



JOURNAL OF
INDUSTRIAL ECOLOGY



International Society
for Industrial Ecology

中文摘要
《产业生态学报》
第23卷第6期

翻译

曹植 丛薇 高美勋 雷锦明
李霄 李杨 李智伟 刘仟策
王婉君 魏瑶 余颢凡 张安迎

Chinese Abstracts
Journal of Industrial Ecology
Volume 23, Issue 6

Translated by

Zhi Cao, Wei Cong, Meixun Gao, Jinming Lei,
Xiao Li, Yang Li, Zhiwei Li, Qiance Liu,
Wanjun Wang, Yao Wei, Haofan Yu, Anying Zhang

《产业生态学报》

2019 年, 第23卷 第6期

<http://dx.doi.org/10.1111/jiec.12932>

为什么需要重视对单个公司供应链的研究

作者: Benjamin Goldstein, Joshua P. Newell

关键字: 环境正义, 全球价值链, 非政府组织, 政治生态学, 政治-产业生态学, 可持续商业

摘要:

尽管产业生态学等领域的研究让我们更加了解清洁技术、回收利用和生活方式的改变如何减少生产和消费对人类和地球的影响, 但环境恶化和不公平的现象仍然存在。在日益紧迫的当下, 我们需要新的战略来实现改变。本文建议学者从单个公司供应链的角度开展研究, 并将其与特定地理区域中的环境和社会影响联系起来。非政府组织 (NGO) 从这一角度出发, 针对与森林砍伐、血汗工厂和其他社会关注问题有关的公司活动已发布了多项报告。然而, 总体而言, 现有学术研究更多关注通用产品、产业和部门。为证实这一点, 我们回顾了约 11,000 篇关于供应链的研究, 仅发现了 27 篇针对单个公司的学术论文。这些研究主要来自于非政府组织和社会科学家, 然而, 在我们的筛选出的文章中, 没有研究来自产业生态学家。研究者采用了两种不同的方法来研究公司供应链: 现场 (in situ), 如访谈、调查和监视, 以及非现场 (ex situ), 如采用贸易数据、文献资料分析和地图。在本文中, 我们解释了学者为什么需要研究单个公司的供应链以及如何开展研究。通过将产业生态学的方法与地理、社会学和其他社会科学的方法相结合, 发展供应链的政治-产业生态学 (Political-industrial ecology), 从而达成研究目的。这既将实际的产品流与它们对环境的影响联系在一起, 又探讨了它们如何影响正义、公平和福利。这一研究建议同样能够使 NGO、行业和媒体之间建立清晰的协作联系。

Journal of Industrial Ecology

2019, Vol. 23, Issue 6

<http://dx.doi.org/10.1111/jiec.12932>

Why academics should study the supply chains of individual corporations

Benjamin Goldstein, Joshua P. Newell

Keywords: environmental justice, global value chain, nongovernmental organization, political ecology, political-industrial ecology, sustainable business

Summary:

Although fields such as industrial ecology have advanced our understanding of how cleaner technologies, recycling, and lifestyle changes can reduce the impacts of production and consumption on people and planet, environmental deterioration and social injustices stubbornly persist. New strategies are needed to achieve change in an era of increasing urgency. This paper proposes that academics study the supply chains of individual corporations and link them to environmental and social impacts in geographically specific areas. Nongovernmental organizations (NGOs) have used this approach successfully, issuing reports about corporate activity related to deforestation, sweatshops, and other issues of social concern. But academics, by and large, have studied generic products, industries, and sectors. To verify this, after reviewing approximately 11,000 studies on supply chains, we identified just 27 academic papers that focused on individual corporations. These were primarily by NGOs and social scientists, with no studies by industrial ecologists meeting our review criteria. To uncover corporate supply chains, researchers used two distinct methodological approaches: in situ (interviews, surveys, and surveillance) and ex situ (trade data, document analysis, and maps). In this paper, we explain why and how academics should study the supply chains of individual corporations. This is done by combining approaches from industrial ecology, with those from geography, sociology, and other social sciences to develop a political-industrial ecology of supply chains. This both physically links actual product flows with their environmental impacts, and explores how they affect justice, equity, and welfare. The work we propose offers clear collaborative linkages with NGOs, industry, and the media.

《产业生态学报》

2019 年, 第23卷 第6期

<http://dx.doi.org/10.1111/jiec.12939>

城市物质存量的空间聚类分析: 北欧案例研究

作者: Paul Gontia, Liane Thuvander, Babak Ebrahimi, Victor Vinas, Leonardo Rosadoand, Holger Wallbaum

关键字: 由下至上方法, 建成环境, 建筑材料, 地理空间数据, 材料强度, 城市形态

摘要:

城市建成环境中累积了大量的建筑材料存量, 掌握建筑材料存量的空间分布有助于相关资源的可持续利用。本文利用 K 均值聚类算法对街区尺度的物质存量进行细致的空间分析。本文选取位于北欧地区的瑞典哥德堡市为研究对象, 涵盖三类建成环境 (建筑物、道路交通系统、管道系统) 和七种建筑材料 (木材、陶瓷和砖、水泥基材料、石料、钢铁材、沥青、玻璃等)。本文从材料组成、寿命分布、物质密度三个角度进行了分析, 并将最终结果以人均存量的形式与文献中其他城市的物质存量估计进行横向比较。

