

中国可持续能源项目能源基金会资助

China Sustainable Energy Project Funded by Energy Foundation

中国建筑节能发展报告

China Building Energy Efficiency Development Report

(2010年)

住房和城乡建设部科技发展促进中心

Center of Science and Technology of Construction,
Ministry of Housing and Urban-Rural Development, P.R. China



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内 容 摘 要

我国的建筑节能工作始于 20 世纪 80 年代中期,从北方采暖地区开始,到全国范围内顺序铺开,直到现阶段全面开展,走过了坚实的历程,取得了明显成效。当然,不可否认,还仍然存在如施工阶段没有严格执行节能设计标准,既有建筑节能改造推进困难,节能技术与产品无法满足市场需求等问题。

有鉴于此,本书试图对我国建筑节能工作进行全面梳理和总结,从我国建筑节能的发展历程、民用建筑能耗状况、新建建筑节能、既有建筑节能、建筑用能系统运行节能、可再生能源建筑应用、建筑节能技术与推广、低能耗建筑工程与示范、绿色建筑发展与标识制度等方面,进行了比较系统的阐释。

本书适用于从事建筑节能工作的管理人员、技术人员、房地产开发商、产品供应商、大专院校师生及关心关注建筑节能工作的读者。

Abstract

The work of energy conservation in buildings dates back to the middle of the 1980s in our country. It has gone through a process of sound development and yielded outstanding effects from the initial launching in regions with heating provision in the North, through the popularizing gradually and orderly nationwide to the overall implementation at the current stage. However, it cannot be denied that there are still some problems, for example, the energy conservation design standard has not been strictly executed at the stage of construction; it has been difficult to promote the energy conservation retrofit in existing buildings and the energy conservation technology and products have failed to satisfy the market demand, etc.

On that account, this book endeavors to sort out and summarize the building energy conservation work in China in an all-round way, and gives a systematical elaboration on such aspects as the development history of the building energy conservation in our country, the energy consumption condition of civil buildings, energy conservation in new buildings, energy conservation in existing buildings, energy conservation in the operation of the energy-utilizing system of buildings, the application of renewable energy sources in buildings, the research and popularization of the building energy conservation technology, low energy-consuming construction project and demonstration as well as the development and the identification system of green buildings.

This book is targeted at the administrative staff, technical researchers, real estate developers, product suppliers, teachers and students of universities and colleges who are engaged in the work of energy conservation in buildings as well as the vast readers who are concerned with such work.

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序

中国人口众多，能源资源相对不足，人均拥有量远低于世界平均水平。中国工业化和城镇化的快速发展，带动了建筑业的飞速发展，每年新增建筑面积 20 多亿 m^2 ；既有建筑存量高达 400 多亿 m^2 ，其中 90% 以上是高能耗建筑；居民居住、生活条件逐步得到改善和提高，导致建筑用能持续增长，进一步加剧了能源供求矛盾和环境污染状况。

建筑节能是国家能源节约战略的重要组成部分，能源是国民经济和社会赖以发展的动力和基础。节能是缓解能源约束，减轻环境压力，保障经济安全，实现可持续发展的必然选择。中国政府高度重视建筑节能，通过建立和完善建筑节能法律法规，制定建筑节能技术经济政策，创新建筑节能管理制度，制定和执行建筑节能标准，开展既有建筑节能及计量改造，组织建筑节能关键技术攻关，加强国际间建筑节能交流，建筑节能工作取得了显著成效。

新建建筑节能标准执行率逐年提高，2009 年达到 90%，分别比 2008 年、2007 年提高了 8% 和 19%。截至 2009 年底，已累计建成节能建筑 40 余亿 m^2 。

既有建筑节能改造稳步推进。“十一五”期间，实施的北方采暖区既有居住建筑供热计量及节能改造 1.5 亿 m^2 的任务如期完成。

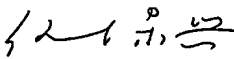
国家机关办公建筑和大型公共建筑节能运行与改造服务体系建设深入开展。国家机关办公建筑和大型公共建筑能耗统计、能源审计、能耗公示、实时能耗动态监测继续推进。

可再生能源建筑一体化规模化应用实现突破性增长。截至 2009 年底，全国太阳能光热应用面积 11.79 亿 m^2 ，浅层地能应用面积 1.39 亿 m^2 ，分别比 2008 年增长 14.2%、35.4%。光电建筑应用装机容量达 420.9MW。

