

# Environmental Industry

## 中国环境产业 绩效评估

Performance of China's Environmental Industry

薛婕 马忠玉 周景博 罗宏 / 著

中国环境出版集团

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中国环境出版集团·北京

图书在版编目(CIP)数据

中国环境产业绩效评估 / 薛婕等著. —北京: 中国环境出版集团,  
2018.4

ISBN 978-7-5111-3449-3

I. ①中… II. ①薛… III. ①环保产业—研究—中国 IV.  
① X324.2

中国版本图书馆 CIP 数据核字 (2017) 第 316721 号

出版人 武德凯  
责任编辑 陈雪云  
责任校对 任丽  
封面设计 岳帅



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中国环境出版集团  
第一分社

出版发行 中国环境出版集团  
(100062 北京市东城区广渠门内大街16号)  
网 址: <http://www.cesp.com.cn>  
电子邮箱: [bjgl@cesp.com.cn](mailto:bjgl@cesp.com.cn)  
联系电话: 010-67112765 (编辑管理部)  
010-67112735 (第一分社)  
发行热线: 010-67125803 010-67113405 (传真)

印 刷 北京建宏印刷有限公司  
经 销 各地新华书店  
版 次 2018年4月第1版  
印 次 2018年4月第1次印刷  
开 本 787×1092 1/16  
印 张 10.25  
字 数 220千字  
定 价 36.00元

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## 前 言

环境产业在宏观经济战略上是被国家寄予厚望的战略新兴产业，在环境保护方面是建设生态文明和实现可持续发展的动力支撑，其在经济新常态下如何发展更加备受瞩目。

目前，我国环境产业正处于产业生命周期的成长阶段，面临升级转型，提高环境产业整体绩效水平成为现阶段发展环境产业的重点。我国现有的环境产业绩效分析仍然停留在一个比较低的层面，多层次、多维度，系统化的环境产业绩效评估体系尚未建立，长期以来导致环境产业发展规划和政策的制定主要是从宏观管理机构需要出发，缺乏对产业绩效水平的科学评估，不利于全面和深入了解环境产业发展的现实状况。因此，亟需从宏观与微观的结合上，从绩效评估的广度与深度上，对环境产业的绩效及影响因素开展研究。

基于上述判断，本书以评估环境产业的效果、效率和影响因素为主线，采用文献研究、干系人访谈、问卷调查、二手数据分析、计量经济学模型分析和案例研究等方法对环境产业绩效的一些相关问题进行了研究。实证研究的主要数据来源于 2004 年和 2011 年的环境产业调查数据。概括本书的研究内容，主要取得了以下几个方面的理论和实证成果：

(1) 在综合论述国内外环境产业绩效相关研究成果和实践的基础上，初步构建了环境产业绩效评估的基本理论与方法体系

该评估体系包括综合绩效评估、经营效率评估和影响因素评估三个层次。从具体的指标体系构建和评估方法来看，环境产业综合绩效评估指标体系包含自身水平、外部效益和发展能力 3 个维度，选择综合指数法结合专家赋权进行评估；环境产业经营效率评估指标体系包含投入指标和产出指标，选择数据包络分析法（DEA）进行评估；环境产业绩效影响因素评估指标体系包含产业内部影响因素（市场规模、结构，市场体制、机制和技术水平）和产业外部影响因素（政策因素、经济因素、社会因素和环境因素），选择计量经济学 Tobit 回归模型进行分析。其中，综合绩效评估侧重广度，力求全面；经营效率评估侧重深度，是对综合绩效评估中自身水平的有效补充和深化；而影响因素评估则是对综合绩效和经营效率制约和促进因素的进一步挖掘。