本文的估算表明: 哥德堡市的总物质存量约为 840 万吨; 其中, 建筑的占比约为 73%, 道路的占比约为 26%, 管道的占比约为 1%; 物质存量的主要组成为水泥基材料; 哥德堡市的人均物质存量为 153 吨, 其中居民建筑的人均物质存量为 62 吨, 相较于其他城市, 哥德堡市的人均物质存量处于中游水平。根据空间聚类分析, 物质密度较高街区的物质存量由非住宅和住宅建筑组成, 其道路和管道的占比较高; 而物质密度较低的街区的物质存量, 主要由独栋住宅组成。独栋住宅的建筑材料主要为木材, 多户住宅的建筑材料主要由水泥基材料、砖石和钢铁。本文还对未来研究进行展望, 以期未来相关研究中覆盖更多的城市案例 (尤其是大型城市) 和应用能够发掘更多空间规律的分析方法。

Journal of Industrial Ecology

2019, Vol. 23, Issue 6

<http://dx.doi.org/10.1111/jiec.12939>

Spatial analysis of urban material stock with clustering algorithms: A Northern European case study

Paul Gontia, Liane Thuvander, Babak Ebrahimi, Victor Vinas, Leonardo Rosadoand, Holger Wallbaum

Keywords: bottom-up method, built environment, construction materials, geospatial data, material intensity, urban form

Summary:

A large share of construction material stock (MS) accumulates in urban built environments. To attain a more sustainable use of resources, knowledge about the spatial distribution of urban MS is needed. In this article, an innovative spatial analysis approach to urban MS is proposed. Within this scope, MS indicators are defined at neighborhood level and clustered with k-mean algorithms. The MS is estimated bottom-up with (a) material-intensity coefficients and (b) spatial data for three built environment components: buildings, road transportation, and pipes, using seven material categories. The city of Gothenburg, Sweden is used as a case study. Moreover, being the first case study in Northern Europe, the results are explored through various aspects (material composition, age distribution, material density), and, finally, contrasted on a per capita basis with other studies worldwide.

The stock is estimated at circa 84 million metric tons. Buildings account for 73% of the stock, road transport 26%, and pipes 1%. Mineral-binding materials take the largest share of the stock, followed by aggregates, brick, asphalt, steel, and wood. Per capita, the MS is estimated at 153 metric tons; 62 metric tons are residential, which, in an international context, is a medium estimate. Denser neighborhoods with a mix of nonresidential and residential buildings have a lower proportion of MS in roads and pipes than low-density single-family residential neighborhoods. Furthermore, single-family residential neighborhoods cluster in mixed-age classes and show the largest content of wood. Multifamily buildings cluster in three distinct age classes, and each represent a specific material composition of brick, mineral binding, and steel. Future work should focus on megacities and contrasting multiple urban areas and, methodologically, should concentrate on algorithms, MS indicators, and spatial divisions of urban stock.

《产业生态学报》

2019 年, 第23卷 第6期

<http://dx.doi.org/10.1111/jiec.12921>**产业生态学支持可持续医疗保健的潜力: 对零散文献和未来研究概念框架的范围综述**

作者: Alexander Cimprich, Jair Santillán-Saldivar, Cassandra L. Thiel, Guido Sonnemann, Steven B. Young

关键字: 医疗保健部门, 医疗保健可持续性, 产业生态学, 文献综述, 医学活动, 范围综述

摘要:

医疗保健是一个重要的服务部门, 其直接经济活动以及相关产品和基础设施的间接排放都会对环境产生巨大的影响。与所有其他行业一样, 医疗卫生行业的“内生性”环境影响(如温室气体排放、导致光化学烟雾和酸化的排放)对公众健康有害。医疗保健的环境影响受到多种因素的影响, 包括发展中经济体的医疗服务的扩张、全球人口增长和人口老龄化等。此外, 能源和资源密集型的医疗程序、设备和技术的部署, 也是一个重要因素。从外生视角来看, 医疗保健系统越来越容易受到气候变化、资源获取的限制和其他外部因素的影响。我们根据 1987 年至 2017 年期间发表的 1700 多篇文章的典型抽样, 对关于医疗保健系统中的环境问题和其他可持续发展方面的文献进行了全面的范围综述。为了指导文献回顾工作, 并为未来的研究建立理论基础, 我们制定了一个医疗保健可持续发展的产业生态学框架。根据我们的框架, 医疗保健行业由“后台产品系统”和提供医疗服务的“前台系统”组成。通过将现有的文献映射到我们的框架上, 我们展示了一些新的机会, 可以用产业生态学中“自上而下”和“自下而上”的方法来建立医疗保健可持续发展的实证基础。

Journal of Industrial Ecology

2019, Vol. 23, Issue 6

<http://dx.doi.org/10.1111/jiec.12921>**Potential for industrial ecology to support healthcare sustainability: Scoping review of a fragmented literature and conceptual framework for future research**

