

# 中国建筑节能发展报告

——建筑节能运行管理

(2016年)

住房和城乡建设部科技发展促进中心

中国建筑工业出版社

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## 图书在版编目(CIP)数据

中国建筑节能发展报告. 2016年: 建筑节能运行管理/  
住房和城乡建设部科技发展促进中心主编. —北京:  
中国建筑工业出版社, 2015.3  
ISBN 978-7-112-19199-4

I. ①中… II. ①住… III. ①建筑-节能-研究报告-  
中国-2016 IV. ①TU111.4

中国版本图书馆 CIP 数据核字 (2016) 第 040028 号

责任编辑: 张文胜 田启铭

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中国建筑工业出版社出版、发行(北京西郊百万庄)

各地新华书店、建筑书店经销

北京科地亚盟排版公司制版

北京中科印刷有限公司印刷

\*

开本: 787×1092 毫米 1/16 印张: 16¼ 字数: 394 千字

2016 年 3 月第一版 2016 年 3 月第一次印刷

定价: 48.00 元

ISBN 978-7-112-19199-4

(28416)

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(邮政编码 100037)

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## 序

党的十八大以来，党中央、国务院高度重视生态文明和绿色发展，2015年4月、9月，中共中央、国务院分别印发了《关于加快推进生态文明发展的意见》、《关于生态文明建设总体方案》，明确提出了新型工业化、信息化、城镇化、农业现代化和绿色化“五化”协同发展的理念，凸现出绿色发展在新时期我国经济社会发展中的重要作用和生态文明体制改革的系统性、整体性、协同性要求。2015年12月，我国在巴黎气候大会上承诺，2030年单位国内生产总值二氧化碳排放比2005年下降60%~65%，非化石能源占一次能源消费比重达到20%左右。这些都为未来一段时期我国节能减排工作开展提出更高要求。

目前我国建筑能耗约占全社会终端能耗的20%，并呈现持续上升态势，是节能减排非常重要的领域。根据发达国家城市化、工业化进程的发展规律来看，未来随着经济结构调整、人口的迁移、城市群的涌现，建筑能耗占全社会终端能耗的比例将上升至30%~40%，建筑能源消费将占据越来越重要的地位。推动建筑节能和绿色建筑发展对降低全国的能源资源消耗和保护生态环境，推进生态文明建设都具有举足轻重的作用。“十二五”以来，通过不懈的努力，建筑节能和绿色建筑工作取得了长足发展和显著成效，截至目前，全国各地已能全面较好地执行现行节能标准，部分省市已开始实施更高要求的节能标准，公共建筑从2015年开始执行了新的节能标准，“超低能耗”、“近零能耗”建筑标准体系也在积极研究并开展试点，实施北方采暖地区居住建筑节能改造10亿m<sup>2</sup>，公共建筑节能改造近5000万m<sup>2</sup>，新增可再生建筑应用面积22亿m<sup>2</sup>，累计太阳能光电装机容量3300MW，绿色建筑总量达到10亿m<sup>2</sup>。建筑节能和绿色建筑工作持续推进，建筑能效水平得到持续提高。

城市居民工作生活中有80%的时间是在建筑中度过的，节能建筑和绿色建筑建设或改造完成后的运行管理阶段是实现“节能”、“绿色”效果的重要阶段。2015年中央城市工作会议明确要求：抓城市工作，一定要抓住城市管理和这个重点，不断完善城市管理和这个重点，彻底改变粗放型管理方式，让人民群众在城市生活得更方便、更舒心、更美好。2007年以来住房和城乡建设部开展的公共建筑节能监管体系建设，通过能耗统计、能源审计、能效公示、监测分析、定额管理等方式提升运行管理水平，取得了一定成效，很多学校、医院籍此为抓手开展了大量有益实践，有效带动了社会节约风尚。下一步，随着节能建筑、绿色建筑数量爆发式增长，以及运行调适、智能管理等技术手段的普及，建筑节能和绿色运行管理成为越来越重要的领域。