(2) 基于环境产业综合绩效评估指标体系, 选取综合指数法结合专家赋权, 对我国环境产业的综合绩效进行了评估

我国环境产业综合绩效的评估结果表明: 2004—2011年, 环境产业综合绩效在自身水平、外部效益和发展能力方面均有显著的提高, 特别是自身水平方面提高最快。但是, 与国内其他行业相比, 环境产业的整体规模仍然偏小, 仅占 GDP 不到 1%, 对国民经济的支撑和拉动作用不足; 盈利能力一般, 利润率指标值略高于全国全行业的平均值, 并没有足够的优势吸引大量的社会资本投入; 与发达国家相比, 研发投入和出口额仍低于发达国家水平, 国际竞争力有待进一步提高。因此, 在现阶段, 我国环境产业应继续由政府引导为主, 逐步利用市场机制, 通过环境规制手段, 释放更多的产业需求, 促进环境产业规模扩张和盈利能力的提高。

(3) 基于环境产业经营效率评估指标体系, 选取数据包络分析法 (DEA), 对我国环境产业的经营效率进行了评估

我国宏观层面环境产业经营效率均值为 0.679, 微观层面环境企业经营效率均值为 0.12, 环境企业整体的经营效率低下。企业规模过小和技术无效是造成我国环境产业效率值低下的主要原因。从规模报酬来看, 超过 85% 的环境企业处于规模报酬递增阶段, 说明我国环境企业是处于成长期。因此, 需要培育龙头企业, 扩大企业规模, 增加技术创新投入, 从而实现整个行业效率的提升。

(4) 以经营效率评价的 DEA 效率值为因变量, 以各影响因素为解释变量, 运用 Tobit 计量经济回归模型, 定量分析了各影响因素对环境产业经营效率的影响

在宏观层面, 产业集中度具有正向显著影响, 说明产业集中度高的地区环境产业效率较高。符合我国目前整体产业集中度低, 竞争分散导致效率低下的产业现实状况。环保投资、对外贸易和技术水平等影响因素对地区环境产业经营效率的影响并不显著。说明我国目前的环保投资规模远远不够, 环境产业“走出去”的成果仍不显著, 技术创新还没有达到影响产业效率的水平。在制定促进环境产业发展的宏观政策时, 应继续扩大环保投资, 鼓励环境产业“走出去”和大力推进环境产业的技术创新。

在微观层面, 从业特征对环境产品生产经营企业和污染治理服务企业均有正向显著影响, 说明不论是环境产品的生产还是环境服务, 专业从事环保领域的企业可获得更高的效率。所有制对两个细分行业均具有负的显著影响, 表明公有制企业缺乏内生动力, 制约了企业的创新和发展, 这为我国推进公共事业市场化和大力推进第三方治理提供了现实依据。上市情况和企业聚集只对污染治理行业有正向的显著影响, 说明向大规模集团化的综合环境服务企业转型是提高绩效的有效途径。并且, 在产业园区中的环境服务企业能获得更高的效率, 也说明发展产业园区, 有助于污染治理服务类企业提高绩效。研发人员和出口合同额对环境产品的生产企业有正向的显著影响, 说明人才是环境产品生产经营企业创新的核心竞争力, 而对外出口拓展了环境产品的海外市场。从业年限对环境产品生产经营企业具有负向显著影响, 也间接地说明早些年发展起来的环境企业的技术和产品已经落后, 在市场上缺乏竞争力。微观管理措施上, 应鼓励和扶持专业的非

公有制环境企业,大力推进第三方治理,鼓励企业兼并重组及上市,培育污染治理服务龙头企业和产业聚集区,对环境产品生产企业应更注重研发人员的培养,技术创新,以及环境产品的对外输出。

(5) 以“环保之乡”宜兴为案例研究对象,对宜兴环境产业的综合绩效、经营效率和影响因素开展了实证研究,并总结了宜兴在环境产业发展中可供借鉴的经验

宜兴环境产业整体的综合绩效和经营效率均优于全国平均水平。规模过小是导致宜兴环境企业经营效率低下的主要原因。这与宜兴环境企业超过 85% 是小微型企业,竞争分散,低价竞争的发展现实状况相符。从外部效益看,宜兴环境产业经济总量在全市的比重仍然不大,环境产业对宜兴经济的带动力和支撑力还没有充分发挥出来。在效率影响因素方面,研发资金具有负的显著影响,说明研发投入具有滞后性,在短期内甚至会反向影响企业的经营效率。因此,需要政府通过政策保障及鼓励技术创新和技术成果的转化。企业聚集对宜兴经营效率具有正的显著影响,说明园区聚集的发展模式对环境企业效率提高有积极作用。这与宜兴环科园企业发展现实相符,也与全国环境企业在国家级园区中绩效较高的实证结论相符。充分说明,打造高质量的环境产业聚集区,对提高环境企业绩效和环境产业的发展有促进作用。

