，植物生物量，反刍动物

摘要：食物与农业系统是人类利用土地和生物初级生产的最大规模的活动之一，并直接影响碳元素、水和氮元素的地球生物化学循环。然而与其重要程度相比，有关食物与农业系统的研究稍显不足，对系统的基础物流（如生物质）循环和关键过程（如畜产品生产过程）的资源使用效率的认识目前都还不够深入。

本文调查了食物和农业系统内的生物质流，分析了从庄稼种植、牧草种植到蔬菜和牲畜养殖再到废热、粪便和其他废物排放等全过程的生物质物流和能量平衡特性。研究将世界分为 8 个主要区域，综合考察各区域内的终端食品消费、食品生产和处理效率以及生物副产品和渣滓作为饲料等的回收情况，并由此推出人类必须的植物生物量和庄稼产量。

食品系统 1992 到 1994 年平均每年的全球植物生物质产量约为 13Pg 的干物质或 230 EJ（以高热值计）的能量，其中约 8%作为最终产品为人类所消费。以能量计，畜产品系统约消耗了植物生物量的三分之二，而它对人类膳食的贡献却仅为 13%。反刍类动物的生物量转化效率（表现为畜体生物质与饲料生物质含量之比）比其它系统要低的多，因此对整个食物系统的生物质代谢的影响也最大。

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The Biomass Metabolism of the Food System: A Model-Based Survey of the Global and Regional Turnover of Food Biomass

Stefan Wirsenius

KEYWORDS:
agriculture, biomass, food production, materials flow analysis (MFA), phytomass, ruminants

SUMMARY:
The food and agriculture system is among the largest anthropogenic activities in terms of appropriation of land and biological primary production, as well as alteration of the grand biogeochemical cycles of carbon, water, and nitrogen. Despite its importance in these respects, physically coherent descriptions and analyses of the food and agriculture system regarding the total turnover of fundamental flows (such as biomass) and resource use and efficiency of critical processes (such as animal food production) are relatively scarce.

This article presents a survey of the current flows of biomass in the food and agriculture system. The survey gives a mass- and energy-balanced description of biomass from its production on cropland and grassland through its transformations into animal and vegetable food products to its final conversion into respiratory heat, feces, and other residues. This assessment was carried out by means of a physical model that, for eight world regions, calculates the necessary production of crops and other phytomass (plant biomass) from a prescribed end use of food, efficiency in food production and processing, and use of system-internal by-products and residues as feed, feedstock, and food.

The global appropriation of terrestrial phytomass production by the food system was estimated to be some 13 Pg (1.43 × 1010 short tons) dry matter, or 230 EJ (2.18 × 1017 Btu) gross energy (higher heating value), per year in 1992-1994. Of this phytomass, about 8% ended up in food commodities eaten. Animal food systems accounted for roughly two-thirds of the total appropriation of phytomass, whereas their contribution to the human diet was about 13% (both on a gross energy basis). The ruminant meat systems were found to have a far greater influence than any other subsystem on the food system's biomass metabolism, primarily because of the lower feed-conversion efficiency (calculated as carcass produced by total feed intake, including pasture and other human-inedible feedstuffs) of those systems.

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题目：瑞典材料国内消耗和出口的物流会计研究

作者：Viveka Palm, Kristina Jonsson

关键字：直接材料消耗(DMC)，直接材料投入(DMI)，环境会计，出口，产业代谢，材料流分析(MFA)

摘要：本文介绍了 1987 至 1998 年间瑞典国民经济的物流会计，并通过区分材料的国内消耗和出口，增强了不同国家间材料消耗的数据可比性。文中计算了每年从自然系统到经济系统的除水和空气之外的全部直接材料投入(DMI)，既包括研究区域内的本地生产也包括进口。这样，当 DMI 用于一组国家时，可避免对贸易物流作重复计算。