在住房和城乡建设部建筑节能与科技司的指导下，住房和城乡建设部科技与产业化发展中心组织相关人员以公共建筑节能运行为主题，编写了《中国建筑节能发展报告（2016年）》。报告回顾了“十二五”期间建筑节能和绿色建筑领域新的进展，并重点针对我国公共建筑节能运行的实际工作，系统梳理了公共建筑节能运行工作政策制定的背景、进展、

问题、模式、成效和经验，介绍了相关优秀实践案例。

目前专门针对建筑节能运行管理方面的书籍较少，本书的出版具有较好的理论和现实意义。借本书出版发行之际，向在为推动我国建筑节能和绿色建筑发展而辛勤工作、勇于创新、大胆实践的同志们表示诚挚的谢意，也衷心的希望本书的出版能够为促进我国公共建筑节能工作的深入推进做出有力贡献。

住房和城乡建设部建筑节能与科技司

二〇一六年一月

## Introduction

Since the Eighteenth National Congress of the Communist Party of China, CPC Central Committee and State Council paid great attention to ecological progress and green development. In April and September 2015, CPC Central Committee and State Council have respectively issued *Opinions on Accelerating Ecological Civilization Progress*, and *General Plan of Ecological Civilization Progress Promotion*, which clearly proposed the concept of collaborative development of new industrialization, IT application, urbanization, agricultural modernization and greening. The highlighted green development plays an important role in China's economic social development in new century. And the systemic, holistic and collaborative requirements of ecological civilization reform were raised. In December 2015, China pledged on United Nations conference on climate change (COP21) to reduce CO<sub>2</sub> per unit of GDP by 60%-65% over the 2005 level by 2030, and raise the share of non-fossil fuels in primary energy consumption to about 20%. These objectives have put forward higher requirements for China's energy saving and emission reduction in the upcoming period.

Currently building energy consumption accounts for 20% of total social energy consumption and shows a trend of rising, which is a major field of energy saving and emission reduction. Based on the urbanization and industrialization development trend of developed countries, along with future economic structure adjustment, population migration and the emergence of urban agglomerations, building energy consumption would account for 30%-40% of total social energy consumption. Building energy consumption will play an increasingly important role. And the promotion of building energy efficiency and green building development has significant influence on reducing China's overall energy resource consuming, protecting ecological environment, and promoting ecological civilization progress. Since "Twelfth Five-Year", through tireless of efforts, great development and significantly achievements happened in building energy efficiency and green building fields. Until now, the existing energy efficiency standards have been fully better implemented over the national wide, the requirements of higher energy efficiency standards have been started to implement in some provinces and cities, and a new energy efficiency standard for public buildings also have been started to implement from 2015. The "ultra-low energy consumption" and "near-zero energy consumption" building standard system was also under research and pilot. The implementation of 1 billion m<sup>2</sup> of residential building energy-saving retrofit in Northern heating areas, nearly 50 million m<sup>2</sup> of public building energy-saving

retrofit, 2.2 billion m<sup>2</sup> of newly built buildings applying renewable energy, accumulative 3300 MW of solar PV capacity, and 1 billion m<sup>2</sup> of green building has been completed. The promotion of building energy efficiency and green building would be continued, and the level of building energy efficiency has continued to improve.

Urban residents spend 80% of life time in buildings. Therefore the operation and management stage after the completion of building energy-saving retrofit and green building construction is very important to achieve “energy efficiency” and “green effects”. Central Urban Work Conference clearly required to catch the point of constantly improving urban management and services, and to completely change the extensive management mode, in order to make life easier, happier and more comfortable for people living in the cities. Since 2007, the public building energy efficiency supervision system carried out by Ministry of Housing and Urban-Rural Development has gained some achievements on improving operation and management through energy statistics, energy audits, energy efficiency publicity, monitoring analysis, quota management and other methods. Taking this as the starting point, many schools and hospitals carried out a lot of useful practices, which effectively led the community toward energy-saving. Next, along with explosive growth of energy-efficient buildings and green buildings, and the popularization of techniques such as operation and commissioning, intelligent management and so on, building energy efficiency and green operation management would become increasingly important.