显然,将本书的理论体系与实践方法应用于宜兴案例绩效评估研究,所得结论与宜兴环境产业发展的现实状况相符,证明了本书构建的理论与方法科学可行,对于分析中国环境产业的发展状况具有一定的理论指导意义。

最后,本书从环境产业发展存在的问题出发,结合对未来环境产业发展趋势的分析,基于环境产业绩效及影响因素的研究结论,以进一步释放市场的有效需求和提高环境产业优质供给为主要思路,分别从影响环境产业绩效的 4 个主要因素(政策因素、经济因素、市场因素和技术因素),提出提高我国环境产业绩效水平的政策建议。在政策方面,应重视顶层设计,完善和落实环境产业政策,积极实施环境产业“走出去”战略,扩大国内和国外的环境产业市场需求。在经济方面,应进一步加大财税支持,发挥政府资金的引导作用,推动环境综合服务业发展。在市场方面,加速推进第三方治理等市场化模式;培育龙头企业和产业集聚区,促进产业集约化、集群化发展。在技术方面,完善环保技术创新体系与成果转化机制,提升产业有效供给。

## Abstract

The environment industry is the strategic emerging industry with high national expectations in the macro-economic strategy as well as the supporting power of ecological civilization and sustainable development realization in the environmental protection field, so its development under the new normal will be paid enough attention.

At present, China's environmental industry is in the growth phase of the industrial life cycle. Faced with the upgrading and transformation, improving the overall performance of the environmental industry has become the focus of the development of the environmental industry at this stage. The performance analysis of China's current environmental industry still stays at a relatively low level, and multi-level, multi-dimensional, systematic environmental industry performance evaluation system has not been established. In a long time, the environmental industry development planning and policy formulation are mainly started from the macro management institutions' needs, and in lack of scientific evaluation of industrial performance level, and not conducive to understand the real situation of the development of the environment industry comprehensively and deeply, and it is hard to find the right remedy for the problem of how to improve the performance level of environmental industry. Therefore, it is urgent to study the performance and influence factors of environmental industry from the macro and micro level, from the breadth and depth of the performance evaluation.

Based on the above judgment, with the qualitative and quantitative evaluation of the environmental industry effect and efficiency as the main line, the performance of the environmental industry and the related problems are studied by using the methods such as literature research, questionnaire survey, interviews, stakeholders, secondary data analysis, econometric model analysis, case study and so on. The main data of the empirical study are the environmental industry survey data from 2004 to 2011. To summarize the research contents of this paper, the theoretical and empirical results can be mainly concluded as follows:

(1) Based on the relevant theories of industrial economics and environmental economics, the performance evaluation system of environmental industry has been established.

The evaluation system includes three levels: comprehensive performance evaluation, management efficiency evaluation and influencing factors. From the specific index system construction and evaluation method, the comprehensive performance of industry environment evaluation index system includes three dimensions, i.e. the own level, external benefit and development ability, and the method of synthetic index and expert determining weights have been selected to evaluate. Environmental industry management efficiency evaluation index system includes input indicators and output indicators, and the data envelopment analysis (DEA) has been selected to assess it. Environmental factors affecting the industry performance evaluation index system include the internal influence factors (market size, market structure, system, mechanism and technology level) and external influence factors (industrial policy factors, macro economic factors, social factors and environmental factors), and econometrics Tobit regression model has been chosen to analyze it. Among them, the comprehensive performance evaluation focuses on the breadth, and strives to be comprehensive; Operational efficiency assessment focuses on depth, and is an effective supplement and deepening to the level of comprehensive performance evaluation; The impact factor evaluation is the further mining of comprehensive performance, operational efficiency constraints and the promoting factors.

