中华人民共和国气候变化
第一次两年更新报告

2016 年 12 月

序　言

《联合国气候变化框架公约》（以下简称《公约》）第 4 条及第 12 条规定，每一个缔约方都有义务提交本国的国家信息通报。中华人民共和国（以下简称“中国”）作为《公约》非附件一缔约方，高度重视自己所承担的国际义务，已分别于 2004 年和 2012 年提交了《中华人民共和国气候变化初始国家信息通报》和《中华人民共和国气候变化第二次国家信息通报》，全面阐述了中国应对气候变化的各项政策与行动，并报告了中国 1994 年和 2005 年国家温室气体清单。

根据 2010 年《公约》第十六次缔约方大会通过的第 1/CP.16 号以及 2011 年《公约》第十七次缔约方大会通过的第 2/CP.17 号决定，非附件一缔约方应根据其能力及为编写报告所获得的支持程度，从 2014 年开始提交两年更新报告，内容包括更新的国家温室气体清单、减缓行动、需求和获得的资助等，并接受对两年更新报告的国际磋商与分析。在 2015 年获得全球环境基金赠款后，中国政府组织国内有关部门和科研机构，根据《公约》第十七次缔约方大会通过的有关非附件一缔约方两年更新报告编制指南，启动了第一次两年更新报告的编写工作，经过 1 年多的努力，完成了《中华人民共和国气候变化第一次两年更新报告》。此报告在广泛征求意见的基础上，经过多次反复修改后由国务院批准提交。

经中国政府批准的《中华人民共和国气候变化第一次两年更新报告》，分为国家基本情况与应对气候变化机构安排、国家温室气体清单、减缓行动及其效果、资金、技术和能力建设需求及获得的资助、国内测量、报告和核查相关信息、其他信息、香港特别行政区应对气候变化基本信息、澳门特别行政区应对气候变化基本信息等篇章，全面反映了中国与气候变化相关的国情。本报告给出的国家温室气体清单为 2012 年数据，其他章节有关现状的描述一般截止到 2014 年或 2015 年。本报告所涉及的全国性数据和资料，除行政区划、国土面积和其他特别注明的以外，均未包括香港特别行政区、澳门特别行政区和台湾省。根据中华人民共和国《香港特别行政区基本法》和《澳门特别行政区基本法》的有关原则，本报告中香港和澳门特别行政区应对气候变化基本信息分别由香港特别行政区政府环境保护署、澳门特别行政区政府地球物理暨气象局提供。

应对气候变化是人类共同的事业。中国将从基本国情和发展阶段的特征出发，大力推进生态文明建设，推动绿色循环低碳发展，把应对气候变化融入国家经济社会发展中长期规划，坚持减缓和适应气候变化并重，通过法律、行政、技术、市场等多种手段，全力推进各项工作。中国政府也将一如既往地履行自己在《公约》下承诺的义务，坚持共同但有区别的责任原则、公平原则和各自能力原则，积极承担与中国基本国情、发展

阶段和实际能力相符的国际义务，落实国家适当减缓行动及强化应对气候变化行动的国家自主贡献，积极参与应对全球气候变化谈判，推动建立公平合理、合作共赢的全球气候治理体系，深化气候变化多双边对话交流与务实合作，充分发挥气候变化南南合作基金作用，支持其他发展中国家加强应对气候变化能力建设。

目　录

第一部分 国家基本情况与应对气候变化机构安排

中国人口众多，气候条件复杂，生态环境脆弱，是最容易受到气候变化不利影响的国家之一。作为世界上最大的发展中国家，中国政府高度重视全球气候变化问题，把应对气候变化纳入国民经济和社会发展规划，把低碳发展作为生态文明建设基本途径，并在中央和地方政府建立了应对气候变化领导小组或跨部门的协调机构，扎实推进应对气候变化各项工作。

第一章 自然条件与资源

一、自然条件

（一）气候概况

中国气候类型复杂多样，降水的时空变化显著。按照自然地理环境和气候特征可划分为三大气候区：东部地区属季风气候区，四季分明，气候受季风影响很大，一旦季风规律反常，就会出现较大范围的旱涝灾害；西北部地区属大陆型干旱气候区，冬冷夏热；青藏高原属高原气候区，大部分地区年平均气温低于 0℃。总体而言，中国气温季节变化显著，大部分地区气温的季节变化比全球同纬度地区剧烈；全国地区间温差巨大，按照温度指标，从南到北可划分为赤道带、热带、亚热带、暖温带、温带、寒温带六个温度带。从时间分布看，降水多集中在夏季，降水在季节上的不均衡分布经常造成洪涝和干旱灾害；从空间分布看，降水量的区域差异巨大，年降水量从东南沿海的 1500 多毫米向内陆逐渐减少，到西北极端干旱地区不足 50 毫米。

（二）气候灾害

中国是气候灾害严重的国家。气候灾害频率高、强度大、影响面广，造成的直接损失严重。2014 年，全国农作物受灾面积 2489 万公顷，其中绝收 309 万公顷；因洪涝和地质灾害造成直接经济损失 1030 亿元，因旱灾造成直接经济损失 836 亿元，因低温冷冻和雪灾造成直接经济损失 129 亿元，因海洋灾害造成直接经济损失 136 亿元[1]。

二、自然资源

（一）土地资源

[1] 数据来源：《2014 年国民经济和社会发展统计公报》

中国土地资源的构成和分布具有三大特征。一是土地类型复杂多样，耕地、林地、草地、荒漠、滩涂等在中国都有大面积分布，但宜农土地仅占国土面积的 17.34%。二是人均耕地占有量少，2014 年中国耕地面积 13500 万公顷，人均耕地面积为 0.099 公顷，与 2010 年基本持平。三是土地资源分布不均，东北平原、华北平原、长江中下游平原、珠江三角洲和四川盆地是耕地分布最为集中的地区，草原多分布在北部和西部，而森林主要集中分布在东北、西南和华南地区[1]。

（二）水资源

中国是一个水资源短缺且时空分布不均的国家。2014 年，中国平均年降水量为 622.3 毫米，全国水资源总量为 2.73 万亿立方米，比常年值偏少 1.6%。全国总供水量 6095 亿立方米，占当年水资源总量的 22.4%，其中地表水源供水量 4921 亿立方米，占 80.8%；地下水源供水量 1117 亿立方米，占 18.3%；其他水源供水量 57 亿立方米，占 0.9%。中国水力资源理论蕴藏年发电量为 60829 亿千瓦时，技术可开发装机容量 66042 万千瓦，年可发电量 29882 亿千瓦时。2014 年，中国水电装机达到 30486 万千瓦，是 2010 年的 1.4 倍，水电在全国电力装机总量中的比重达到 22.2%[2]。

（三）森林资源

中国森林资源总量相对不足、质量不高、地区分布不均。据第八次（2009-2013 年）全国森林资源清查结果，全国森林面积 2.08 亿公顷，森林覆盖率 21.63%，活立木总蓄积 164.33 亿立方米，人工林面积 0.69 亿公顷，人工林面积仍居世界首位[3]。

（四）草原资源

中国是一个草原资源大国，拥有各类天然草原面积近 4 亿公顷。2014 年，全国草原鲜草总产量 10.2 亿吨，较近十年平均水平提高 4.04%；全国草原综合植被盖度为 53.6%，较 2011 年增加 2.6 个百分点。2014 年底，全国保留种草面积 2200.7 万公顷，同比增长 5.5%。

第二章 社会与经济发展

一、社会发展

（一）人口

中国是世界上人口最多的国家。2014 年末，中国总人口为 13.68 亿人，比 2010 年增加 2691 万人，其中城镇常住人口 7.49 亿人，占总人口比重为 54.8%；乡村人口 6.19 亿人，占总人口比重为 45.2%。2014 年人口出生率为 12.37‰，死亡率为 7.16‰，自然

[1,2,3] 数据来源：《中国统计年鉴-2015》

增长率为 5.21‰（表 1-1）。

表 1-1 2014 年年末人口数及其构成[1]

指　标	年末数（万人）	比重（%）
全国总人口	136782	100.0
其中：城镇	74916	54.8
乡村	61866	45.2
其中：男性	70079	51.2
女性	66703	48.8
其中：0-14 岁	22558	16.5
15-64 岁	100469	73.4
65 岁及以上	13755	10.1

（二）就业

中国新增就业持续增加。2014 年末，全国就业人员 77253 万人。按三次产业分，第一、第二和第三产业就业人数分别为 22790 万人、23099 万人和 31364 万人，分别占总就业人数的 29.5%、29.9%和 40.6%。按照城乡属地关系划分，城镇就业人员为 39310 万人，乡村就业人员为 37943 万人，城乡从业人员比例为 50.9:49.1。与 2010 年相比，2014 年就业人口增加了 1148 万人，城镇就业人员超过了乡村就业人员（2010 年城乡就业人员比例为 45.6:54.4）[2]。

（三）教育卫生

中国教育卫生基本公共服务供给仍然不足。2014 年中国普通小学在校学生 9451.1 万人，普通初中在校学生 4384.6 万人，普通高中在校学生 2400.5 万人，普通高等学校在校学生 2547.7 万人。每十万人口平均拥有高等学校学生数 2488 人，高中阶段学生数 3065 人，初中阶段学生数 3222 人，小学生 6946 人。2014 年中国有医疗卫生机构 98.2 万个，卫生技术人员 759 万人，医疗卫生机构床位数 660 万张，每万人拥有的执业医师 21.2 人，每万人医疗床位 48.3 张，医疗基础设施水平不断提高[3]。

（四）贫困人口

中国农村贫困人口数量逐年下降。按照年人均收入 2300 元（2010 年不变价）的农村扶贫标准计算，2014 年农村贫困人口为 7017 万人，比 2010 年的 1.66 亿人大幅减少[4]。贫困人口主要分布在资源匮乏、自然环境较差的地区，消除贫困的难度很大。