Alexander Cimprich, Jair Santillán-Saldivar, Cassandra L. Thiel, Guido Sonnemann, Steven B. Young

Keywords: healthcare sector, healthcare, sustainability, industrial ecology, literature review, medical activities, scoping review

Summary:

Healthcare is a critical service sector with a sizable environmental footprint from both direct activities and the indirect emissions of related products and infrastructure. As in all other sectors, the “inside-out” environmental impacts of healthcare (e.g., from greenhouse gas emissions, smog-forming emissions, and acidifying emissions) are harmful to public health. The environmental footprint of healthcare is subject to upward pressure from several factors, including the expansion of healthcare services in developing economies, global population growth, and aging demographics. These factors are compounded by the deployment of increasingly sophisticated medical procedures, equipment, and technologies that are energy- and resource-intensive. From an “outside-in” perspective, on the other hand, healthcare systems are increasingly susceptible to the effects of climate change, limited resource access, and other external influences. We conducted a comprehensive scoping review of the existing literature on environmental issues and other sustainability aspects in healthcare, based on a representative sample from over 1,700 articles published between 1987 and 2017. To guide our review of this fragmented literature, and to build a conceptual foundation for future research, we developed an industrial ecology framework for healthcare sustainability. Our framework conceptualizes the healthcare sector as comprising “foreground systems” of healthcare service delivery that are dependent on “background product systems.” By mapping the existing literature onto our framework, we highlight largely untapped opportunities for the industrial ecology community to use “top-down” and “bottom-up” approaches to build an evidence base for healthcare sustainability.

《产业生态学报》

2019 年, 第23卷 第6期

<http://dx.doi.org/10.1111/jiec.12923>

美国城市代谢 2.0

作者: Christopher M. Chini, Ashlynn S. Stillwell

关键字: 隐含能源, 水能关联, 产业生态学, 可持续性, 城市环境, 城市代谢

摘要:

自阿贝尔·沃尔曼 (Abel Wolman) 首次发表关于美国城市代谢的测算研究以来的 50 年中, 城市代谢领域的研究开始蓬勃发展, 美国以外的城市成为人们关注的重点。当前各城市正力求实现本地和国际可持续性目标, 重新审视美国国内城市的城市代谢正当其时。使用现有的物质流经验数据库 (货运分析框架) 和已发布的城市水通量数据库, 我们为美国典型城市提供了代谢的修订估算值。考虑到水资源、食物、燃料和建筑材料, 我们估算了一个有 100 万人的城市的代谢中值。食品消费和废物生产分别大幅增加至每天 3800 吨和每天 4900 吨。为了促进第二代城市代谢, 我们将传统分析扩展到包括促进物质消耗所需的嵌入能量, 这对于确定可持续的城市代谢具有重要意义。我们估计, 一个拥有 100 万人口的城市每天需要将近 4000 吉焦的一次能源来促进其代谢。我们的结果表明, 美国各地城市代谢的异质性很高。我们得出结论, 特别需要在区域或城市范围内推广收集城市代谢研究数据的政策。城市代谢是一种重要的教育和决策工具, 随着数据可用性的增加, 可以为城市及其可持续发展目标提供重要信息。

Journal of Industrial Ecology

2019, Vol. 23, Issue 6

<http://dx.doi.org/10.1111/jiec.12923>

The metabolism of U.S. cities 2.0

Christopher M. Chini, Ashlynn S. Stillwell

Keywords: embedded energy, energy-water nexus, industrial ecology, sustainability, urban environment, urban metabolism

Summary:

In the fifty years since Abel Wolman first published an estimate of U.S. urban metabolism, the field of urban metabolism has begun to thrive, with cities outside the United States being much of the focus. As cities attempt to meet local and international sustainability goals, it is time to revisit the metabolism of cities within the United States. Using existing empirical databases for material flows (the Freight Analysis Framework) and a published database on urban water flux, we provide a revised estimate of urban metabolism for the typical U.S. city. We estimate median values of metabolism for a city of one million people, considering water resources, food, fuel, and construction materials. Food consumption and waste production increased substantially to 3,800 metric tons per day and 4,900 metric tons per day, respectively. To facilitate a second generation of urban metabolism, we extend traditional analyses to include the embedded energy required to facilitate material consumption with important implications in determining sustainable urban metabolism. We estimate that a city of one million people requires nearly 4,000 gigajoules of primary energy per day to facilitate its metabolism. Our results show high heterogeneity of urban metabolism across the United States. As a result of the study, we conclude that there is a distinct need to promote policies at the regional or city scale that collect data for urban metabolism studies. Urban metabolism is an important educational and decision-making tool that, with an increase in data availability, can provide important information for cities and their sustainability goals.