1997 到 1998 年瑞典的年均 DMI 为每人 24 到 27 吨。其中化石燃料投入的数量变化不大，从 1991 年的每人 3.2 吨增至 1996 年的每人 3.6 吨，但这仍然不能满足瑞典环保局认定的可持续发展目标。可再生材料的投入在每人 8 到 9 吨之间，矿产资源消耗在每人 11 到 15 吨的区间内变化。在人均 DMI 中，约 5 吨材料归于最后出口，其余 20 吨为个人消耗。瑞典人均 DMI 比德国、美国和日本高，与荷兰相当。这种数据差异主要涉及到出口占经济总量的比重以及自然资源的系统边界问题。为加强数据的可比性，不同国家间的自然资源界定标准和数据来源仍有待统一。

直接材料消耗(DMC)，即 DMI 与出口的差值，表现出一个国家消耗自然资源的强度。对固体废物的统计表明，除采矿废物外瑞典固体废物的产生量约占资源消耗总量的 10%，废物管理系统的废物回收量约为社会全年天然原料消耗的 5%。

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Materials Flow Accounting in Sweden: Material Use for National Consumption and for Export

Viveka Palm and Kristina Jonsson

KEYWORDS:
direct material consumption (DMC), direct material input (DMI), environmental accounts, exports, industrial metabolism, materials flow analysis (MFA)

SUMMARY:

This article presents Swedish economy-wide material flow accounts for the period 1987-1998. It also shows possibilities for enhancing the international comparability of aggregated data on material use, by distinguishing between materials used for consumption and export purposes. The direct material input (DMI) is used as an aggregate measure to estimate the amounts of natural resources (except water and air) that are taken from nature into the economy within a year, including imports to and production within the region in question. The division of materials used for consumption and export purposes avoids double counting trade flows when DMI is applied to a group of countries.

The annual DMI in Sweden for 1997-1998, including production and imports, amounts to 24 to 27 metric tons per capita (t/c). The fossil fuel input varies only slightly over the period, from 3.2 t/c in 1991 to 3.6 t/c in 1996, a level deemed unsustainable by the Swedish Environmental Protection Agency. The input of renewable raw materials varies between 8 and 9 t/c. Ores and minerals vary between 11 and 15 t/c. The DMI puts Sweden above estimates made for Germany, the United States, and Japan and in the same range as the Netherlands. The differences in these values can mainly be explained by the relative importance of exports as compared to the size of the economy and by the variation in system boundaries for the data on natural resources. The system boundaries and data sources for natural resources need to be further defined to make the measures fully comparable. Around 5 t/c is exported, whereas the rest, around 20 t/c, is national consumption.

The aggregate direct material consumption (DMC), which is the DMI minus exports, communicates the magnitude of resource use. Comparisons of the input with solid waste statistics indicate that quantity of waste (excluding mining waste) in Sweden is equal to about 10% relative of the total resource use. Material collected for recycling by the waste management system is equal to about 5% of the amount of virgin resources brought into society each year.

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题目：水泥生产及其环境影响第 2 部份：环境挑战和机遇

作者：Hendrik van Oss, Amy C. Padovani

关键字：替代燃料，二氧化碳，熟料，温室气体(GHG)，工业共生，硅酸盐水泥

摘要：工业化国家中建筑材料是燃料以外的一项主要材料流。水泥，作为混凝土和砂浆的粘合材料，是一种极为重要的建材，其主要成分是硅酸钙。人类利用石灰石和其它原料在窑炉中高温煅烧最后研磨得到水泥。每生产 1 吨水泥需 3.2 到 6.3GJ 的能量以及 1.7 吨左右的原材料（主要是石灰石）。同时产生大量的污染物如二氧化碳、氮氧化物、氧化硫和粉尘等。每吨水泥熟料的二氧化碳排放量约为 1 吨，其中约一半来自石灰石的煅烧，另一半来自燃料的燃烧。水泥行业是温室气体的两个重要工业来源之一。水泥需求量高、能耗和原料消耗大，但另一方面水泥生产可利用多种废物和燃料，并能利用很多其它工业的副产物，其环保改进的潜力也很大。本文是一个系列论文的后半部分，在前文分析水泥制造的化学过程、技术原料和能耗特性的基础上，总结了水泥工业面临的种种环境挑战和机遇。文中主要利用美国水泥工业的数据状况展开分析。

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Cement Manufacture and the Environment, Part II: Environmental Challenges and Opportunities