（五）环境保护

中国生态环境恶化趋势尚未得到根本扭转。2014 年，中国废水中化学需氧量和氨

[1] 数据来源：《中国统计年鉴-2016》
[2,3,4] 数据来源：《中国统计年鉴-2015》

氮排放量分别为 2294.6 万吨和 238.5 万吨，废气中二氧化硫和氮氧化物排放量分别为1974.4万吨和2078.0万吨，与2010年相比，化学需氧量和氨氮分别增加85.3%和98.3%，二氧化硫和氮氧化物[1]分别减少 9.6%和 13.6%[2]。全国开展空气质量新标准监测的 161 个城市中，有 16 个城市空气质量年均值达标，145 个城市空气质量超标。全国 470 个城市开展了降水监测，酸雨城市比例为 29.8%。春季、夏季和秋季，全海域劣于第四类海水水质标准的海域主要分布在辽东湾、渤海湾、莱州湾、长江口、杭州湾、浙江沿岸、珠江口等近岸海域[3]。

二、经济发展

（一）经济发展水平

中国是一个经济发展水平处于中等的发展中国家。2014 年中国国民总收入 644791.1 亿元，国内生产总值 643974.0 亿元，人均国内生产总值约为 47203 元，按 2014 年汇率折算，约合人均 7684 美元[4]，按照世界银行的划分标准，中国经济发展水平相当于中等偏上收入国家。2011-2014 年，中国国内生产总值年均增速为 8.1%。当前中国经济发展进入新常态，增长速度从高速转向中高速，发展方式从规模速度型转向质量效率型，经济结构调整从增量扩能为主转向调整存量、做优增量并举，发展动力从主要依靠资源和低成本劳动力等要素投入转向创新驱动，中国经济向形态更高级、分工更优化、结构更合理阶段演化的趋势更加明显。

（二）经济结构与产业发展

中国经济结构仍处于转型期。2014 年，中国国内生产总值中三次产业的占比为 9.1：43.1：47.8，与 2010 年相比，第一、二产业所占比重分别下降了 0.4 和 3.3 个百分点，第三产业比重增加了 3.7 个百分点。随着现代服务业等第三产业快速发展，第三产业占比已经超过了第二产业，中国第二产业占比高的情况正在发生变化。2014 年，中国农林牧渔业总产值达到 102226.1 亿元，农作物总播种面积 16544.6 万公顷，粮食总产量达到 60703 万吨，比 2010 年增加 6055 万吨[5]。

（三）收入与消费水平

中国城乡居民收入增长与经济增速基本同步。2014 年，全国居民人均可支配收入 20167.1 元，其中城镇居民人均可支配收入 28843.9 元，农村居民人均可支配收入 10488.9 元。全国居民人均消费支出 14491.4 元，其中，城镇居民人均消费支出 19968.1 元，农

[1] 因缺乏 2010 年排放量统计数据，氮氧化物为 2014 年与 2011 年比较的结果。
[2] 数据来源：《中国统计年鉴-2015》《中国统计年鉴-2011》《中国统计年鉴-2012》。
[3] 数据来源：《2014 中国环境状况公报》
[4] 数据来源：《中国统计年鉴-2016》
[5] 数据来源：《中国统计年鉴-2016》

村居民人均消费支出 8382.6 元。居民收入与消费水平与 2010 年相比显著增长（表 1-2）。

表 1-2 中国居民收入与支出变化情况（元）[1]

指　标	2010	2014
城镇居民人均可支配收入	19109	28843.9
农村居民人均可支配收入	5919	10488.9
城镇居民人均消费支出	13472	19968.1
农村居民人均消费支出	4382	8382.6

（四）对外经济贸易

中国是一个进出口贸易大国。2014 年，中国货物进出口总额、实际使用外资额、对外承包工程合同金额和对外承包工程完成营业额分别达到 43015 亿美元、1197 亿美元、1918 亿美元和 1424 亿美元，与 2010 年相比，分别提高了 44.6%、10.0%、42.7%和 54.4%，对外经济贸易规模不断扩大[2]。

第三章 国家发展战略与目标

为实现中华民族伟大复兴的梦想，中国提出了“两个百年”的奋斗目标：到 2020 年全面建成小康社会，到 2050 年建成社会主义现代化国家。为实现上述目标，中共中央、国务院先后发布了《加快推进生态文明建设的意见》、《生态文明体制改革总体方案》等重要文件，明确把加快推进生态文明建设作为积极应对气候变化、维护全球生态安全的重大举措，把绿色发展、循环发展、低碳发展作为生态文明建设的基本途径，加快建立系统完整的生态文明制度体系，增强生态文明体制改革的系统性、整体性、协同性。《中华人民共和国国民经济和社会发展第十三个五年规划纲要》提出把“创新、协调、绿色、开放、共享”作为中国发展的核心理念，绿色发展在国家发展战略中的地位进一步提升。

在经济社会发展方面，中国政府提出了到 2020 年的主要目标：

——进一步提升经济发展的质量。在提高发展平衡性、包容性、可持续性基础上，到 2020 年国内生产总值和城乡居民人均收入比 2010 年翻一番，“十三五”时期国内生产总值年均增长 6.5%，居民人均可支配收入年均增速高于 6.5%，主要经济指标平衡协调，发展质量和效益明显提高，服务业增加值占国内生产总值比重达到 56%。

——进一步增强发展协调性。继续加大消费对经济增长贡献，使投资效率和企业效率明显上升。改善城镇化质量，提高户籍人口城镇化率，常住人口城镇化率达到 60%。

[1] 数据来源：《中国统计年鉴-2016》
[2] 数据来源：《中国统计年鉴-2015》

形成区域协调发展新格局，优化发展空间布局。提高对外开放的深度和广度，增强全球配置资源能力，优化进出口结构，国际收支基本平衡。

——普遍提高人民生活水平和质量。健全就业、教育、文化体育、社保、医疗、住房等公共服务体系，稳步提高基本公共服务均等化水平，增加劳动年龄人口受教育年限，增加就业，缩小收入差距，增加中等收入人口比重，对贫困人口实施精准扶贫，到 2020 年解决区域性整体贫困问题。

——改善生态环境质量。提升生产方式和生活方式绿色、低碳水平，大幅提高能源资源开发利用效率，有效控制能源和水资源消耗、建设用地、碳排放总量，大幅减少主要污染物排放总量，主体功能区布局和生态安全屏障基本形成。

在应对气候变化方面，中国政府提出了到 2020 年的主要目标与任务：

减缓方面。2020 年单位国内生产总值二氧化碳排放在 2015 年基础上降低 18％，推进工业、能源、建筑、交通等重点领域低碳发展，有效控制电力、钢铁、建材、化工等重点行业碳排放。推进能源生产和消费革命，非化石能源占一次能源消费比重达到 15%，能源消费总量控制在 50 亿吨标准煤以内。支持优化开发区域和低碳试点城市率先实现碳排放达峰，为 2030 年全国碳排放达峰并尽可能提前达峰奠定坚实基础。深化各类低碳试点，实施近零碳排放区示范工程。控制非二氧化碳温室气体排放。推动建设全国统一的碳排放权交易市场，实行重点单位碳排放报告、核查、核证和配额管理制度。健全统计核算、评价考核和责任追究制度，完善碳排放标准体系。加大低碳技术和产品推广应用力度。

适应方面。增强重点领域和生态脆弱地区适应气候变化能力。初步建立农业适应技术标准体系，农田灌溉水有效利用系数提高到 0.55 以上；沙化土地治理面积占可治理沙化土地治理面积的 50%以上；森林生态系统稳定性增强，林业有害生物成灾率控制在 4‰以下；增强城市适应气候变化能力和水平；提高城乡供水保证率；改善沿海脆弱地区和低洼地带适应能力，增强重点城市城区及其他重点地区防洪除涝抗旱能力；科学防范和应对极端天气与气候灾害，逐步完善预测预警和防灾减灾体系。

2015 年气候变化巴黎大会前夕，中国政府进一步提出了 2020 年以后应对气候变化国家自主贡献的行动目标：二氧化碳排放 2030 年左右达到峰值并争取尽早达峰，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，森林蓄积量比 2005 年增加 45 亿立方米左右。

第四章 国家应对气候变化组织机构

为切实加强对应对气候变化和节能减排工作的领导，2007 年 6 月，中国政府决定

成立国家应对气候变化及节能减排工作领导小组（以下简称领导小组），对外视工作需要可称国家应对气候变化领导小组或国务院节能减排工作领导小组（一个机构，两个牌子），作为国家应对气候变化和节能减排工作的议事协调机构。2013 年根据国务院机构设置及人员变动情况和工作需要，领导小组组长由国务院总理李克强担任，成员单位由成立之初的 20 个调整至 26 个，除中国民用航空局与交通运输部合并外，新增了教育部、民政部、国务院国有资产监督管理委员会、国家税务总局、国家质量监督检验检疫总局、国家机关事务管理局、国务院法制办公室等 7 个成员单位，办公室设在国家发展和改革委员会（以下简称国家发展改革委），承担领导小组的具体工作。2015 年领导小组研究提交了国家自主贡献文件。为加强应对气候变化的战略研究和国际合作，2012 年在国家发展改革委下成立了国家应对气候变化战略研究和国际合作中心（以下简称国家气候战略中心），其主要职责为组织开展中国应对气候变化政策、法规、规划等方面的研究工作。

各省（区、市）人民政府按照中央政府的要求，相继成立了由政府主要领导任组长、有关部门参加的地方应对气候变化领导小组，负责领导和协调各地应对气候变化工作，并在省级发展改革部门设立了应对气候变化工作机构（图 1-1）。

根据中国政府应对气候变化工作的部门职责分工，国家发展改革委负责组织编写《中华人民共和国气候变化第三次国家信息通报》和《中华人民共和国气候变化第一次两年更新报告》，包括组织有关单位编制 2010 和 2012 年国家温室气体清单（详见第二部分）。