《产业生态学报》

2019 年, 第23卷 第6期

<http://dx.doi.org/10.1111/jiec.12926>

2050 年中国的铜需求: 基于动态存量和流量分析的基准情景

作者: Di Dong, Arnold Tukker, Ester Van der Voet

关键字: 自下而上的方法, 铜, 动态存量分析, 产业生态学, 物质流分析, 情景分析**摘要:**

在本文中, 我们基于政府和相关部门政策, 开发了一种动态存量模型和情景分析, 其中包括一种自下而上的方法来分析 2005 年至 2050 年中国的铜需求。结果表明, 短期内, 如果不采取其他措施, 中国的铜行业将无法实现完全的循环经济。铜的总需求和人均铜需求都将大幅增长, 特别是在基础设施、交通运输和建筑领域。在 2016 年至 2050 年之间, 铜的总需求将增长近三倍。建筑用铜将在 2050 年之前稳定下来, 但是基础设施和交通运输中的铜存量到 2050 年仍不会达到饱和。铜存量的持续增长意味着到 2050 年次级铜将至多能够满足略高于 50% 的需求, 即使假设回收率达到 90%。最后, 未来的铜需求在很大程度上取决于其各类应用的使用寿命。因此, 迫切需要延长最终用途产品的使用寿命, 以减少所用材料的数量, 尤其是在建筑物和基础设施的大规模应用中。

Journal of Industrial Ecology

2019, Vol. 23, Issue 6

<http://dx.doi.org/10.1111/jiec.12926>**Modeling copper demand in China up to 2050: A business-as-usual scenario based on dynamic stock and flow analysis**

Di Dong, Arnold Tukker, Ester Van der Voet

Keywords: bottom-up approach, copper, dynamic stock analysis, industrial ecology, material flow analysis, scenario analysis**Summary:**

In this paper, we develop a dynamic stock model and scenario analysis involving a bottom-up approach to analyze copper demand in China from 2005 to 2050 based on government and related sectoral policies. The results show that in the short-term, China's copper industry cannot achieve a completely circular economy without additional measures. Aggregate and per capita copper demand are both set to increase substantially, especially in infrastructure, transportation, and buildings. Between 2016 and 2050, total copper demand will increase almost threefold. Copper use in buildings will stabilize before 2050, but the copper stock in infrastructure and transportation will not yet have reached saturation in 2050. The continuous growth of copper stock implies that secondary copper will be able to cover just over 50% of demand in 2050, at best, even with an assumed recycling rate of 90%. Finally, future copper demand depends largely on the lifetime of applications. There is therefore an urgent need to prolong the service life of end-use products to reduce the amount of materials used, especially in large-scale applications in buildings and infrastructure.

《产业生态学报》

2019 年, 第23卷 第6期

<http://dx.doi.org/10.1111/jiec.12928>

智能工厂能否改善产品的环境表现? 以家用冰箱为例

作者: Wujie Zhang, Fu Gu, Jianfeng Guo

关键字: 环境表现, 家用冰箱, 产业生态学, 工业4.0, 生命周期评估, 智能工厂**摘要:**

智能工厂引入最先进的技术来改善相关流程, 已被广泛用作新的制造范式。然而, 智能工厂是否会影响环境表现仍然未知。在本文中, 我们研究了生产冰箱的智能工厂的环境表现, 将其产品与以传统方式生产的类似型号产品的环境影响进行比较。本文量化了该智能工厂各流程的环境影响, 对理论预测值进行了验证。尽管两种生产模式的环境影响总体差异很小, 但我们发现, 智能工厂可以显著降低与零件和冰箱生产相关的大多数类别的环境影响; 气候变化相关的影响值降低了 33%。智能工厂对原材料的节约可最大程度地减少大多数类别的影响; 更高的材料效率对减缓气候变化的贡献达 39%。然而, 由于产品的个性化和直接交付, 采购和递送的所有类别的影响都在增大。敏感性分析的结果表明, 提高产品的模块化程度, 采用清洁能源(如风能)可以进一步改善所选冰箱的环境性能。辅助设备和系统的引入会略微增加每种类别的影响; 然而, 与提高生产效率的收益相比, 它们的影响微不足道。本文根据定量结果提出了改善智能工厂的环境绩效的建议, 包括优化当前策略以及促进横向和端到端集成。

Journal of Industrial Ecology

2019, Vol. 23, Issue 6

<http://dx.doi.org/10.1111/jiec.12928>

Can smart factories bring environmental benefits to their products?: A case study of household refrigerators

Wujie Zhang, Fu Gu, Jianfeng Guo

Keywords: environmental performance, household refrigerators, industrial ecology, industry 4.0, life cycle assessment, smart factory**Summary:**

Smart factories have been widely adopted as a new manufacturing paradigm, in which the state-of-the-art technologies are introduced to improve relevant processes. Yet, whether smart factories affect the environmental performance remains unknown. In this article, we examine the environmental performance of a smart refrigerator factory by comparing the environmental impacts of its product to a similar model that is produced in a traditional fashion. This article quantifies and verifies the theoretically predicted impacts of this smart factory on the individual processes. Though the overall differences in the two models are quite minor, we find that this smart factory can notably reduce the values of most impact categories associated with the parts and refrigerator production; the reduction in the value of climate change is 33%. Owing to higher material efficiency—raw material savings in this smart factory contributes to the greatest reductions in most categorized impacts—the contribution to the reduction of climate change is 39%. Yet, all categorized impacts of procurement and delivery are increased due to product personalization and direct delivery. The results of sensitivity analysis show that promoting product modularity, adopting clean energy such as wind power can further improve the environmental performance of the selected refrigerator. The introduction of auxiliary equipment and systems slightly increases the value of each category; yet their impacts are negligible compared to their benefits as facilitating production efficiency. Based on the quantitative results, recommendations are given to improve the environmental performance of smart factory, including optimizing current strategies and promoting horizontal and end-to-end integration.