Hendrik van Oss and Amy C. Padovani

KEYWORDS:
alternative fuels, carbon dioxide, clinker, greenhouse gases (GHG), industrial symbiosis, portland cement

SUMMARY:
Construction materials account for a significant proportion of nonfuel materials flows throughout the industrialized world. Hydraulic (chiefly portland) cement, the binding agent in concrete and most mortars, is an important construction material. Portland cement is made primarily from finely ground clinker, a manufactured intermediate product that is composed predominantly of hydraulically active calcium silicate minerals formed through high-temperature burning of limestone and other materials in a kiln. This process typically requires approximately 3 to 6 million Btu (3.2 to 6.3 GJ) of energy and 1.7 tons of raw materials (chiefly limestone) per ton (t) of clinker produced and is accompanied by significant emissions of, in particular, carbon dioxide (CO_2), but also nitrogen oxides, sulfur oxides, and particulates. The overall level of CO_2 output, about 1 ton/ton clinker, is almost equally contributed by the calcination of limestone and the combustion of fuels and makes the cement industry one of the top two manufacturing industry sources of this greenhouse gas. The enormous demand for cement and the large energy and raw material requirements of its manufacture allow the cement industry to consume a wide variety of waste raw materials and fuels and provide the industry with significant opportunities to symbiotically utilize large quantities of by-products of other industries. This article, the second in a two-part series, summarizes some of the environmental challenges and opportunities facing the cement manufacturing industry. In the companion article, the chemistry, technology, raw materials, and energy requirements of cement manufacture were summarized. Because of the size and scope of the U.S. cement industry, the article relies primarily on data and practices from the United States.

《产业生态学报》
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题目：产业生态学原理在宾馆饭店业的应用

作者：Auden Schendler

关键字：生态旅游，饭店业，娱乐，观光度假产业，服务，滑雪

摘要：产业生态学主要用于制造业，但也可进一步应用到其它经济部门，特别是那些被认为是相对洁净的部门。饭店业产生很大“生态足迹”，而且往往地处生态敏感地区，产业生态学在此大有用武之地。科罗拉多 Aspen 滑雪公司每年接待 130 万滑雪者，拥有 5000 英亩滑雪区。Aspen 滑雪公司全面地将节能、再利用、生命周期成本管理、营养循环、可再生能源、生态系统多样性、资源来源本地化、人力成本等各种措施综合地运用到其四个滑雪场和两个滑雪旅馆的经营中。产业生态学的引入使得宾馆饭店业能够在一个更长的历史时期和更大的背景下理解环境问题，避免一些传统的环境主义对回收和末端污染控制的片面强调。产业生态学的原理其实可以直接应用于旅馆和度假村，但执行者们往往要遇到来自文化、体制和经济等很多方面的障碍。本文根据 Aspen 滑雪公司的滑雪场、餐厅和五星级宾馆等第一手资料撰写而成，分析了产业生态学原理在宾馆饭店业应用的种种成败得失。

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Applying the Principles of Industrial Ecology to the Guest-Service Sector

Auden Schendler

KEYWORDS:
eco-tourism, hospitality industry, recreation, resort industry, services, skiing

SUMMARY:
Industrial ecology (IE) has historically focused on manufacturing but could be applied more broadly, particularly to sectors of the economy not typically considered "dirty." The guest-service sector, for example, has a significant ecological footprint, often in environmentally sensitive areas, and would benefit from an IE perspective. Colorado's Aspen Skiing Company, which hosts 1.3 million skiers annually on 5,000 acres of skiable terrain, is integrating concepts of energy efficiency, feedback, life-cycle costing, nutrient cycling, renewable energy, ecosystem diversity, local sourcing, and human capital into operations at four ski areas and two hotels. An IE perspective offers the guest service sector a holistic view of its environmental impacts, a big-picture view that is missing from an industry where environmentalism has historically meant "recycling" or end-of-pipe pollution control. Many industrial ecology principles are directly applicable to resorts, but implementers will encounter a host of obstacles cultural, institutional, and economic that express themselves in unique ways in the guest service sector. Written using firsthand experiences from Aspen's ski slopes, restaurants, and a five-star hotel, this article explores what happens when the principles of industrial ecology are applied to the guest service sector, particularly what goes right, and what goes wrong.