国家应对气候化及节能减排工作领导小组

成员单位：

外交部	国家发展改革委
教育部	科技部
工业和信息化部	民政部
财政部	国土资源部
环境保护部	住房城乡建设部
交通运输部	水利部
农业部	商务部
卫生计生委	国资委
税务总局	质检总局
统计局	林业局
国管局	法制办
中科院	气象局
能源局	海洋局

领导小组办公室设在国家发展改革委

省级应对气候变化领导小组

成员单位：

省级发展改革委、

省级财政厅等部门

领导小组办公室

设在省级发展改革委

图 1-1 中国应对气候变化综合协调机构示意图

第二部分 国家温室气体清单

根据《公约》相关决定的要求和中国的实际情况，2012 年国家温室气体清单编制和报告范围包括能源活动、工业生产过程、农业活动、土地利用变化和林业、废弃物处理五个领域的二氧化碳(CO_2)、甲烷(CH_4)、氧化亚氮(N_2O)、氢氟碳化物(HFCs)、全氟化碳(PFCs)和六氟化硫(SF_6)六类气体。国家温室气体清单编制方法主要采用了《IPCC 国家温室气体清单编制指南（1996 年修订版）》（简称《1996 年 IPCC 清单指南》）和《IPCC 国家温室气体清单优良作法指南和不确定性管理》（简称《IPCC 优良作法指南》），活动水平数据主要来自官方统计，排放因子优先采用 2012 年本国特征化参数。与第二次国家信息通报报告的 2005 年国家温室气体清单相比，2012 年国家温室气体清单的完整性和可比性有所提高。

第一章 清单编制机构安排

为更好地开展国家温室气体清单编制工作，中国初步建立了温室气体清单编制国家体系。国家发展改革委负责编制国家温室气体清单，包括选择国内专业研究机构和高等院校等清单编制单位，会同国家统计局组织有关部门为温室气体清单编制提供基础统计数据，协调行业协会和典型企业提供相关资料，并建立国家温室气体清单数据库以支持清单编制和数据管理。

在第一次和第二次气候变化信息通报编制工作基础上，国家发展改革委通过招投标方式，选择确定了国家气候战略中心、清华大学、中国农业科学院农业环境与可持续发展研究所、中国科学院大气物理研究所、中国林业科学研究院森林生态环境与保护研究所、中国环境科学研究院等单位分别承担 2012 年中国能源活动、工业生产过程、农业活动、土地利用变化和林业、废弃物处理温室气体清单编制（表 2-1）。国家发展改革委能源研究所、复旦大学、中国特种设备检测研究院、环境保护部环境保护对外合作中心、国家林业局调查规划设计院、中国林业科学研究院林业新技术研究所等单位参与相关领域清单研究工作。在各领域清单编制成果基础上，国家发展改革委组织国家应对气候变化领导小组成员单位及相关专家开展广泛讨论，最终形成 2012 年国家温室气体清单。

表 2-1 中国 2012 年国家温室气体清单编制机构安排

单 位	职 责
国家发展改革委	总负责
国家气候战略中心	能源活动温室气体清单 国家温室气体清单数据库
清华大学	工业生产过程温室气体清单
中国农科院农业环境与可持续发展研究所	农业活动温室气体清单（畜牧业）
中国科学院大气物理研究所	农业活动温室气体清单（农田）
中国林科院森林生态环境与保护研究所	土地利用变化和林业温室气体清单
中国环境科学研究院	废弃物处理温室气体清单

第二章 排放源范围和计算方法

一、关键类别分析

关键类别是指由于绝对排放量较大或不确定性较高，从而对清单结果准确性有较大影响的排放源或吸收汇。为提高清单编制质量，关键类别一般需采用层级较高的计算方法。根据《IPCC 优良作法指南》和《IPCC 土地利用、土地利用变化与林业优良作法指南》关键类别确定方法，清单编制机构采用定量和定性方法分析了 2005 年国家温室气体清单的关键类别。分析结果表明，2005 年国家温室气体清单共有 51 个关键类别，包括公用电力和热力二氧化碳排放，道路交通二氧化碳排放，己二酸生产氧化亚氮排放，HCFC-22 生产过程 HFC-23 排放，稻田甲烷排放，乔木林生物质生长碳吸收，固体废弃物处理甲烷排放等。这些关键类别在 2012 年国家温室气体清单中都尽量采用了层级较高的计算方法以及国别排放因子。2012 年中国各领域温室气体清单计算方法见表 2-2。

二、能源活动

2012 年中国能源活动温室气体清单编制和报告范围包括燃料燃烧和逃逸排放。燃料燃烧覆盖能源工业、制造业和建筑业、交通运输、其他行业及其他类别下的二氧化碳、甲烷和氧化亚氮排放。燃料逃逸覆盖固体燃料和油气系统的甲烷排放。与 2005 年中国温室气体清单相比，新增报告内容有：能源工业甲烷排放，制造业和建筑业及其他行业甲烷和氧化亚氮排放。

燃料燃烧二氧化碳排放采用 IPCC 部门法计算，并利用参考方法进行校核。道路交通运输甲烷和氧化亚氮排放采用层级 3 方法，即 COPERT 模型方法；新增报告的能源工业甲烷排放、制造业和建筑业及其他行业甲烷和氧化亚氮排放采用层级 1 方法。煤炭开采和矿后活动甲烷逃逸排放采用层级 1 和层级 2 相结合的方法，油气系统甲烷逃逸排放采用层级 1 和层级 3 相结合的方法（表 2-2）。

表 2-2 2012 年中国温室气体清单计算方法

排放源/吸收汇类别	CO_2		CH_4		N_2O	
	方法论	排放因子	方法论	排放因子	方法论	排放因子
能源工业(1A1)	T2	CS	T1	D	T1	D
制造业和建筑业(1A2)	T2	CS	T1	D	T1	D
交通运输(1A3)	T2	CS	T1,T3	D,CS	T1,T3	D,CS
其他行业(1A4)	T2	CS	T1	D	T1	D
其他(1A5)	T2	CS	T1,T2	D,CS	T1	D
固体燃料逃逸排放(1B1)			T1,T2	D,CS		
石油和天然气逃逸排放(1B2)			T1,T3	D,CS		
非金属矿物制品生产(2A)	T1,T2	D,CS				
化工生产(2B)	T1,T2	D,CS			T3	CS
金属制品生产(2C)	T1,T2	D,CS	T1	D		
动物肠道发酵(4A)			T1,T2	D,CS		
动物粪便管理(4B)			T1,T2	D,CS	T1,T2	D,CS
水稻种植(4C)			T3	CS		
农用地(4D)					T1,T2	D,CS
农业废弃物田间焚烧(4F)			T1	D	T1	D
森林和其他木质生物质储量的变化(5A)	T2	CS				
森林转化(5B)	T2	CS	T1	D	T1	D
固体废弃物处理(6A)			T1,T2	D,CS	T1	D
污水处理(6B)			T1,T2	D,CS	T1,T2	D,CS
废弃物焚烧处理(6C)	T2	CS	T1	D	T1	D

注：方法论代码中 T1、T2、T3 分别代表层级 1、层级 2、层级 3 方法；排放因子代码中 CS 代表本国特定排放因子，D 代表 IPCC 缺省排放因子。并列出现表示该类别下的不同子类别采用了不同的层级方法或排放因子数据来源。“其他(1A5)”包括生物质燃料燃烧甲烷和氧化亚氮排放以及非能源利用的二氧化碳排放等。

三、工业生产过程

2012 年中国工业生产过程温室气体清单编制和报告范围包括非金属矿物制品生产、化工生产、金属制品生产、卤烃和六氟化硫生产、以及卤烃和六氟化硫消费温室气体排放。与 2005 年国家温室气体清单相比，非金属矿物制品生产增加了玻璃生产过程二氧化碳排放，化工生产增加了纯碱生产过程二氧化碳排放，金属制品生产增加了铁合金生产过程二氧化碳和甲烷排放、镁冶炼过程二氧化碳排放及铅锌冶炼过程二氧化碳排放，其中，纯碱生产过程采用层级 2 方法，其他新增排放源采用层级 1 方法。原有排放源计算方法与 2005 年国家温室气体清单相同，如表 2-2 所示。

四、农业活动

2012 年中国农业温室气体清单编制和报告范围包括动物肠道发酵甲烷排放、粪便管理甲烷和氧化亚氮排放、稻田甲烷排放、农用地氧化亚氮排放以及农业废弃物田间焚烧甲烷和氧化亚氮排放。与 2005 年国家温室气体清单相比，动物肠道发酵和粪便管理把非奶牛细分为肉牛、牦牛和其他牛，农用地增加了农业废弃物田间焚烧氧化亚氮排放，其中，肉牛的肠道发酵和粪便管理甲烷排放采用层级 2、牦牛和其他牛排放采用层级 1 方法，农业废弃物田间焚烧氧化亚氮排放采用层级 1 方法，其他排放源计算方法同 2005 年国家温室气体清单，如表 2-2 所示。

五、土地利用变化和林业

2012 年中国土地利用变化和林业温室气体清单编制和报告范围包括森林和其他木质生物质碳储量变化以及森林转化排放。该领域二氧化碳排放源和吸收汇采用层级 2 方法计算，甲烷和氧化亚氮排放采用层级 1 方法，与 2005 年国家温室气体清单一致，如表 2-2 所示。

六、废弃物处理

2012 年中国废弃物处理温室气体清单编制和报告范围包括城市固体废弃物处理、污水处理以及废弃物焚烧处理温室气体排放。与 2005 年国家温室气体清单相比，增加了城市生活垃圾生物处理的甲烷和氧化亚氮排放以及废弃物焚烧处理的甲烷和氧化亚氮排放。新增排放源采用层级 1 方法计算，其他排放源计算方法同 2005 年国家温室气体清单，如表 2-2 所示。