《产业生态学报》

2019 年, 第23卷 第6期

<http://dx.doi.org/10.1111/jiec.12929>

巴西砂浆和混凝土供应链的物质流分析和材料使用效率

作者: Daniel da Costa Reis, Yazmin Mack-Vergara, Vanderley Moacyr John

关键字: 去物质化、代谢率、采石场废物、未使用的开采、废品率、耗水量

摘要:

水泥基材料, 主要是混凝土和砂浆, 约占全世界材料开采量的三分之一。该行业的物质流数据仍然不能令人满意, 尤其是与未使用的开采量、采石场废物和水消耗有关的方面, 而环境分析研究通常不包括这些方面。本研究旨在对巴西混凝土和砂浆供应链进行物质流分析 (MFA), 以量化材料使用效率 (ME) 和去物质化 (dematerialization) 潜力。MFA 包括以下指标的开采、生产和建设阶段: i) 未使用的开采; ii) 采石场废物; iii) 耗水量; iv) 材料浪费; v) 原材料消耗; vi) 能量载体; vii) 大气排放。结果表明, 巴西主要原材料足迹约为 4.56 亿吨, 相应的代谢率为 2.2 吨/人。包括未使用的开采、采石场废物、水消耗和二次材料后, 该值增加到人均 4.1 吨, 相当于材料总消耗 840 吨。混凝土和砂浆可以使用两种方法生产 (现场混合或工业混合)。我们得出的结论是, 工业情景下, 按质量计算, 混凝土的去物质化率约为 8%, 而砂浆的去物质化率约为 24%。平均材料使用效率较低, 混凝土约为 53%, 砂浆约为 34%。

Journal of Industrial Ecology

2019, Vol. 23, Issue 6

<http://dx.doi.org/10.1111/jiec.12929>

Material flow analysis and material use efficiency of Brazil's mortar and concrete supply chain

Daniel da Costa Reis, Yazmin Mack-Vergara, Vanderley Moacyr John

Keywords: dematerialization, metabolic rate, quarry waste, unused extraction, wastage rate, water consumption

Summary:

Cementitious materials, mostly concrete and mortar, account for about one-third of all materials extraction worldwide. Material flow data in this industry are still unsatisfactory, especially related to unused extraction materials, quarry wastes, and water consumption, aspects which usually are not included in environmental analysis studies. The aim of this study is to conduct a material flow analysis (MFA) of the Brazilian concrete and mortar supply chain to quantify material use efficiency (ME) and dematerialization potential. The MFA includes extraction, production, and construction stages for the following indicators: i) unused extraction; ii) quarry waste; iii) water consumption; iv) material wastage; v) raw material consumption; vi) energy carriers; and vii) atmospheric emissions. The results demonstrated that the primary raw material footprint is about 456 million metric tons (Mt) corresponding to a metabolic rate of 2.2 metric tons/capita (t/capita). After including unused extraction, quarry wastes, water consumption, and secondary materials this value increases to 4.1 t/capita corresponding to a total material consumption of 840 Mt. Concrete and mortar can be produced using two routes—mixing on site or industrial mixing. We conclude that the industrial scenario allows for dematerialization by about 8% for concrete and 24% for mortar, by mass; and the average material use efficiency is low, at about 53% for concrete and 34% for mortar.

《产业生态学报》

2019年, 第23卷 第6期

<http://dx.doi.org/10.1111/jiec.12931>

美国环境扩展投入产出模型中资本内生化的方法

作者: T. Reed Miller, Peter Berrill, Paul Wolfram, Ranran Wang, Yookyung Kim, Xinzhu Zheng, Edgar G. Hertwich

关键字: 资金流矩阵, 资本库存平均年数, 环境扩展投入产出, 投入产出分析, 投入产出生命周期评价, 国民账户体系

摘要:

每年, 美国的企业、政府和住房持有者都会将国内生产总值的大约五分之一投入到资本性资产的创造上, 如: 建筑, 机械和软件, 以实现生产和消费。尽管在某种程度上, 资本的使用带来的环境影响通常包含于商品和服务的生命周期评估中, 但并未纳入大多数环境扩展的投入产出 (EEIO) 模型, 其中也包括美国环境保护署的模型 USEEIO。由于资本资产通常是在使用前的几年内创建的, 研究者面临的挑战是如何考虑时间跨度分配其带来的影响。本研究采用了高度细化的资金流矩阵, 将固定资本资产的使用分配给消费的对应该行业。通过创建一致性表, 将美国经济分析局 (BEA) 固定资产帐户的数据与其行业帐户数据合并。公共高速公路和街道部分重新分配给使用车辆的行业。最终将资本使用矩阵合并为一个调整后的 USEEIO。研究发现, “住房” 是固定资产的最大消费者, 其次是政府、化石燃料开采和涉及租赁的金融行业。建筑, 车辆和机械大多以固定资产的形式用于工业。不同行业使用的固定资产类型与预期一致: 住房以结构为主, 运输以设备为主, 信息产业以知识产权产品为主。