Under the guidance of Building Energy Efficiency and Technology Department of Ministry of Housing and Urban-Rural Development, Center of Science and Technology of Construction, Ministry of Housing and Urban-Rural Development organized relevant personnel to compiling this Report of China’s Building Energy Efficiency Development (2016) themring public building energy efficiency operation. The Report reviews the new progresses in building energy efficiency and green building during “Twelfth Five-Year”, and systematically introduces policy background, progresses, problems, modes, achievements and experiences of public building energy efficiency operation focusing on and presenting the actual relevant best practices.

Currently we have few books focusing on building energy efficiency management, so this book has a good theoretical and practical significance. Taking the opportunity of the book’s publication, we sincerely appreciate the hard-working, innovative people daring to practice in order to promote building energy efficiency and green building development, and sincerely hope that the publication of this book would make great contributions to the promotion in depth of public building energy efficiency development in our country.

Department of Building Energy Efficiency and S&T  
Ministry of Housing and Urban-Rural Development of China

January, 2016



# 前 言

我国在 2015 年巴黎气候大会上承诺，2030 年左右二氧化碳排放达到峰值并争取尽早实现，2030 年单位国内生产总值二氧化碳排放比 2005 年下降 60%~65%，非化石能源占一次能源消费比重达到 20%左右。建筑是化石能源利用的重点领域，依据发达国家经验，建筑能耗消费量占社会终端总能耗比例将稳定在 40%左右，做好建筑节能工作是实现国家战略目标的重要环节。

“十二五”期间，住房和城乡建设部会同财政部等有关部门大力推进建筑节能与绿色建筑发展，取得了一系列成绩：新建建筑节能标准逐步提高，执行比例接近 100%；老旧小区节能改造稳步推进，已完成 10 亿 m<sup>2</sup> 以上，单位建筑面积供暖能耗已出现下降趋势；公共建筑节能改造示范加快实施，节约型校园、医院纷纷涌现；可再生能源建筑应用呈强制性、规模化发展态势；绿色建筑标识数量和强制执行效果快速提升等。我国建筑节能工作初步实现了由单体实施转向规模化、区域化发展，由单项技术应用转向集成化、产业化发展，由示范引导转向法制化、标准化发展。

我国正处于城市发展新的历史时期，时隔 37 年召开的中央城市工作会议提出要贯彻“创新、协调、绿色、开放、共享”的发展理念，坚持“一个尊重、五个统筹”，着力解决各类“城市病”，提升城市管理水平。2016 年是“十三五”开局之年，建筑节能工作需进一步总结经验教训，不断创新政策机制，加快实现重点领域工作突破，并要注重建筑运行阶段节能效益实现，切实将建筑领域的节能减排效果从理论层面体现到实际。为此，在住房和城乡建设部建筑节能与科技司的指导下，住房和城乡建设部科技发展促进中心组织有关人员编写了本书。本书分上下两篇共 8 章。上篇是我国建筑节能与绿色建筑进展与展望，第 1 章介绍了“十二五”期间我国新建建筑节能、绿色建筑发展、既有居住建筑节能、公共建筑节能、可再生能源建筑应用、绿色建材与建筑工业化、被动式超低能耗建筑发展等方面工作进展、存在的问题及下一步建议；第 2 章对“十三五”建筑节能与绿色建筑发展机遇、挑战进行了分析，并提出总体目标和重点领域目标；第 3 章对我国建筑总量和能耗总量进行了分析与预测。下篇是建筑节能运行管理发展情况，第 4 章介绍了建筑节能运行管理现状及工作历程，针对面临形势及国外先进经验总结未来工作启示；第 5 章对我国建筑能源统计、审计、公示、监测、定额管理制度成效进行了总结，介绍了目前流行的建筑运行调适相关内容，并尝试构建了建筑节能运行管理体系；第 6 章对目前实施的省级节能监测平台，高校、医院、商业、办公等行业节能监管系统建设特点、经验及成效进行了总结提炼；第 7 章对建筑节能运行投融资模式、政策激励方式进行了研究与探讨；第 8 章分区域、单体遴选若干建筑节能运行管理实例进行展示，以求推广经验，扩大交流。最后，回顾了 2014 年至今我国建筑节能领域发生的重要事件。