(2) Based on the comprehensive performance evaluation index system and comprehensive index method, the comprehensive performance evaluation of environmental industry in China has been studied.

China's environmental industry comprehensive evaluation results show that: during the period of 2004-2011, the comprehensive performance of industry environment has been improved significantly in own level, external benefit and development capacity, especially its own level improves the fastest. However, compared with other domestic industries, the overall size of the environmental industry is still small, only less than 1% of GDP, and has limited supporting and stimulating effect to the national economy; With general profitability, its profit ratio is just slightly higher than the national average, and it does not have enough advantage to attract a large number of social capital investment. Therefore, at this stage, China's environmental industry should continue to be driven by the government. With proper means of environmental regulation, more industrial demand should be released, and environmental industry's scale expansion and profitability improvement should be promoted.

(3) Based on the evaluation index system and data envelopment analysis (DEA) of environmental industry management efficiency, the research on the management efficiency of China's environmental industry has been carried out.

China's macro level environmental industry operating efficiency mean is 0.679, and micro level environmental enterprise operating efficiency mean is 0.12, namely, the overall operating efficiency of environmental enterprises is low. The main reason for the low efficiency of China's environmental industry is that the scale of environmental enterprises is too small and the technology is invalid. From the point of view of the returns to scale, more than 85% environmental enterprises are in the stage of increasing returns to scale, which indicates that China's environmental enterprises are in the growth stage and need increasing the investment as well as expanding the scale to improve the efficiency of the whole industry.

(4) Based on the DEA efficiency value of operating efficiency evaluation, with the econometric Tobit regression model, the impact of the various factors on the efficiency of the environmental industry has been analyzed quantitatively.

At the macro level, industry concentration has a positive impact, which shows that the environmental industry is highly efficient in the region with high environmental industry concentration. This conforms to our country's current reality condition: the whole industry concentration degree is low, and the competition dispersion causes the low efficiency. Environmental protection investment, foreign trade and technical level and other factors fail to make significant impact on the regional environmental industry operating efficiency. This shows that: China's current investment in environmental protection is not enough, the "going out" of the environmental industry is still not significant, technological innovation has not yet reached the level of industrial efficiency. In the formulation of macroeconomic policies to promote the development of the environmental industry, we should continue to expand investment in environmental protection, to encourage the environment industry "going out", and vigorously promote the technological innovation of environmental industry.

At the micro level, working characteristics have positive effects on environmental pollution control products production enterprises and service enterprises, indicating professional enterprises, whether the products production enterprises or service enterprises, tend to obtain higher efficiency. Ownership has significant negative influence on the two sub sectors, showing that state-owned enterprises are in lack of internal power and restricting the development environment of enterprise. And this provides realistic basis to boost public utilities market and promote the third party governance in China. Listing and corporate aggregation only have significant positive influence on the pollution control industry, which indicates that environmental service enterprises need more large scale more urgently, and it is an effective way to improve the performance to transform to comprehensive environmental service enterprise with large scale. Besides, environmental services companies in the industrial park can get a higher efficiency, which also illustrates the development of industrial parks can help pollution control services enterprises to improve their performances. R&D personnel and the

export contract amount have significant positive effect on the environment product production enterprise, showing that talent is environmental products production enterprises' innovation capital and core competitiveness, and foreign exports can expand the overseas market for environmental products. The number of years of service has a negative impact on the production and operation of environmental products. It also shows that the environmental enterprises developed earlier have lagged behind in terms of the technology and products, and they are in lack of competitiveness in the market. For micro management measures, it is advisable to encourage and support professional non-public environmental enterprises, to vigorously promote the third party governance, to encourage corporate mergers, acquisitions and listing, to cultivate leading enterprises of pollution control services and industrial gathering area. And environmental products production enterprises should pay more attention to the training of R & D personnel, technical innovation, as well as the external output of environmental products.