第三章 数据来源

一、能源活动

2012 年中国化石燃料燃烧活动水平数据主要来自国家统计局提供的能源统计数据以及其他相关统计资料。考虑到 2015 年国家统计局修订并发布了中国 2000 年以来的能源统计数据，化石燃料燃烧温室气体清单采用最新修订的统计数据编制，其中 2012 年煤炭、石油、天然气消费量分别为 27.5 亿、6.8 亿、1.9 亿吨标准煤。

生物质燃烧活动水平数据来源有《中国农业统计年鉴 2013》等。煤炭开采和矿后活动逃逸排放的活动水平数据主要来自《中国能源统计年鉴 2014》和《中国煤炭工业年鉴 2013》。油气系统逃逸排放的活动水平数据主要来自企业提供的统计数据。固体燃料燃

烧二氧化碳排放因子、道路交通甲烷和氧化亚氮排放因子等根据 2012 年情况进行了更新，其他排放源的排放因子同 2005 年国家温室气体清单。

二、工业生产过程

2012 年中国水泥熟料、粗钢和原铝产量来源于国家统计局统计资料，合成氨产量主要来源于《中国化学工业统计年鉴 2013》，石灰产量来源于中国石灰协会估算数据，硝酸产量来源于全国化工硝酸硝酸盐技术协作网调查数据，己二酸、硅铁合金和 HCFC-22 产量来源于企业调研，工业生产过程主要活动水平数据见表 2-3。水泥熟料、合成氨、己二酸和 HCFC-22 生产过程的排放因子均采用典型企业调研方法获取的 2012 年国别数据，其他排放源的排放因子采用 2005 年国家温室气体清单数据。

表 2-3 2012 年工业生产过程主要活动水平数据（万吨）

产品	产量	产品	产量
水泥熟料	130392	硅铁合金	583
粗钢	73104	电解铝	2025
合成氨	5528	HCFC-22	57.8

三、农业活动

2012 年中国农业活动的活动水平数据主要来源于《中国农业统计年鉴 2013》、《中国统计年鉴 2013》和《中国畜牧业年鉴 2013》，主要活动水平数据见表 2-4。农田氧化亚氮直接排放因子采用观测数据。奶牛、肉牛、水牛、绵羊和山羊肠道发酵，猪、肉牛、奶牛等主要动物的粪便管理甲烷排放因子，以及稻田甲烷排放因子采用 2012 年国别数据。其他排放源的排放因子采用 2005 年国家温室气体清单数据。

表 2-4 2012 年农业活动主要活动水平数据

	活动水平		活动水平
奶牛存栏量（万头）	1494	生猪存栏量（万头）	47592
肉牛存栏量（万头）	6339	农作物总播种面积（万公顷）	16342
水牛存栏量（万头）	1057	粮食作物播种面积（万公顷）	11120
山羊存栏量（万只）	14136	氮肥消费量（万吨）	2400
绵羊存栏量（万只）	14368	复合肥折纯消费量（万吨）	1990

四、土地利用变化和林业

2012 年中国土地利用变化和林业清单编制采用了全国第 6~9 次森林资源连续清查资料数据，并根据各省（区、市）实际清查年份采用内插或外推法获得 2012 年各省（区、市）活动水平数据，全国数据由各省数据加总获得。生物量扩展因子、生物量含碳量等参数采用 2005 年国家温室气体清单数据。

五、废弃物处理

2012 年中国废弃物处理活动水平数据来源于《2012 年中国城市建设统计年鉴》和《2012 年中国环境统计年鉴》等，废弃物处理活动水平相关数据见表 2-5。固体废弃物处理排放因子采用 2012 年国别数据，其他排放因子采用 2005 年国家温室气体清单数据。

表 2-5 2012 年废弃物处理活动水平相关数据（万吨）

	活动水平相关数据
城市生活垃圾填埋处理量	10512
废弃物焚烧量	4176
城市生活垃圾生物处理量	393
废水排放 COD 总量	2424

第四章 2012 年国家温室气体清单

一、综述

2012 年中国温室气体排放总量（不包括土地利用变化和林业）为 118.96 亿吨二氧化碳当量（表 2-6），其中二氧化碳、甲烷、氧化亚氮、氢氟碳化物、全氟化碳和六氟化硫所占的比重分别为 83.2%、9.9%、5.4%、1.3%、0.1%和 0.2%；土地利用变化和林业的温室气体吸收汇为 5.76 亿吨二氧化碳当量，考虑温室气体吸收汇后，温室气体净排放总量为 113.20 亿吨二氧化碳当量。2012 年中国温室气体总量及构成见表 2-6 和表 2-7。

表 2-6 2012 年中国温室气体总量（亿吨二氧化碳当量）

	二氧化碳	甲烷	氧化亚氮	氢氟碳化物	全氟化碳	六氟化硫	合计
能源活动	86.88	5.79	0.69				93.37
工业生产过程	11.93	0.00	0.79	1.54	0.12	0.24	14.63
农业活动		4.81	4.57				9.38
废弃物处理	0.12	1.14	0.33				1.58
土地利用变化和林业	-5.76	0.00	0.00				-5.76
总量（不包括土地利用变化和林业）	98.93	11.74	6.38	1.54	0.12	0.24	118.96
总量（包括土地利用变化和林业）	93.17	11.74	6.38	1.54	0.12	0.24	113.20

注：1）阴影部分不需填写；0.00表示计算结果小于0.005；由于四舍五入的原因，表中各分项之和与总计可能有微小的出入。

2）全球增温潜势值采用《IPCC第二次评估报告》中100年时间尺度下的数值（表2-8）

表 2-7 2012 年中国温室气体排放构成

温室气体	不包括土地利用变化和林业		包括土地利用变化和林业	
	二氧化碳当量(亿吨)	比重(%)	二氧化碳当量(亿吨)	比重(%)
二氧化碳	98.93	83.2	93.17	82.3
甲烷	11.74	9.9	11.74	10.4
氧化亚氮	6.38	5.4	6.38	5.6
含氟气体	1.91	1.6	1.91	1.7
合计	118.96		113.20	

注：由于四舍五入的原因，表中各项比重之和可能不足或高于 100%。

表 2-8 清单所涉及温室气体的全球增温潜势

温室气体种类	全球增温潜势	温室气体种类	全球增温潜势
CO_2	1	HFC-152a	140
CH_4	21	HFC-227ea	2900
N_2O	310	HFC-236fa	6300
HFC-23(CHF_3)	11700	HFC-245fa	1030
HFC-32	650	PFC-14(CF_4)	6500
HFC-125	2800	PFC-116(C_2F_6)	9200
HFC-134a	1300	SF_6	23900
HFC-143a	3800		

注：HFC-245fa 全球增温潜势值采用《IPCC 第四次评估报告》中 100 年时间尺度下的数值。

能源活动是中国温室气体的主要排放源。2012 年中国能源活动排放量占温室气体总排放量（不包括土地利用变化和林业）的 78.5%，工业生产过程、农业活动和废弃物处理的温室气体排放量所占比重分别为 12.3%、7.9%和 1.3%，如图 2-1。

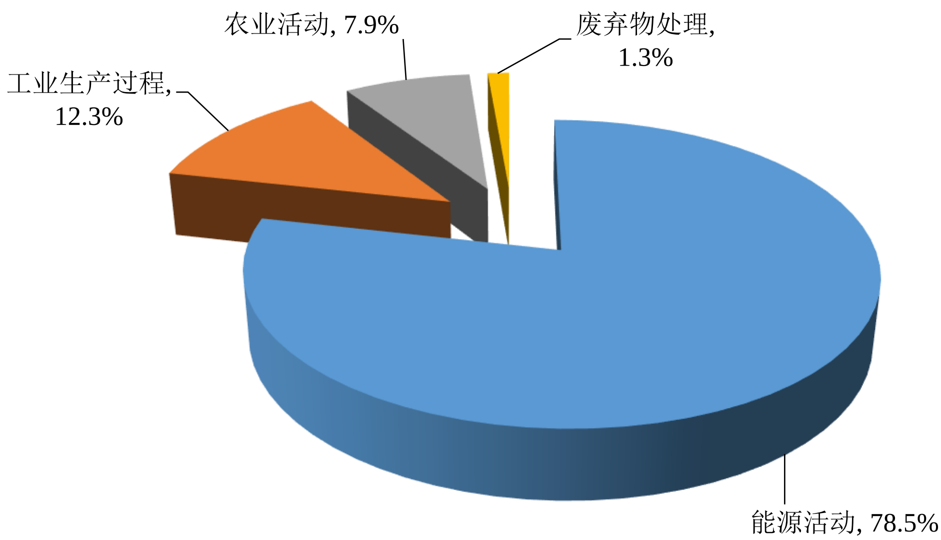

图 2-1 2012 年中国温室气体排放部门构成

（一）二氧化碳

2012 年中国二氧化碳排放量（不包括土地利用变化和林业）为 98.93 亿吨，其中：能源活动排放 86.88 亿吨，占 87.8%；工业生产过程排放 11.93 亿吨，占 12.1%；废弃物处理排放 0.12 亿吨，占 0.1%，见表 2-6。土地利用变化和林业表现为碳吸收汇，共吸收二氧化碳 5.76 亿吨。此外，2012 年国际航空排放 0.17 亿吨二氧化碳，国际航海排放 0.27 亿吨二氧化碳，生物质燃烧排放 8.13 亿吨二氧化碳，作为信息项报告不计入清单排放总量，如表 2-9。

（二）甲烷

2012 年中国甲烷排放量为 5591.5 万吨，其中：能源活动排放 2758.6 万吨，占 49.3%；工业生产过程排放 0.6 万吨；农业活动排放 2288.6 万吨，占 40.9%；土地利用变化和林业排放 1.4 万吨；废弃物处理排放 542.3 万吨，占 9.7%。

（三）氧化亚氮

2012 年中国氧化亚氮排放量为 205.9 万吨，其中：能源活动排放 22.4 万吨，占 10.9%；工业生产过程排放 25.5 万吨，占 12.4%；农业活动排放为 147.5 万吨，占 71.6%；土地利用变化和林业排放 0.01 万吨；废弃物处理排放 10.5 万吨，占 5.1%。