参加本书撰写的有：第 1 章梁俊强，丁洪涛（1.1），宋凌、张川（1.2），彭琛

(1.3), 梁传志、戚仁广 (1.4), 殷帅 (1.5), 刘幼农、姚春妮 (1.6), 刘敬疆、刘珊珊 (1.7), 武洁青 (1.8), 张小玲、彭梦月 (1.9); 第2章曾获; 第3章丁洪涛、刘海柱; 第4章殷帅、廖雅双; 第5章刘海柱 (5.1), 郝斌、刘珊 (5.2), 殷帅、孙鹏程 (5.3); 第6章侯晓坤、戴薇薇 (6.1), 薛志峰、贾宇 (6.2.1)、李凌渝、汪冰冰、邱益农 (6.2.2、6.2.4), 朱滨、何中凯 (6.2.3); 第7章刘军民; 第8章根据相关项目提供素材整理成稿。全书由梁俊强审查并提出修改意见。在本书的撰写过程中, 得到了住房和城乡建设部建筑节能与科技司的全力支持及中肯建议, 在此表示诚挚感谢!

此外, 感谢上海建筑科学研究院、中国建筑标准设计研究院、江苏联宏自动化系统工程有限公司、同方泰德国际科技(北京)有限公司、江苏天合能源管理有限责任公司、中节能唯绿(北京)建筑节能科技有限公司、北京合众科林自动化工程技术有限公司、南京天溯自动化控制系统有限公司为本书提供的案例资料和相关支持。

由于时间紧张、编写水平有限, 本书存在不少疏漏和不足之处, 恳请读者批评指正。

编写组  
2016年1月

## Preface

China pledged on United nations conference on climate change (COP21) to peak CO<sub>2</sub> emissions by around 2030 and strive to achieve it as soon as possible, and by 2030, reduce CO<sub>2</sub> per unit of GDP by 60%-65% over the 2005 level, raise the share of non-fossil fuels in primary energy consumption to about 20%. Major fossil energy use happens in building field. Based on the experience of developed countries, building energy consumption volume would steadily account for around 40% of total social energy consumption. Therefore building energy efficiency is an important part of achieving national strategic objectives.—

During “Twelfth Five-Year” period, Ministry of Housing and Urban-Rural Development, together with Ministry of Finance and other relevant departments, vigorously promoted building energy efficiency and green building development, and has made a series of achievements. The energy efficiency standards for newly built buildings have been gradually improved, and the implementation rate is close to 100%. Energy-saving retrofit of old communities was steadily promoted, and above 1 billion square meters’ retrofit has been completed. Energy consumption per unit area of building heating has appeared a declining trend. The implementation of public building energy-saving retrofit speeded up, and lots of energy-saving campuses and hospitals emerged. The development of renewable energy applied in building showed a mandatory and scale up trend. The number of green building labeling and the mandatory implementation effects grew rapidly. China’s building energy efficiency has primarily transformed from the implementation in single building to large-scale and regional development, shifted from individual technology application to integrated and industrialized development, and turned demonstration and guidance to legalization and standardization.