(5) Taking "The town of environmental protection" Yixing as a case study, an empirical study on the comprehensive performance, operational efficiency and influencing factors of the environmental industry in Yixing has been carried out.

The overall performance and operating efficiency of Yixing's environmental industry are better than the national average. Small scale is the main reason that leads to the low management efficiency of Yixing's environmental enterprises. This conforms to the reality in Yixing that more than 85% of environmental enterprises are small and micro enterprises with low-cost competition. From the external benefits, the total economic output of Yixing's environmental industry still has small proportion, and belt power and support force of the environmental industry in Yixing has not been fully played out. In terms of efficiency factors, R & D funds have negative impact, which shows that R & D investment has lag effect and even may reduce the operating efficiency of the enterprise in the short term. Therefore, the government needs to ensure and encourage the transformation of technological innovation and technological achievements through policy support and encouragement. Enterprise agglomeration has positive impact on the operational efficiency of Yixing, which shows that the development model of Park agglomeration has positive effect on improving the efficiency of environmental enterprises. This is consistent with not only the reality of the development of the Yixing Environmental Science Park enterprises, but also with the empirical conclusions that the national environmental enterprises in the National Park have better performance. This fully illustrates that building high quality environmental industry gathering area can improve the environmental performance of enterprises and promote the development of the environmental industry.

Obviously, the theoretical system and practical methods of the paper are applied to the study of Yixing case performance evaluation, and the conclusion is consistent with the reality of the development of environmental industry in Yixing. Thus, it is proved that the theory

and method of this paper is scientific and feasible, and it has a certain theoretical guiding significance for the analysis of the development situation of China's environmental industry.

Finally, from the existing problems of the industrial development environment, combined with the analysis of the development trend of future environmental industry, based on the research results of industry performance and its influencing factors, taking the further release of effective market demand and more supply of high quality of environmental industry as the main idea, the policy suggestions to improve the performance level of China's environmental industry have been put forward from four main factors affecting environmental industry performance (policy factors, economic factors, market factors and technical factors). In terms of policy, we should pay attention to the top-level design, improve and implement the environmental industrial policy, and actively implement the "going out" strategy, and expand the domestic and foreign environmental industry market demand. In the economic aspect, we should further increase fiscal and tax support and play the guiding role of government funds. In terms of market, we should promote the development of the comprehensive service industry, accelerate the third party governance and other market-oriented model, foster leading enterprises and industrial agglomeration areas, and promote industrial development as well as cluster development. In terms of technology, we should improve the environmental technology innovation system and achievement transformation mechanism, and enhance the effective supply of the industry.

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# 第1章 绪论

## 1.1 研究背景与研究意义

### 1.1.1 研究背景

#### (1) 环境产业是建设生态文明和实现可持续发展的动力支撑

近年来,在经济高速增长的同时,气候变化、雾霾蔓延、资源枯竭、能源短缺和海洋污染等全球性环境问题日益突出,严重威胁着人类的能源安全、生态安全、环境安全、水资源安全和公众健康。环境问题已成为21世纪人类社会面临的最严峻挑战之一,事关人类生存和发展。环境产业是连接和协调经济系统与自然系统的特殊产业,具有保护与修复生态环境、解决环境污染物问题、提高资源能源利用率和满足人民的环境需求的功能。环境产业的发展具有增长速度快、产业关联度大、渗透力强、吸纳就业人口多、对社会经济和可持续发展影响大等特点。因此,环境产业不断受到重视,已经成为国际经济科技竞争的新领域。保障环境产业快速、良性发展是缓解中国资源环境约束的客观需要,也是建设生态文明的重要抓手。

#### (2) 环境产业是新常态下的经济增长点

随着国内外政治、经济形势的不断发展,环境产业在国民经济中的地位不断提高。2010年9月,《国务院关于加快培育和发展战略性新兴产业的决定》首次明确提出“节能环保产业”作为七大战略性新兴产业之首予以支持。随后又相继发布了《“十二五”国家战略性新兴产业发展规划》和《“十二五”节能环保产业规划》。国家对环境产业的发展寄予厚望,环境保护的地位及重要性上升到前所未有的高度,在这样的背景下,环境产业发展面临的不仅是发展契机,更是严峻的挑战。