Journal of Industrial Ecology

2019, Vol. 23, Issue 6

<http://dx.doi.org/10.1111/jiec.12931>

Method for endogenizing capital in the United States Environmentally-Extended Input-Output model

T. Reed Miller, Peter Berrill, Paul Wolfram, Ranran Wang, Yookyung Kim, Xinzhu Zheng, Edgar G. Hertwich

Keywords: capital flow matrix, capital vintage, environmentally extended input-output, input-output analysis, input-output life cycle assessment, System of National Accounts

Summary:

Each year businesses, governments, and homeowners in the United States invest around one fifth of gross domestic product into the creation of capital assets such as buildings, machinery, and software to enable production and consumption. Use of capital is typically included to some extent in environmental life cycle assessments of goods and services but is not incorporated into most environmentally extended input-output (EEIO) models, including the US Environmental Protection Agency's USEEIO. Capital assets are typically created in years prior to their use, so a challenge lies in distributing the impacts of their creation over time. In this work, a highly detailed capital flow matrix approach is followed to distribute the use of fixed capital assets to consuming industries. Data from the US Bureau of Economic Analysis's Fixed Asset Accounts is merged with its Industry Accounts data by the creation of concordance tables. Public highways and streets are partially reallocated to industries operating vehicles. The resulting capital use matrix is later combined into a modified USEEIO. “Housing” is found to be the largest consumer of fixed assets, followed by general government, fossil fuel extraction, and financial industries involved in leasing. Construction, vehicles, and machinery are mostly used by industries in the form of fixed assets. The types of fixed assets used by industries are consistent with expectations: housing is dominated by structures, transport by equipment, and information industries by intellectual property products.

《产业生态学报》

2019年, 第23卷 第6期

<http://dx.doi.org/10.1111/jiec.12933>

中国区域物质流账户：国家和省域尺度的自然资源利用研究

作者: Heming Wang, Heinz Schandl, Guoqiang Wang, Lin Ma, Yao Wang

关键字: 中国, 环境政策, 产业生态学, 物质流核算(MFA), 区域MFA, 资源效率

摘要:

在过去的三十年里, 中国经历了最有活力的经济发展, 生活水平提高, 自然资源利用迅速增长。过去, 研究的重点一直放在国家层面上, 这对拥有 19%的世界人口和 30%的全球资源使用全球的第二大经济体——中国来说, 似乎显得不够。在本研究中, 我们利用最新的统计数据和国际通用的物质流核算方法, 对 1995–2015 年期间中国在省域范围内的资源开采情况进行了核算。特别是, 我们结合了一种自下而上和自上而下的方法来构建中国经济系统的国内资源开采数据集。这种方法也改进了中国的国家物流账户, 使我们能够为中国提供迄今为止可靠的资源开采数据库。我们的新数据集为计算中国地区尺度的物质足迹和环境影响提供了基础。该数据集还能帮助我们评估中国的区域资源效率趋势。研究发现, 在过去二十年中, 中国的资源开采量从 1995 年的 117 亿吨猛增到 2015 年的 354 亿吨, 尤其在 2000 年至 2010 年期间加速增长, 但在 2010 年至 2015 年之间却有所放缓, 这反映了全球金融危机造成的经济收缩, 减少了对中国制造业的需求, 也反映了中国的宏观经济政策正在由高速增长向高质量增长转变的趋势。此外, 我们还发现中国不同地区在资源供应链中扮演着不同的角色, 并具有不同的经济表现, 从而导致了各地区资源效率的不同。以上研究结果对于采取更有针对性的政策方法来提高资源效率, 减少资源利用对环境的影响以及提高中国人们的福祉至关重要, 同时对全球可持续发展具有积极的影响。该研究为今后制定不同地区的相关资源管理政策提供了基础。

Journal of Industrial Ecology

2019, Vol. 23, Issue 6

<http://dx.doi.org/10.1111/jiec.12933>

Regional material flow accounts for China: Examining China's natural resource use at the provincial and national level

Heming Wang, Heinz Schandl, Guoqiang Wang, Lin Ma, Yao Wang

Keywords: China, environmental policy, industrial ecology, material flow accounting (MFA), regional MFA, resource efficiency

Summary:

Over the last three decades, China has experienced the most dynamic economic development lifting living standards and resulting in fast-growing use of natural resources. In the past, the focus has been on national MFA accounts which do not do justice to the second largest economy, home to 19% of the world population and having 30% of global material use. In this research, we calculate material extraction for China at the regional level during 1995–2015 using the most recent available statistical data and applying the most up-to-date international calculation methods. In particular, we combine a bottom-up and top-down approach for constructing the dataset of China's economically used Domestic Extraction (DEU) in an integrated way. This approach also improves the Chinese national material flow accounts and allows us to present a reliable database of DE of materials for China to date. Our new dataset provides the basis for calculating material footprints and environmental impacts of China's regions. The dataset enables us to evaluate regional resource efficiency trends in China. We find that during the past two decades, China's material use has grown strongly from 11.7 billion tonnes in 1995 to 35.4 billion tonnes in 2015. Material use has accelerated between 2000 and 2010 but slowed down between 2010 and 2015 reflecting the economic contraction caused by the Global Financial Crisis which reduced the global demand for China's manufacturing and a reorientation of China's economic policy settings toward quality of growth. Unsurprisingly, different regions play different roles in the supply chain of materials, achieving different economic performances resulting in very diverse material efficiency outcomes. This information is important to allow for a targeted policy approach to increase resource efficiency, reduce environmental impacts of resource use, and grow wellbeing in China with large positive implications for global sustainability. This study provides the basis for the development of relevant resource management policies for different regions in the future.

《产业生态学报》

2019 年, 第23卷 第6期

<http://dx.doi.org/10.1111/jiec.12935>

从元素流分析的视角揭示孟加拉国食品生产和消费系统中磷的人源路径

作者: Bidhan Bhuson Roy, Rubel Biswas Chowdhury, Amit Robert Baroi, Shupa Rahman, StephenM. Powers, Nick Milne and Mohammad Sujauddin

关键字: 孟加拉国农业部门, 全球粮食安全, 养分回收与再循环, 磷, 元素流分析, 可持续磷管理

摘要:

磷 (P) 对食品生产至关重要。当前对全球磷系统的主要了解由一些较富裕的国家主导, 这些国家很早就建立了土壤肥力、肥料供应链和农艺追踪。相比之下, 发展中国家正经历着重要的农业转型, 相关的磷流仍然存在巨大的知识缺口。我们利用磷的元素流分析, 汇编并分析了孟加拉国 (目前是人口第八大国) 最近几年的农业数据集。从 2000 年到 2016 年, 水稻产量增长了 50% 以上, 仍然是主要农作物, 磷流量 (2016 年为 49.96 kt) 显著高于所有其他农作物。畜牧产品中的磷含量超过 6.00 kt, 是 2000 年的两倍多, 主要原因是牛奶中的磷, 其次是肉/蛋中的磷。这些农业变化与 2000 年以来全国磷肥消费量翻了一番, 自全球粮食危机 (2009 年) 以来增长了四倍, 磷进口依赖率显著上升, 在所有国家中最高。相反, 在 21 世纪 10 年代, 肥料磷的使用超过了磷, 因为食物和饲料的生产, 导致土壤磷积累, 损失的肥料是整个系统中最大的磷流量之一, 相当于肥料使用量的一半。孟加拉国磷系统的这种戏剧性重构说明了农业扩张和集约化的一个重要案例仍在发挥作用, 在人口增长率很高且获得商业化肥的发展中国家中也发生了类似情况。

Journal of Industrial Ecology

2019, Vol. 23, Issue 6

<http://dx.doi.org/10.1111/jiec.12935>

Unravelling the anthropogenic pathways of phosphorus in the food production and consumption system of Bangladesh through the lens of substance flow analysis

Bidhan Bhuson Roy, Rubel Biswas Chowdhury, Amit Robert Baroi, Shupa Rahman, StephenM. Powers, Nick Milne and Mohammad Sujauddin

Keywords: Bangladesh agriculture sector, global food security, nutrient recovery and recycling, phosphorus, substance flow analysis (SFA), sustainable phosphorus management

Summary:

Phosphorus (P) is central to food production. Current understanding about the global phosphorus system is dominated by studies in wealthier nations where soil fertility, fertilizer supply chains, and agronomic tracking have long been established. In contrast, developing nations are experiencing major agricultural transitions and the associated phosphorus flows remain a significant knowledge gap. We compiled and analyzed several years of recent agricultural datasets for Bangladesh, currently the eighth most populous nation, using substance flow analysis for phosphorus. From 2000 to 2016, rice production increased by >50% and remained the dominant crop with remarkably higher phosphorus flow (49.96 kt in 2016) than all other crops. Phosphorus content of livestock products in 2016 exceeded 6.00 kt, more than double in the year 2000, driven primarily by phosphorus in milk and secondarily in meat/eggs. These agricultural changes coincided with a doubling of national phosphorus fertilizer consumption since 2000, a fourfold increase since the global food crisis (2009), and a pronounced rise in the phosphorus import dependency ratio, which was the highest among all countries compared. In turn, during 2010s fertilizer phosphorus use exceeded phosphorus as food + feed production leading to soil phosphorus accumulation, and loss as burned manure became one of the largest phosphorus flows in the entire system, equivalent to half of fertilizer use. This dramatic reconfiguration of the Bangladesh phosphorus system illustrates an important case of agricultural expansion and intensification that is still playing out, with similar situations occurring in developing nations where population growth rates are high, and access to commercial fertilizers has risen.