Our country’s urban development is in a new historical period. The Central Urban Work Conference held after an interval of 37 years proposes a solid development concept of “innovation, coordination, green, open, and sharing”, insists on “respect for urban development rules, plan as a whole” and keeps working to resolve all types of “urban diseases”, and improves urban management. The year of 2016 is the starting year of “Thirteenth Five-Year”. And building energy efficiency work requires further lesson-learned, continuous innovation of policies, accelerating breakthroughs in key fields, focusing on achieving efficiency benefit during building energy efficiency operation stage, and effectively turning the theoretical building energy-saving and emission reduction into practice. Therefore, under the guidance of Building Energy Efficiency and Technology Department of

Ministry of Housing and Urban-Rural Development, the compiling of this book has been organized by Center of Science and Technology of Construction, Ministry of Housing and Urban-Rural Development. This book has two parts with 8 chapters. Part One introduces the development status and forecast of China's building energy efficiency and green building. Chapter One introduces the work progress, existing problems and follow-up suggestions for China newly built building energy efficiency, green building development, existing residential building energy efficiency, public building energy efficiency, renewable energy application in buildings, green building materials and building industrialization, and passive ultra-low energy consumption building development during "Twelfth Five-Year". Chapter Two analyzes challenges and opportunities of building energy efficiency and green building development during "Thirteenth Five-Year", and proposes overall objectives and targets in major fields. Chapter Three analyzes and forecasts China's total building volume and total energy consumption. Part Two discusses the development status of building energy efficiency operation management. Chapter Four introduces current status and history of building energy efficiency operation management, proposes future work enlightenment according to current situation and foreign advanced experiences. Chapter 5 summarizes the achievements of China's building energy statistics, audit, publicity, monitoring, and fixed quota management, introduces currently popular building operation and commissioning related contents, and attempts to frame building energy efficiency operation management system. Chapter 6 summarizes the characteristics, experiences and achievements of provincial energy efficiency monitoring platforms, and energy efficiency supervision systems of universities, hospitals, commercial and office buildings currently implemented. Chapter 7 researches and discusses the investment, financing and incentive policies of building energy efficiency operation. Chapter 8 selects several practices of building energy efficiency operation management of single or regional buildings, in order to share the experiences and expand communications. Finally, the timeline of China building energy efficiency since 2014 is available for references.

Participants in book compiling include: Chapter One-LIANG Junqiang, DING Hongtao (1.1), SONG Ling, ZHANG Chuan (1.2), PENG Chen (1.3), LIANG Chuanzhi, QI Renguang (1.4), YIN Shuai (1.5), LIU Younong, YAO Chunni (1.6), LIU Jingjiang, LIU Shanshan (1.7), WU Jieqing (1.8), ZHANG Xiaoling, PENG Mengyue (1.9), Chapter Two-ZENG Di, Chapter Three-DING Hongtao, LIU Haizhu, Chapter Four-YIN Shuai, LIAO Yashuang, Chapter Five-LIU Haizhu (5.1), HAO Bin, LIU Shan (5.2), YIN Shuai, Sun Pengcheng (5.3), Chapter Six-HOU Xiaokun, DAI Weiwei (6.1), XUE Zhifeng, JIA Yu (6.2.1), LI Lingyu, WANG Bingbing, QIU Yinong (6.2.2, 6.2.4), ZHU Bin, HE Zhongkai (6.2.3), Chapter Seven-LIU Junmin, and Chapter 8 was drafted according to source materials from related projects. The book was reviewed by LIANG Junqiang, who also provided modification suggestions. Sincerely thanks to the full support and practical suggestions provided by Building Energy Efficiency

and Technology Department of Ministry of Housing and Urban-Rural Development during the process of book compiling!

In addition, thanks to the case materials and related support provided from China Academy of Building Research Shanghai Institute, China Institute of Building Standard Design and Research, Jiangsu Lianhong Automation Company Limited, Technovator International (Beijing) Company Limited, Jiangsu Trina Solar Company Limited, CECEP Valeen (Beijing) Company Limited, Beijing He Zhong Ke Lin Automation Company Limited, and Nanjing Tiansu Automation Company Limited.

Due to time and compiling skills limitation, we invite readers to comment on the omissions and deficiencies of the book for us to improve.

Compiling Group  
January, 2016

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