绿色建筑和低能耗建筑工程示范继续推进，对引导建设更高标准的节能建筑，影响深远。

中国作为当今世界最大的新兴经济体，是一个负责任的发展中国家，恪守全球气候保护协定《联合国气候变化框架公约》，积极应对世界气候变化问题，致力于控制温室气体排放，遏制全球变暖趋势。在丹麦首都哥本哈根召开的联合国气候大会上，中国向全世界庄严承诺：到 2020 年单位国内生产总值二氧化碳排放量比 2005 年下降 40%~45%。这一目标的实现，需要全国各方共同努力。约占全社会能源消耗总量近 1/3 的建筑领域，尽管已经取得了一定进展，但是由于中国建筑节能工作起步相对较晚，社会各阶层对于建筑节能的理解和认识还不够深入，在推动建筑节能工作的过程中，还存在一些突出问题需要深入研究和解决：新建建筑节能标准执行率需要进一步提高，数百亿平方米既有建筑的节能改造需要全面推进，可再生能源在建筑中的规模化应用需要体制机制创新。总之，“十二五”及今后更长的时期内，建筑节能工作任务依然艰巨，仍需做出不懈的努力。

为进一步推动建筑节能工作的深入开展，在住房和城乡建设部建筑节能与科技司指导下，由住房和城乡建设部科技发展促进中心组织相关人员，从我国建筑节能发展历程与主要成就、民用建筑能耗统计调查制度、新建建筑节能、既有建筑节能、建筑用能系统运行节能、可再生能源建筑应用、建筑节能技术与推广、低能耗建筑工程与示范、绿色建筑发展与标识制度、2010 年前的建筑节能大事记等十个部分，对我国历年的建筑节能工作进行了系统回顾和总结，梳理存在的问题，总结成功的经验，希望能对推动建筑节能工作，实现 2020 年单位国内生产总值二氧化碳排放量比 2005 年下降 40% ~45% 的目标，做出应有的贡献。

中华人民共和国住房和城乡建设部副部长 
2011 年 2 月 15 日

Foreword

With a huge population, China is relatively short of energy resources and the amount of energy resources per capita is far below the world average. The rapid development of industrialization and urbanization in China has driven the fast development of the construction industry. The area of newly increased buildings every year amounts to over 2 billion square meters and the stock of existing buildings has an area of up to over 40 billion square meters, more than 90% of which belong to the highly energy-consuming buildings. The gradual improvement in people's housing and living conditions has led to the continual growth in the energy utilization of buildings, further aggravating the contradiction between the supply and demand of energy as well as the environmental pollution.

Energy conservation in buildings is an important part of the national strategy of energy saving. Energy sources are the driving force as well as the foundation for the national economic and social development. Energy conservation is an inevitable choice to relieve the restraints of energy sources, alleviate the environment stress, safeguard the economic security and achieve the sustainable development. The Chinese government attaches great importance to energy conservation in buildings. Through their efforts to establish and improve the laws and regulations on the building energy conservation, formulate the technical and economic policies on energy conservation in buildings, make innovations in the building energy conservation management system, lay down and implement the building energy conservation standard, carry out the energy conservation as well as the metering retrofit of existing buildings, make breakthroughs in the key technologies of energy conservation in buildings as well as strengthen the international exchange on the building energy conservation, the work of energy conservation in buildings has yielded remarkable effects.

The implementation rate of the energy conservation standard has risen year after year in new buildings, which reached 90% in 2009, respectively 8% and 19% higher than that in 2008 and 2007. By the end of 2009, the area of energy-saving buildings completed had accumulated to 4 billion square meters.

The energy conservation retrofit of existing buildings has progressed steadily. During "the eleventh five-year period", the task of the 150 million square meters' area of the heating metering and energy conservation retrofit in existing residential buildings in regions with heating provision in the North has been accomplished on time.

The construction of the energy conservation operation and retrofit service system in the office buildings of the state organs as well as large public buildings has been carried out in a deep-going way. The energy consumption statistics, energy audit, public notice of energy consumption as well as the real-time dynamic monitoring of energy consumption have proceeded in the office buildings

of the state organs and large public buildings.

Breakthroughs have been made in the growth of the integrated and large-scale application of renewable energy sources in buildings. By the end of 2009, the area with the solar photo-thermal application had amounted to 1.179 billion square meters nationwide and that with the application of shallow geothermal energy had reached 139 million square meters, respectively rising by 14.2% and 35.4% compared with that in 2008. The installed capacity of the application of photo-electricity in buildings had been 420.9 megawatt.

Demonstration of green buildings and low energy-consuming construction projects has been pushed ahead continuously, which would have a profound and lasting influence on guiding the construction of energy-saving buildings of a higher standard.