（四）含氟气体

2012 年中国含氟气体排放量为 1.91 亿吨二氧化碳当量，全部来自工业生产过程。其中：金属制品生产排放 0.11 亿吨二氧化碳当量，占 5.7%；卤烃和六氟化硫生产排放 1.18 亿吨二氧化碳当量，占 61.8%；卤烃和六氟化硫消费排放 0.62 亿吨二氧化碳当量，占 32.5%，详见表 2-10。

二、能源活动

2012 年中国能源活动温室气体排放 93.37 亿吨二氧化碳当量，其中：燃料燃烧排放 88.13 亿吨二氧化碳当量，占 94.4%；燃料逃逸排放 5.24 亿吨二氧化碳当量，占 5.6%。

从气体种类构成看，二氧化碳排放量为 86.88 亿吨，全部来自燃料燃烧；甲烷排放 2758.6 万吨，其中燃料燃烧排放占 9.5%，逃逸排放占 90.5%；氧化亚氮排放为 22.4 万吨，全部来自燃料燃烧。

表 2-9 2012 年中国二氧化碳、甲烷和氧化亚氮清单（千吨，Gg）

温室气体排放源与吸收汇的种类	CO_2	CH_4	N_2O
总量（包括土地利用变化和林业）	9317408	55915	2059
1. 能源活动	8688288	27586	224
燃料燃烧	8688288	2620	224
能源工业	4078222	48	89
制造业和建筑业	3205343	204	52
交通运输	788625	78	22
其他行业	542600	758	7
其他	73498	1531	55
逃逸排放		24966	
固体燃料		23847	
油气系统		1119	
2. 工业生产过程	1193164	6	255
非金属矿物制品	834034		
化学工业	131076	NE	255
金属制品生产	228055	6	NE
卤烃和六氟化硫生产			
卤烃和六氟化硫消费			
3. 农业活动		22886	1475
动物肠道发酵		10743	
动物粪便管理		3331	249
水稻种植		8458	
农用地		NE	1218
农业废弃物田间焚烧		354	8
4.土地利用变化和林业	-575848	14	0
森林和其他木质生物质储量的变化	-597529		
森林转化	21681	14	0
5. 废弃物处理	11804	5423	105
固体废物处理		2531	1
污水处理		2892	97
废弃物焚烧处理	11804	0	7
信息项			
国际航空	16796	0	0
国际航海	27094	3	1
生物质燃烧	813325		

注：阴影部分不需填写；0表示数值低于0.5；NE (未计算)表示对现有源排放量和汇清除没有计算；由于四舍五入的原因，表中各分项之和与总计可能有微小的出入；信息项不计入排放总量。

表 2-10 2012 年中国含氟气体排放量（千吨，Gg）

温室气体排放源与吸收汇种类	HFC-23	HFC-32	HFC-125	HFC-134a	HFC-143a	HFC-152a	HFC-227ea	HFC-236fa	HFC-245fa	CF_4	C_2F_6	SF_6
总排放量	9.9	0.2	0.3	28.8	0.1	0.2	0.0	0.0	0.1	1.6	0.2	1.0
1. 能源活动												
2. 工业生产过程	9.9	0.2	0.3	28.8	0.1	0.2	0.0	0.0	0.1	1.6	0.2	1.0
非金属矿物制品												
化学工业												
金属制品生产	NE	NE	NE	NE	NE	NE	NE	NE	NE	1.4	0.2	NE
卤烃和六氟化硫生产	9.9	0.2	0.3	0.7	0.1	0.2	0.0	0.0	0.0	0.0	0.0	NE
卤烃和六氟化硫消费	NE	NE	NE	28.0	NE	NE	NE	NE	0.1	0.1	0.0	1.0
3. 农业活动												
4. 土地利用变化和林业												
5. 废弃物处理												

注：阴影部分不需填写；0.0表示数值低于0.05；NE (未计算)表示对现有源排放量和汇清除没有计算。

三、工业生产过程

2012 年中国工业生产过程温室气体排放总量为 14.63 亿吨二氧化碳当量，其中：非金属矿物制品排放 8.34 亿吨，占 57.0%；化学工业排放 2.10 亿吨，占 14.4%；金属制品生产排放 2.39 亿吨，占 16.3%；卤烃和六氟化硫生产排放 1.18 亿吨，占 8.1%；卤烃和六氟化硫消费排放 0.62 亿吨，占 4.2%。

从气体种类构成看，二氧化碳排放量为 11.93 亿吨，其中非金属矿物制品排放占 69.9%，化学工业排放占 11.0%，金属制品生产排放占 19.1%；甲烷排放 0.6 万吨，全部来自金属制品生产；氧化亚氮排放为 25.5 万吨，全部来自化学工业；氢氟碳化物排放量为 1.54 亿吨二氧化碳当量，其中生产排放占 76.3%，消费排放占 23.7%；全氟化碳排放量为 0.12 亿吨二氧化碳当量，其中金属制品生产排放占 91.1%，卤烃和六氟化硫生产、消费排放分别占 0.3%、8.6%；六氟化硫排放量为 0.24 亿吨二氧化碳当量，全部来自卤烃和六氟化硫消费排放。

四、农业活动

2012 年中国农业活动温室气体排放总量为 9.38 亿吨二氧化碳当量，其中：动物肠道发酵排放 2.26 亿吨，占 24.1%；动物粪便管理排放 1.47 亿吨，占 15.7%；水稻种植排放 1.78 亿吨，占 18.9%；农用地排放 3.78 亿吨，占 40.3%；农业废弃物田间焚烧排放 0.10 亿吨，占 1.1%。

从气体种类构成看，甲烷排放 2288.6 万吨，其中动物肠道发酵排放占 46.9%，动物粪便管理排放占 14.6%，水稻种植排放占 37.0%，农业废弃物田间焚烧排放占 1.5%；氧化亚氮排放为 147.5 万吨，其中动物粪便管理排放占 16.9%，农用地排放占 82.6%，农业废弃物田间焚烧排放占 0.6%。

五、土地利用变化和林业

2012 年中国土地利用变化和林业吸收 5.76 亿吨二氧化碳当量，其中，森林和其他生物质碳储量变化吸收 5.98 亿吨二氧化碳当量，森林转化排放 0.22 亿吨二氧化碳当量。

从气体种类构成看，二氧化碳吸收 5.76 亿吨，其中森林和其他生物质碳储量变化吸收 5.98 亿吨，森林转化排放 0.22 亿吨；甲烷排放 1.4 万吨，全部来自森林转化；氧化亚氮排放为 120 吨，全部来自森林转化。

六、废弃物处理

2012 年中国废弃物处理温室气体排放总量为 1.58 亿吨二氧化碳当量，其中：固体废弃物处理排放 0.54 亿吨，占 33.8%；废水处理排放 0.91 亿吨，占 57.3%；废弃物焚烧处理排放 0.14 亿吨，占 8.9%。

从气体种类构成看，二氧化碳排放 0.12 亿吨，全部来自废弃物焚烧处理排放；甲烷排放 542.3 万吨，其中固体废弃物处理排放占 46.7%，废水处理排放占 53.3%；氧化亚氮排放 10.5 万吨，其中固体废弃物处理排放占 1.1%，废水处理排放占 91.8%，废弃物焚烧处理排放占 7.0%。

第五章 质量保证和质量控制

一、质量保证和质量控制工作

在 2012 年国家温室气体清单编制过程中，为降低清单不确定性，提高清单编制质量，清单编制机构注重加强质量保证和质量控制工作。

在清单编制方法方面，清单编制机构开展了关键类别分析，分析结果用于指导 2012 年清单编制方法的选择。关键类别在 2012 年国家温室气体清单中都尽量采用了层级较高的计算方法以及国别排放因子，从而提高了清单估算结果的准确性。

在活动水平数据方面，国家统计局建立了应对气候变化部门统计报表制度，细化和增加了能源统计品种，逐步把温室气体清单编制所需的活动水平数据纳入政府统计体系。在估算煤炭燃烧二氧化碳排放方面，进一步增加了对主要耗煤行业分煤种分用途煤炭低位发热量的调查研究。此外，清单编制机构及时采用了国家最新修订的统计数据，以保证清单计算结果准确反映中国的实际排放水平。

在排放因子方面，国家统计局初步建立了相关参数统计调查制度，清单编制机构及其他相关单位专门开展了煤化工行业固碳率研究、主要畜禽氮排泄量、农用地氧化亚氮直接排放因子田间实验测定，获得了国别排放因子及相关参数。在 2012 年中国温室气体清单编制过程中，优先采用 2012 年国别排放因子，其次采用 2005 年国别数据，国别数据无法获得时采用 IPCC 相关指南的缺省值。

在数据管理方面，清单编制机构重视数据文档管理，及时保存清单编制相关支撑材料。国家清单编制团队就数据管理及质量控制与加拿大、美国、荷兰、日本、韩国等国家及联合国粮农组织等国际机构开展了交流。同时，为保证清单相关数据的电子化管理水平，中国还建立了国家和各领域温室气体清单数据库系统。

此外，清单编制机构组织召开了多次技术研讨会，与国内其他研究机构和专家进行学术交流和讨论，充分吸纳相关研究成果，同时还邀请没有参与清单编制工作的专家对清单编制方法和结果进行独立分析和审评，为清单质量保证提供支持。

二、不确定性分析

根据《IPCC 优良作法指南》的误差传递法分析，2012 年国家温室气体清单总不确定性为 5.4%，其中能源活动、工业生产过程、农业活动、土地利用变化和林业、废弃物处理领域的不确定性分别为 5.5%、4.4%、21.3%、43.2%和 24.0%，如表 2-11 所示。