中国长期以来资源高度密集的经济增长方式,需要依赖不断增长的资源供给方式来维持,消耗了大量的非再生资源,加剧了环境污染和生态破坏。“十三五”中国经济从高速增长转为中高速增长,进入“新常态”,经济发展更多强调“好”和“稳”,产业结

构进入转型升级的关键时期，经济增长方式由粗放向可持续转变。在结构调整中需要淘汰落后和过剩产能，淘汰高污染、高耗能产品，这就需要培育接续产业，从而形成新的经济增长点，实现稳增长、调结构的目的。目前，环境产业在中国经济中的比重越来越高，环境产业的发展可以带动上下游相关产业发展，起到稳增长的作用。因此，在资源环境约束下，环境产业成为中国经济新常态下的增长点和推动供给侧改革的重要动能，对我国经济增长和产业结构调整、转型的作用日益重要。

(3) 提高环境产业整体绩效水平成为现阶段发展环境产业的重点

正是由于环境产业的这种特殊性和重要性，在过去的十多年间，中国的环境产业年均增速超过 15%，部分领域达 30% 以上，远高于 GDP 的增速。环境产业及环境污染治理投资与国民经济发展情况对比见图 1-1<sup>①</sup>。目前，中国环境产业已进入高速发展期，环境产业收入总额从 1993 年的 311.5 亿元增长到 2011 年的 30 752.5 亿元，增长了将近 100 倍，从业单位数从 1993 年的 8 651 个迅速发展至 2011 年的 23 820 个，从业人数也由 1993 年的 188.2 万人扩大至 2011 年的 319.6 万人，运行质量和效益进一步提高。同时，中国环保产业开始逐步拓展国际市场，出口合同额由 2000 年的 14.1 亿美元增至 2011 年的 333.8 亿美元，详见表 1-1。虽然环境产业发展增速较高，但在 GDP 中的占比没有明显提高，表明环境产业绩效水平不高，成为其高效发展的重点制约。

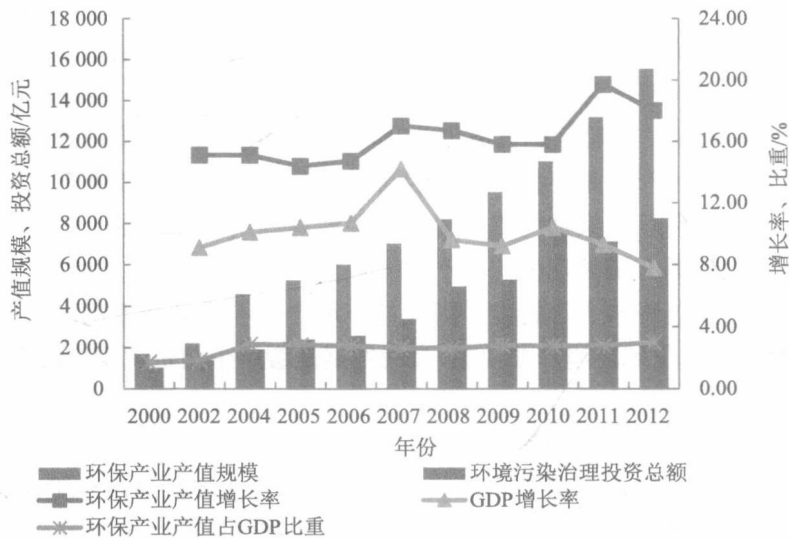


图 1-1 环境产业与国民经济发展情况（2000—2012 年）

资料来源：环境统计年鉴、赛迪顾问、环保产业调查。

① 我国还未建立起环境产业常态化统计制度，缺乏连续、一致的环境产业产业调查和统计数据。图 1-1 的连续数据是结合了环境统计年鉴、咨询报告和环保产业调查的数据，产业范围不一致，数据并不严谨，仅为了展示环境产业的大致增长趋势。