As the largest emerging economic entity in the world as well as a responsible developing country, China scrupulously abides by the global climate protection protocol of *United Nations Framework Convention on Climate Change*, actively responds to the problem of climate change in the world, and devotes itself to controlling the greenhouse gas emission and the global warming trend. The Chinese government made a solemn promise at the United Nations Climate Change Conference in Copenhagen, Denmark, that the carbon dioxide emission per unit GDP will reduce by 40% to 45% in 2020 in China compared with that in 2005. The achievement of this objective requires the concerted efforts of all professions and trades throughout the country. Considerable progress has been made in the construction field which consumes nearly one third of the total energy sources of the whole society. Nevertheless, as a result that the building energy conservation work started relatively late in China and the people of various social strata lack a thorough understanding of the energy conservation in buildings, some striking problems remain to be researched in depth and resolved in the process of promoting the building energy conservation work. The execution of the energy conservation standard in new buildings should be further advanced; the energy conservation retrofit of several tens of billions of square meters in exiting buildings should be pushed forward in a comprehensive way; and the system and mechanism should be innovated for the large-scale application of renewable energy sources in buildings. In short, unremitting efforts remain to be made on the work of energy conservation in buildings for “the twelfth five-year period” or even longer.

With a view to further promoting the in-depth development of the building energy conservation work and led by the Scientific and Technological Department of the Ministry of Housing and Urban-Rural Development, the Scientific and Technological Development Promotion Center of the Ministry of Housing and Urban-Rural Development has organized the relevant staff to review and summarize the building energy conservation work over the years in a systematic way from the ten perspectives of the development history and main achievements in energy conservation in buildings, the system of the energy consumption statistical survey of civil buildings, energy conservation in new buildings, energy conservation in existing buildings, energy conservation in the operation of the energy-utilizing system of buildings, the application of renewable energy sources in buildings, research and popularization of the building energy conservation technology, low energy-consuming construction engineering and demonstration, the development and identification system of

green buildings as well as chronicles of events in building energy conservation before 2010. They have sorted out the existing problems and summed up the successful experience. It is hoped that we could make contributions to advancing the work of energy conservation in buildings and attaining the goal of reducing the carbon dioxide discharge per unit GDP by 40% to 45% in 2020 compared with that in 2005 through composing this book.

By Qiu Baoxing, Vice Minister of the Ministry of
Housing and Urban-Rural Development
of the People's Republic of China
Feb. 15th, 2011

前 言

建筑节能是国家节约资源战略的重要组成部分。

自 20 世纪 80 年代开展建筑节能工作以来,我国建筑节能已走过了近 30 年的历程。通过与发达国家开展技术交流,借鉴国外的成功经验,组织建筑节能技术攻关,研究引进国外先进成熟技术与产品,从试点工程入手,开展了从单一产品到结构体系、从单一工程到住宅小区的系列研究,逐步建立和完善了建筑节能的法律法规和管理制度,制定了建筑节能技术经济政策,逐步构建了建筑节能标准体系,形成了国家重视建筑节能,社会关注建筑节能,居民参与建筑节能的良好局面。

同时,应该清醒地看到,约占全社会能源消耗总量近 1/3 的建筑节能领域,虽然工作已经全面启动,取得了一定进展。但是,与开展建筑节能工作较早的发达国家还有很大差距。在推进建筑节能工作的过程中,无论是执法与管理部门,还是具体实施单位,依然存在着建筑节能标准执行水平不高,技术经济政策不完善,工作能力与实际需要不相符合,市场机制作用没有充分发挥等突出问题,在“十二五”期间甚至更长的时期内,建筑节能工作任务依然艰巨,并且任重道远。

为进一步推动建筑节能工作的深入开展,住房和城乡建设部科技发展促进中心组织相关人员,在住房和城乡建设部建筑节能与科技司指导下,对我国建筑节能的发展历程、民用建筑能耗状况、新建建筑节能、既有建筑节能、建筑用能系统运行节能、可再生能源建筑应用、建筑节能技术研究与推广、低能耗建筑工程与示范、绿色建筑发展与标识制度等方面,进行了比较系统的梳理和回顾,以供广大建筑节能工作者参考和借鉴,并希望本书能对推动建设领域节能减排,实现 2020 年单位国内生产总值二氧化碳排放量比 2005 年下降 40%~45% 的目标,做出我们应有的贡献。

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领导和工作人员的全力支持,提供了大量素材,提出了很多具体修改意见,并得到了能源基金会的资助,在此表示诚挚的感谢!