表 2-11 2012 年国家温室气体清单不确定性分析结果

	排放量（亿吨二氧化碳当量）	不确定性（%）
能源活动	93.37	5.5
工业生产过程	14.63	4.4
农业活动	9.38	21.3
土地利用变化和林业	-5.76	43.2
废弃物处理	1.58	24.0
总不确定性		***5.4***

第六章 已提交清单信息

中国在第一次和第二次国家信息通报中已提交了 1994 年和 2005 年国家温室气体清单，以下为两次历史年份清单的信息概要。需要说明的是，这两份清单的报告范围与 2012 年清单有所不同，且国家统计局对 2005 年能源消费量等相关活动水平数据进行了修订。为确保不同年度清单在排放源范围、数据来源等方面具有更好的可比性，中国正在准备的第三次国家信息通报将对 2005 年国家温室气体清单进行重新计算和更新。

一、1994 年国家温室气体清单

1994 年中国温室气体排放总量（不包括土地利用变化和林业）约为 40.57 亿吨二氧化碳当量（表 2-12），其中二氧化碳、甲烷和氧化亚氮所占的比重分别为 75.8%、17.7%和 6.5%（表 2-13）；土地利用变化和林业领域的温室气体吸收汇约为 4.07 亿吨二氧化碳当量。考虑温室气体吸收汇后，1994 年中国温室气体净排放总量约为 36.50 亿吨二氧化碳当量，其中二氧化碳、甲烷和氧化亚氮的所占的比重分别为 73.1%、19.7%和 7.2%。

表 2-12 1994 年中国温室气体总量（亿吨二氧化碳当量）

	二氧化碳	甲烷	氧化亚氮	氢氟碳化物	全氟化碳	六氟化硫	合计
能源活动	27.95	1.97	0.15				30.08
工业生产过程	2.78	NE	0.05	NE	NE	NE	2.83
农业活动		3.61	2.44				6.05
废弃物处理	NE	1.62	NE				1.62
土地利用变化和林业	-4.07	NE	NE				-4.07
总量（不包括土地利用变化和林业）	30.73	7.20	2.64	NE	NE	NE	40.57
总量（包括土地利用变化和林业）	26.66	7.20	2.64	NE	NE	NE	36.50

注：阴影部分不需填写；NE (未计算)表示对现有源排放量和汇清除没有计算；由于四舍五入的原因，表中各分项之和与总计可能有微小的出入。

表 2-13 1994 年中国温室气体排放构成

温室气体	不包括土地利用变化和林业		包括土地利用变化和林业	
	二氧化碳当量(亿吨)	比重(%)	二氧化碳当量(亿吨)	比重(%)
二氧化碳	30.73	75.8	26.66	73.1
甲烷	7.20	17.7	7.20	19.7
氧化亚氮	2.64	6.5	2.64	7.2
合计	40.57		36.50	

二、2005 年国家温室气体清单

2005 年中国温室气体排放总量（不包括土地利用变化和林业）约为 74.67 亿吨二氧化碳当量（表 2-14），其中二氧化碳、甲烷、氧化亚氮和含氟气体所占的比重分别为 80.0%、12.5%、5.3%和 2.2%（表 2-15）；土地利用变化和林业领域的温室气体吸收汇约为 4.21 亿吨二氧化碳当量，考虑温室气体吸收汇后，2005 年中国温室气体净排放总量约为 70.46 亿吨二氧化碳当量，其中二氧化碳、甲烷、氧化亚氮和含氟气体所占比重分别为 78.8%、13.3%、5.6%和 2.3%。

表 2-14 2005 年中国温室气体总量（亿吨二氧化碳当量）

	二氧化碳	甲烷	氧化亚氮	氢氟碳化物	全氟化碳	六氟化硫	合计
能源活动	54.04	3.24	0.40				57.69
工业生产过程	5.69	NE	0.34	1.49	0.06	0.10	7.68
农业活动		5.29	2.91				8.20
废弃物处理	0.03	0.80	0.28				1.11
土地利用变化和林业	-4.22	0.01	0.00				-4.21
总量（不包括土地利用变化和林业）	59.76	9.33	3.94	1.49	0.06	0.10	74.67
总量（包括土地利用变化和林业）	55.54	9.33	3.94	1.49	0.06	0.10	70.46

注：阴影部分不需填写；0.00表示数值小于0.005；NE (未计算)表示对现有源排放量和汇清除没有计算；由于四舍五入的原因，表中各分项之和与总计可能有微小的出入。

表 2-15 2005 年中国温室气体排放构成

温室气体	不包括土地利用变化和林业		包括土地利用变化和林业	
	二氧化碳当量(亿吨)	比重(%)	二氧化碳当量(亿吨)	比重(%)
二氧化碳	59.76	80.0	55.54	78.8
甲烷	9.33	12.5	9.33	13.3
氧化亚氮	3.94	5.3	3.94	5.6
含氟气体	1.65	2.2	1.65	2.3
合计	74.67		70.46	

第三部分 减缓行动及其效果

2010 年中国政府向《公约》秘书处提交了国家适当减缓行动。“十二五”以来，中国高度重视气候变化问题，把积极应对气候变化作为经济社会发展的重大战略，把控制温室气体排放作为应对气候变化的重要任务，把绿色低碳发展作为生态文明建设的重要途径，采取了一系列政策与行动，为应对全球气候变化作出了重要贡献。

第一章 控制温室气体排放目标与行动

“十二五”时期，中国政府组织实施了《中国应对气候变化国家方案》、《“十二五”控制温室气体排放工作方案》、《“十二五”节能减排综合性工作方案》、《节能减排“十二五”规划》、《2014-2015 年节能减排低碳发展行动方案》和《国家应对气候变化规划(2014-2020 年)》，合理控制能源消费总量，加快推进产业结构和能源结构调整，大力开展节能降碳和生态建设，努力控制非能源活动温室气体排放，扎实开展低碳试点、碳排放权交易试点，积极推进国际合作，不断探索符合中国国情的低碳发展新模式。

一、“十二五”控制温室气体排放目标与任务

根据中国政府提出的到 2020 年单位国内生产总值二氧化碳排放比 2005 年下降 40％-45%，非化石能源占一次能源消费的比重达到 15％左右，森林面积比 2005 年增加 4000 万公顷，森林蓄积量比 2005 年增加 13 亿立方米等国家适当减缓行动（NAMAs），2011 年《中华人民共和国国民经济和社会发展第十二个五年规划纲要》首次将单位国内生产总值二氧化碳排放降低作为约束性指标提出。2011 年国务院印发的《“十二五”控制温室气体排放工作方案》明确提出，大幅度降低单位国内生产总值二氧化碳排放，到 2015 年全国单位国内生产总值二氧化碳排放比 2010 年下降 17%；控制非能源活动二氧化碳排放和甲烷、氧化亚氮、氢氟碳化物、全氟化碳、六氟化硫等温室气体排放取得成效。

为了实现上述目标，《“十二五”控制温室气体排放工作方案》明确要求综合运用多种控制措施，主要包括：大力发展服务业和战略性新兴产业，到 2015 年服务业增加值和战略性新兴产业增加值占国内生产总值比例提高到 47%和 8%左右；大力发展循环经济，加强节能能力建设；实施节能重点工程，形成 3 亿吨标准煤的节能能力，单位国内生产总值能耗比 2010 年下降 16%；到 2015 年，非化石能源占一次能源消费比例达到 11.4%；“十二五”时期，新增森林面积 1250 万公顷，森林覆盖率提高到 21.66%，森林蓄积量增加 6 亿立方米。

二、“十二五”控制温室气体排放行动与成效

“十二五”时期，中国通过法律、行政、技术、市场等多种手段，探索符合中国国情的低碳发展新模式。截至 2015 年，中国国家适当减缓行动取得积极进展：单位国内生产总值二氧化碳排放比 2005 年下降 38.6%，比 2010 年下降 21.7%（图 3-1）；非化石能源占能源消费总量比重达到 12.0%，水电装机达到 3.2 亿千瓦，是 2005 年的 2.7 倍，并网风电装机达到 1.3 亿千瓦，是 2005 年的 123 倍，光伏装机达到 4218 万千瓦，是 2005 年的 603 倍，核电装机达到 2717 万千瓦，是 2005 年的 3.9 倍；森林面积比 2005 年增加 3278 万公顷，森林蓄积量比 2005 年增加 26.8 亿立方米左右。

“十二五”时期，各地区重视控制温室气体排放工作，围绕地区碳强度下降目标，认真落实相关任务和措施，扎实推进基础工作和能力建设，积极探索创新本地区低碳发展体制机制，大部分地区均超额完成《“十二五”控制温室气体排放工作方案》规定的碳强度下降目标。

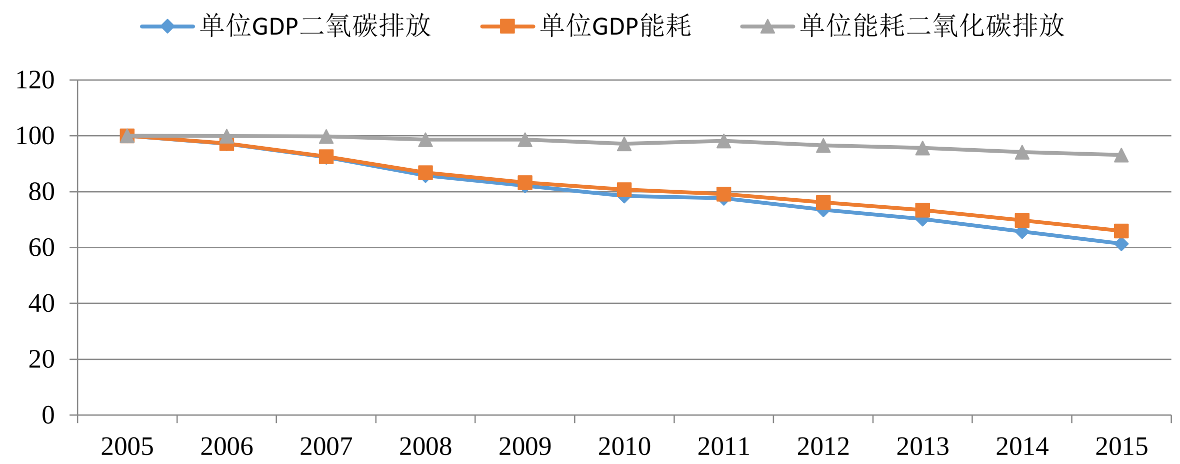

图 3-1 中国低碳能源经济转型主要指标变化情况

三、“十三五”控制温室气体排放目标与任务

根据《中华人民共和国国民经济和社会发展第十三个五年规划纲要》，中国将主动控制碳排放，探索建立碳排放强度与碳排放总量“双控”制度，到 2020 年单位国内生产总值二氧化碳排放在 2015 年基础上进一步降低 18%，支持优化开发区域和低碳试点城市率先实现碳排放达峰。有效控制电力、钢铁、建材、化工等重点行业碳排放，推进工业、能源、建筑、交通等重点领域低碳发展，到 2020 年单位工业增加值二氧化碳排放下降 22%，部分工业行业碳排放量达峰。加快构建清洁低碳、安全高效的现代能源体系，单位国内生产总值能耗下降 15%，非化石能源占能源消费总量比重达到 15%。增加林