《产业生态学报》

2019 年, 第23卷 第6期

<http://dx.doi.org/10.1111/jiec.12940>

多层次资源量化的混合物质流分析

作者: Kuang-Ly Cheng, Shu-Chien Hsu, Cathy C. W. Hung, Pi-Cheng Chen, Hwong-wen Ma

关键字: 人为资源, 循环经济, 混合物质流分析, 多层次, 存量净增量, 城市矿山

摘要:

本研究开发了一种混合物质流分析 (HMFA) 方法, 通过分析固定资本形成 (FCF) 和投入产出表 (IOT) 中的总供应来评估微观和宏观两个层次上物质存量的年度增量, 又称为存量净增量 (NAS)。HMFA 将 NAS 从一个自上而下的平衡指标转变为对城市矿山评估具有重要价值的指标。为了验证 HMFA 的有效性, 本研究通过评估台湾地区和德国的 NAS, 将开发的 HMFA 指标与自上而下的方法和自下而上的方法进行了比较。HMFA 估计的 NAS 量上限比自上而下的方法更为保守, 而自下而上的方法通常会存在低估。研究证明 HMFA 是一种有效、合理的评估方法, 它克服了自上而下方法评估微观尺度物质存量的关键限制, 并解决了自下而上方法对物质存量进行量化的数据需求问题。

Journal of Industrial Ecology

2019, Vol. 23, Issue 6

<http://dx.doi.org/10.1111/jiec.12940>

A hybrid material flow analysis for quantifying multilevel anthropogenic resources

Kuang-Ly Cheng, Shu-Chien Hsu, Cathy C. W. Hung, Pi-Cheng Chen, Hwong-wen Ma

Keywords: anthropogenic resources, circular economy, hybrid material flow analysis, multilevel, net additions to stock urban mining

Summary:

This study develops a hybrid material flow analysis (HMFA) method to evaluate the annual additional quantity of material stock, known as net additions to stock (NAS) at both micro- and macro-levels through analyzing the fixed capital formation (FCF) and total supply in input-output tables (IOTs). HMFA turns NAS from a balance indicator in the top-down approach to an indicator with meaningful value in terms of urban ore evaluation. To verify the validity of HMFA, this study compares the developed HMFA with a top-down approach and a bottom-up approach through assessing the NAS of Taiwan and Germany. The quantity of NAS estimated by HMFA is considered as a more conservative upper bound than that by the top-down approach, while underestimation often occurs with a bottom-up approach. HMFA has been proven as an efficient and rational evaluation method which overcomes a key limitation in assessing micro-level material stock by a top-down approach, and solves the data demanding problem of the bottom-up approach for quantifying material stock.

《产业生态学报》

2019 年, 第23卷 第6期

<http://dx.doi.org/10.1111/jiec.12927>

林业部门的产业共生：巴西南部的案例分析

作者: Júlia Wahrlich, Flávio José Simioni

关键字: 环境管理, 产业布局, 产业生态学, 产业生态系统, 产业共生, 主成分分析

摘要:

产业共生是产业生态学领域中的一个重要概念, 作为一种工业实践已经在世界各地广泛开展。产业共生通过交换系统中各个单元之间的副产物、废物来减少工业过程的生态影响。林业是巴西南部拉格地区的主要经济活动。随着木材加工过程中废料的再利用和不同行业的公司之间合作关系的加强, 系统的产业共生关系得以扩大。本研究主要有三个目的: a) 量化系统中产业共生的程度; b) 确定参与产业共生后的收益; c) 解释为什么需要进一步发展产业共生以形成产业生态系统。本研究利用调查问卷方法对 24 家林业公司的产品、生产流程、商业关系、可持续发展的影响和当地介入等活动进行了分析。利用系统中的废物流数据计算产业共生指标, 该指标用来表示该地区公司之间的共生水平。结果表明, 参与了共生网络的这些公司主要涉及木片、树皮、锯末和刨花的交换。在大多数情况下, 这些交换主要发生在邻近的公司之间, 构成了一个广泛的工业生态系统。

Journal of Industrial Ecology

2019, Vol. 23, Issue 6

<http://dx.doi.org/10.1111/jiec.12927>

Industrial symbiosis in the forestry sector: A case study in southern Brazil

Júlia Wahrlich, Flávio José Simioni

Keywords: environmental management, industrial arrangements, industrial ecology, industrial ecosystem, industrial symbiosis, principal component analysis

Summary:

Industrial symbiosis (IS) is an important concept in the field of industrial ecology that has disseminated worldwide as a practice to decrease the ecological impact of industrial processes through the exchange of by-products and waste between units in a system. The forestry industry is the main economic activity in the region of Lages in southern Brazil. IS relationships have expanded with the use of waste material from wood processing and strengthened cooperation between companies in different sectors. The aims of this article were to: a) quantify the level of IS in the system, b) identify the benefits of IS for participants, and c) explain why the network further developed IS to the formation of an industrial ecosystem. A questionnaire was administered during visits to 24 forestry companies in order to analyze their products and processes, commercial relations, positive impacts, and local insertion. The industrial symbiosis indicator (ISI) was determined using waste stream data from the system to represent the level of symbiosis among the companies in this region. The results show that the companies participate in a symbiotic network, mainly involving the exchange of chips, bark, sawdust and shavings. In most cases, these exchanges occur between nearby companies, constituting an extensive industrial ecosystem.