参加本书撰写的有:第 1 章屈宏乐;第 2 章丁洪涛、刘海柱;第 3 章戚仁广、郝斌、程杰;第 4 章毕既华;第 5 章李现辉、刘珊、林泽;第 6 章郭梁雨、刘幼农、姚春妮、李现辉;第 7 章田永英、张峰、杨西伟、屈宏乐;第 8 章田永英、张峰;第 9 章宋凌、李宏军、马欣伯、张峰、田永英;第 10 章林湧。张洋、彭伴君参与了第 1 章和第 7.3 节的文字修改工作,本书由梁俊强、杨西伟审查、加工总成。

如果本书的出版能对促进我国建筑节能工作发挥应有作用,将是我们的莫大荣耀。尽管我们已倾尽全力投入本书的撰写,但是由于水平所限,书中肯定存在疏漏或不足之处,恳请读者批评指正。

编写组

2011 年 2 月于北京

Preface

Energy conservation in buildings is an important part of the national strategy of resources saving.

The energy conservation in buildings has undergone a history of nearly 30 years since the launching of such work in the 1980s in our country. Through technical exchange with developed countries and by learning from the successful experience overseas, technical breakthroughs have been made in the building energy conservation and the foreign advanced technologies and products have been studied as well as introduced into our country. Besides, by starting with some pilot projects, a series of researches have been carried out ranging from a single product to the structural system, from a single project to the housing district, the laws and regulations as well as the management system of energy conservation in buildings have been gradually set up and improved, technical and economic policies on the building energy conservation have been formulated and the building energy conservation standard system has been established step by step. Moreover, a sound situation that the state attaches importance to the building energy conservation and the residents show concern for it has taken shape in favor of the comprehensive implementing of the building energy conservation work.

Meanwhile, it should be clearly understood that although the work has been launched in an all-round way as well as made some progress in the field of building energy conservation the energy consumption of which takes up nearly one third of the total energy consumption of the society, it still lags far behind the developed countries which have carried out the work of building energy conservation earlier on. In the course of promoting the building energy conservation work, several problems still show up in both the law-enforcing and administrative department and the specific units of implementation. For example, the building energy conservation standard has not been executed to a high extent; the technical and economic policies have been imperfect; the work capacity has failed to meet the actual requirement and the role of the market mechanism has not been given full play to, etc. Therefore, much still remains to be done for "the twelfth five-year period" or even longer.

With a view to further promoting the in-depth development of the building energy conservation work and led by the Scientific and Technological Department of the Ministry of Housing and Urban-Rural Development, the Scientific and Technological Development Promotion Center of the Ministry of Housing and Urban-Rural Development has organized the relevant staff to elaborate on and review in a systematic way such aspects as the development history of the building energy conservation in our country, the energy consumption condition of civil buildings, energy conservation in new buildings, energy conservation in existing buildings, energy conservation in the operation of the

energy-utilizing system of buildings, the application of renewable energy sources in buildings, the research and popularization of the building energy conservation technology, low energy-consuming construction project and demonstration as well as the development and the identification system of green buildings in an effort to be used for reference by the vast workers of energy conservation in buildings. It is also hoped that due contributions could be made through the compiling of this book to advancing the energy conservation and pollutant discharge reduction in the field of construction and attaining the grand objective that the carbon dioxide discharge per unit GDP would reduce by 40% to 45% in 2020 compared with that in 2005.

Heartfelt gratitude should also be extended to the leaders and staff of the Building Energy Conservation and Science & Technology Department of the Ministry of Housing and Urban-Rural Development who have rendered their full support by providing large quantities of materials and proposing many specific suggestions on modification, as well as the Energy Foundation for their financial aid in the composing of this book.

The writers of the respective chapters in this book are as follows: Qu Hongle (Chapter 1), Ding Hongtao, Liu Haizhu (Chapter 2), Qi Renguang, Hao Bin and Cheng Jie (Chapter 3), Bi Jihua (Chapter 4), Li Xianhui, Liu Shan and Lin Ze (Chapter 5), Guo Liangyu, Liu Younong, Yao Chunni and Li Xianhui (Chapter 6), Tian Yongying, Zhang Feng, Yang Xiwei and Qu Hongle (Chapter 7), Tian Yongying and Zhang Feng (Chapter 8), Song Ling, Li Hongjun, Ma Xinbo, Zhang Feng and Tian Yongying (Chapter 9) and Lin Yong (Chapter 10). Zhang Yang and Peng Banyun participated in Chapter 1 and section 7.3 of the text revision. The book has been reviewed, edited and assembled by Liang Junqiang and Yang Xiwei.

It would be a great honor if the publication of this book would make its due contributions to promoting the building energy conservation work in our country. In spite that all people concerned have spared no effort in the composing of this book, there would be oversight or deficiencies for sure in this book due to their limitations, for which it is sincerely hoped that the vast readers could make comments and criticize.

By the compiling group in Beijing in Feb. 2011

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