业碳汇，减少林业排放，到 2020 年森林面积在 2005 年基础上增加 4000 万公顷，森林覆盖率达到 23%以上，森林蓄积量达到 165 亿立方米以上。深化各类低碳试点，实施近零碳排放区示范工程。加大低碳技术和产品推广应用力度，完善碳排放标准体系，推动建设全国统一的碳排放权交易市场。

非二氧化碳温室气体排放得到有效控制，形成一批可推广的非二氧化碳排放控制技术，建成一批具有良好减排效果的重大工程，推广一批可复制的试点示范项目，到 2020 年努力实现中国能源活动甲烷排放和工业生产过程及农田氧化亚氮排放达到峰值，二氟一氯甲烷在 2010 年产量基础上减少 35%，三氟甲烷实现达标排放，“十三五”时期累计减排 11 亿吨二氧化碳当量以上。

第二章 节能和提高能效

2011 年 3 月发布的《中华人民共和国国民经济和社会发展第十二个五年规划纲要》提出到 2015 年单位国内生产总值能耗比 2010 年下降 16%的约束性目标。2011 年 8 月，国务院印发了《“十二五”节能减排综合性工作方案》，明确要求严格落实节能减排目标责任，进一步形成政府为主导、企业为主体、市场有效驱动、全社会共同参与的推进节能减排工作格局。2012 年 8 月，国务院印发了《节能减排“十二五”规划》，进一步提出“十二五”期间实现节约能源 6.7 亿吨标准煤，单位工业增加值（规模以上）能耗比 2010 年下降 21%左右，建筑、交通运输、公共机构等重点领域能耗增幅得到有效控制，主要产品（工作量）单位能耗指标达到先进节能标准的比例大幅提高。通过采取强有力的政策措施，“十二五”期间，中国节能和提高能效进展显著（表 3-1），2015 年单位国内生产总值能耗比 2010 年下降 18.4%，五年间全社会累计节约和少用能源约 8.7 亿吨标准煤。

表 3-1 2011-2015 年中国单位 GDP 能耗变化和节能量

年份	能源消费总量（万吨标准煤）	单位 GDP 能耗（吨标准煤/万元）	单位 GDP 能耗下降率（%）	年度节能量（万吨标准煤）
2010	360648	0.87	--	--
2011	387043	0.86	-2.03	8008
2012	402138	0.82	-3.67	15314
2013	416913	0.79	-3.79	16425
2014	425806	0.75	-4.81	21520
2015	430000	0.71	-5.55	25253

注：年度节能量=（上年度同期单位产值能耗-本年度单位产值能耗）×本年度国内生产总值（不变价 GDP）

能源消费总量和单位 GDP 能耗来源于《中国统计年鉴-2016》，其余数据计算得出。

GDP 为 2010 年不变价。

一、强化节能目标责任考核

中国政府建立和完善了中国特色的节能目标责任制和节能考核评价制度。2011 年《“十二五”节能减排综合性工作方案》将单位国内生产总值能耗下降的节能目标分解落实到了各省（区、市），明确提出要合理分解节能降耗指标，健全单位 GDP 能耗统计、监测和考核体系，加强节能目标责任评价考核。“十一五”以来，国务院组织开展对省级人民政府节能目标完成情况和节能措施落实情况的评价考核工作，并向社会公布考核结果。

为推动重点用能单位加强节能工作，强化节能管理，2011 年国家发展改革委印发了《关于万家企业节能低碳行动实施方案的通知》，要求各地区按照方案规定的万家企业范围，审核提出本地区纳入万家企业节能低碳行动的企业（单位）名单，根据本地区万家企业节能量目标分解确定每个企业“十二五”节能目标，并在方案中明确提出“十二五”期间万家企业要实现节约能源 2.5 亿吨标准煤。从 2012 年开始，国家发展改革委会同工业和信息化部等对 16000 多家年综合能源消费量在 1 万吨标准煤以上的企业以及有关部门指定的年综合能源消费量 5000 吨标准煤以上的重点用能单位进行重点监控和评价考核，并向社会公布考核结果。截至 2014 年，“万家企业节能低碳行动”已实现累计节能 3.09 亿吨标准煤，提前超额完成万家企业节能目标 （表 3-2）。

表 3-2 2012-2014 年中国“万家企业节能低碳行动”节能目标责任考核情况及节能量[1]

年份	参加考核企业数量	“超额完成”占比(%)	“完成”占比(%)	“基本完成”占比(%)	“未完成”占比(%)	累计节能量（亿吨标准煤）
2012	14542	25.9	50.4	14.3	9.5	1.70
2013	14119	28.2	50.4	13.0	8.4	2.49
2014	13328	31.0	51.1	10.8	7.1	3.09

注：累计节能量=历年年度节能量之和

二、调整优化产业结构

中国政府积极鼓励发展战略性新兴产业和服务业，不断降低高能耗行业在国民经济中的比重。2012 年 7 月，国务院印发了《“十二五”国家战略性新兴产业发展规划》，提出了节能环保、新一代信息技术、生物、高端装备制造、新能源、新材料以及新能源汽车等七大战略性新兴产业的重点发展方向和主要任务。2012 年 12 月，国务院又印发了《服务业发展“十二五”规划》，明确提出加快发展以金融服务业、交通运输业、现代物流业、高技术服务业为主的生产性服务业，大力发展商贸服务业、文化产业、旅游业、健康服务业为主的生活性服务业。2012 年中国第三产业增加值占国内生产总值的比重首次与第二产业持平，2015 年达到 50.5%，较 2010 年提高 6.3 个百分点，首次占据“半壁江山”。

与此同时，中国政府实施淘汰落后产能计划，建立健全落后产能退出机制，不断优化第二产业内部结构。2011 年工业和信息化部发布了《“十二五”工业领域重点行业淘汰落后产能目标》，明确了 19 个重点行业淘汰落后产能目标任务，同时发布了配套的《淘汰落后产能工作考核实施方案》。2013 年国务院印发了《关于化解产能严重过剩矛盾的指导意见》，明确把化解产能严重过剩矛盾作为产业结构调整的重点，着力发挥市场机制作用，完善配套政策，“消化一批、转移一批、整合一批、淘汰一批”过剩产能。截至 2014 年底，19 个行业均提前一年且超额完成淘汰落后产能目标任务（见表 3-3）。

[1] 数据来源：国家发展改革委 2012、2013、2014 年万家企业节能目标责任考核结果公告

表 3-3 2011-2014 年中国淘汰落后产能工作完成情况

行业（单位）	2011-2015 年目标任务量	2011 年完成量	2012 年完成量	2013 年完成量	2014 年完成量	2011-2014 年累计完成量
炼铁（万吨）	4800	3192	1078	618	2823	7711
炼钢（万吨）	4800	2846	937	884	3113	7780
焦炭（万吨）	4200	2006	2493	2400	1853	8752
电石（万吨）	380	152	132	118	194	596
铁合金（万吨）	740	213	326	210	262	1011
电解铝（万吨）	90	64	27	27	51	169
铜冶炼（万吨）	80	42	76	86	76	280
铅冶炼（万吨）	130	66	134	96	36	332
锌冶炼（万吨）	65	34	33	19	/	86
水泥（万吨）	37000	15497	25829	10578	8773	60677
平板玻璃（万重量箱）	9000	3041	5856	2800	3760	15457
造纸（万吨）	1500	831	1057	831	547	3266
酒精（万吨）	100	49	73	34	/	156
味精（万吨）	18	8	14	29	/	51
柠檬酸（万吨）	5	4	7	7	/	18
制革（万标张）	1100	488	1185	916	622	3211
印染（亿米）	55.8	19	33	32	21	105
化纤（万吨）	59	37	26	55	11	129
铅蓄电池（万千伏安	746	/	2971	2840	3020	8831
电力（万千瓦）	/	784	551	544	486	2365
煤炭（万吨）	/	4870	4355	14578	23528	47331

数据来源： 工业和信息化部“关于下达十二五期间工业领域重点行业淘汰落后产能目标任务的通知” 和工业和信息化部 2011、2012、2013、2014 年淘汰落后产能目标任务完成情况公告

三、实施节能重点工程

《“十二五”节能减排综合性工作方案》明确提出实施以节能改造工程、节能技术产业化示范工程、节能产品惠民工程、合同能源管理推广工程和节能能力建设工程为主的节能重点工程，到 2015 年，力争实现工业锅炉、窑炉平均运行效率比 2010 年分别提高 5 个和 2 个百分点，电机系统运行效率提高 2-3 个百分点，新增余热余压发电能力 2000 万千瓦，高效节能产品市场份额大幅度提高，“十二五”时期形成 3 亿吨标准煤的节能能力。2010 年以来，节能重点工程得到有效实施，其中“节能产品惠民工程”推广情况见表 3-4，节能服务产业及合同能源管理发展情况见图 3-2。

表 3-4 2011-2013 年“节能产品惠民工程”推广情况

年份	高效电机（万千瓦）	高效节能家电（台）	节能灯（亿只）	节能汽车（万辆）	年节能能力（万吨标准煤）
2011 年	超过 200	超过 1826 万（仅空调）	1.5	超过 400	/
2012 年	超过 1400	超过 9000 万	1.6	超过 350	超过 1200
2013 年	2500	1.3 亿	/	265	2000

数据来源：《中国应对气候变化的政策与行动 2012、2013、2014 年度报告》

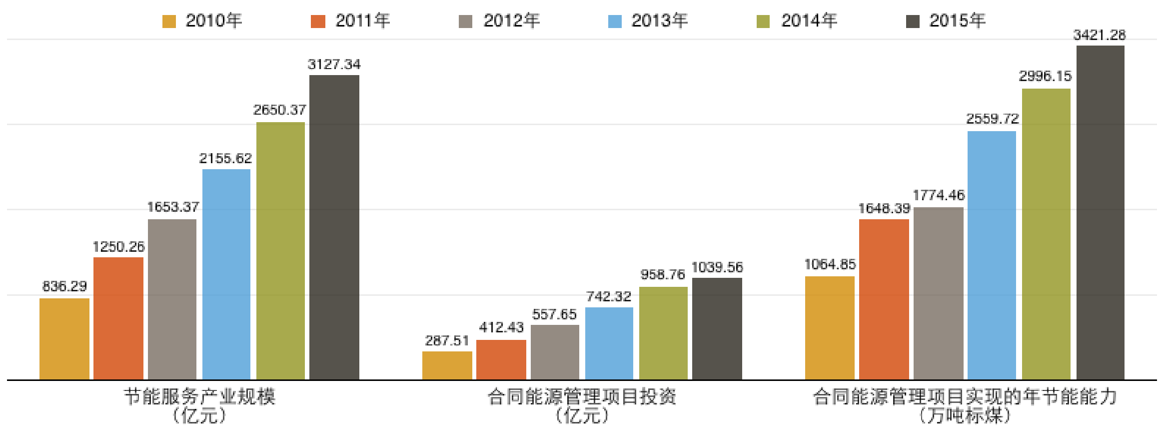

图 3-2 2010-2015 年中国节能服务产业及合同能源管理发展情况[1]

实施煤电高效清洁发展。2012 年，国家发展改革委、国家能源局、财政部印发了《关于开展燃煤电厂综合升级改造工作的通知》，在煤电行业推进实施综合升级改造。2014 年，国家发展改革委、国家能源局、环境保护部印发了《煤电节能减排升级与改造行动计划（2014-2020 年）》，煤电行业全面加快实施节能改造和超低排放改造。2011-2015 年，累计实施煤电节能改造约 4 亿千瓦，淘汰落后火电机组超过 2800 万千瓦。2015 年，中国的 6000kW 以上煤电机组平均供电煤耗约 315 克标准煤/千瓦时，五年累计降低 18 克标准煤/千瓦时[2]，年节约标准煤 7000 万吨以上。

1 数据来源：中国节能协会节能服务产业委员会（EMAC）
2 数据来源：中国电力企业联合会发布的《2016 年度全国电力供需形势分析预测报告》

专栏 3-1 “十二五”节能重点工程专栏

01	**节能改造工程**
	实施锅炉窑炉改造、电机系统节能、能量系统优化、余热余压利用、节约替代石油、绿色照明等节能改造工程，预期在2011-2015年间分别形成7500万吨标准煤、800亿千瓦时、4600万吨标准煤、5700万吨标准煤、1120万吨标准煤和2100万吨标准煤的节能能力[1]。
02	**节能技术产业化示范工程**
	推广低品位余能利用、稀土永磁电机、太阳能光伏发电、零排放和产业链接等一批重大、关键节能技术，并针对节能效果好、应用前景广阔的关键产品或核心部件组织规模化生产，推进产业化应用。根据规划目标，在“十二五”期间产业化推广30项以上重大节能技术，并形成1500万吨标准煤以上的节能能力。
03	**节能产品惠民工程**
	民用领域重点推广高效照明产品、节能家用电器、节能与新能源汽车等，商用领域重点推广单元式空调器等，工业领域重点推广高效电动机等。中国已形成数十万种型号的节能产品惠民工程推广体系。
04	**合同能源管理推广工程**
	贯彻落实国务院办公厅印发的《关于加快推行合同能源管理促进节能服务产业发展意见的通知》，引导节能服务公司加强技术研发、服务创新、人才培养和品牌建设，提高融资能力，不断探索和完善商业模式。五年来，中国节能服务产业规模从2010年的835.29亿元增长为2015年的3127.34亿元，合同能源管理项目投资金额从287.51亿元增长为1039.56亿元，项目节能能力相应地由1064.85万吨标准煤增长为3421.28万吨标准煤[2]。
05	**节能能力建设工程**
	推进节能监测平台建设，建立能源消耗数据库和数据交换系统，强化数据收集、数据分类汇总、预测预警和信息交流能力。开展重点用能单位能源消耗在线监测体系建设试点和城市能源计量示范建设。推进节能监管机构标准化和执法能力建设，中国节能监察机构在编人数大约1.6万人，省、市、县三级节能监察体系基本建立[3]。

1 数据来源：《节能减排“十二五”规划》
2 数据来源：中国节能协会节能服务产业委员会（EMAC）
3 数据来源：《中国应对气候变化的政策与行动 2014 年度报告》

四、完善节能经济激励政策

价格政策。为遏制高耗能产业盲目发展、促进产业结构调整和技术升级，2013 年 12 月，国家发展改革委会同工业和信息化部联合印发《关于电解铝企业用电实行阶梯电价政策的通知》，电解铝企业铝液电解交流电耗不高于每吨 13700 千瓦时用电不加价，高于每吨 13700 千瓦时但不高于 13800 千瓦时用电，每千瓦时加价 0.02 元，高于每吨 13800 千瓦时加价 0.08 元。为引导居民节约用电、合理用电，2011 年国家发展改革委印发了《关于居民生活用电试行阶梯电价的指导意见的通知》，将城乡居民每月用电量按照满足基本用电需求、正常合理用电需求和较高生活质量用电需求划分为三档，电价实现分档递增，其中第一档电量原则上按照覆盖本区域内 80%居民用户的月均用电量确定，二档、三档提价标准分别为每度电不低于 5 分钱和每度电 0.3 元左右。2014 年 3 月国家发展改革委印发了《关于建立健全居民生活用气阶梯价格制度的指导意见》，提出到 2015 年底所有已通气城市均应建立起居民生活用气阶梯价格制度，按照满足不同用气需求，将居民用气量分为三档，其中第一档用气量按覆盖区域内 80%居民家庭用户的月均用气量确定，二档、三档气价分别为第一档气价的 1.2 和 1.5 倍。2014 年 5 月，国家发展改革委、工业和信息化部、质检总局联合印发了《关于运用价格手段促进水泥行业产业结构调整有关事项的通知》，对淘汰类水泥企业每千瓦加价 0.4 元。

税收与信贷政策。2011 年 10 月财政部、国家税务总局修订通过了《中华人民共和国资源税暂行条例实施细则》。2014 年 10 月财政部、国家税务总局印发《关于调整原油、天然气资源税有关政策的通知》和《关于实施煤炭资源税改革的通知》，自 2014 年 12 月 1 日起将原油、天然气矿产资源补偿费费率降为零，相应将油气资源税税率由 5%提高到 6%；在全国范围实施煤炭资源税从价计征改革，煤炭资源税税率幅度定为 2%-10%，并全面清理相关收费基金。中国政府鼓励各类金融机构加大对节能降耗项目的信贷支持力度，创新信贷管理模式。2012 年 2 月银监会印发《关于印发绿色信贷指引的通知》，并于 2013 年制定了《绿色信贷统计制度》，明确了 12 类节能环保项目和服务的绿色信贷统计范畴。截至 2015 年底，银行业金融机构绿色信贷余额 8.08 万亿元，其中 21 家主要银行业金融机构绿色信贷余额达 7.01 万亿元，占各项贷款余额的 9.68%，所支持项目可节能 2.21 亿吨标准煤[1]。

五、完善节能标准标识

2012 年 6 月国家发展改革委、国家标准化管理委员会启动实施“百项能效标准推进工程”，进一步提高中国终端用能产品的能效市场准入门槛和高耗能行业的能耗准入门

[1] 数据来源：《2015 年度中国银行业社会责任报告》

槛，充分发挥节能标准的引领作用。2015 年国务院办公厅印发了《关于加强节能标准化工作的意见》，明确提出要加强重点领域节能标准修订工作、严格执行强制性节能标准、推动实施推荐性节能标准。“十二五”期间，共批准发布 221 项节能国家标准，覆盖工业、能源、建筑、交通、公共机构等重点领域的节能标准体系。国家发展改革委、质检总局、国家认监委共同建立并实施了能效标识制度，截至 2015 年，中国能效标识制度已覆盖 12 批 33 类终端用能产品、备案企业 1 万多家、备案产品型号 93 万多个。据调查分析，98.1%的城镇消费者对能效标识有了一定认知，能效标识制度实施十年来累计节电超过 4419 亿千瓦时[1]。

六、推广节能技术和产品

为加快节能技术进步和推广，引导用能单位采用先进适用的节能新技术、新装备、新工艺，国家发展改革委从 2008 年开始每年发布《国家重点节能技术推广目录》。为统筹协调节能技术与低碳技术的有效推广，2014 年 1 月国家发展改革委印发了《关于节能低碳技术推广管理暂行办法的通知》，并陆续颁布了《国家重点节能低碳技术推广目录（节能部分）》“2014 年本”和“2015 年本”，其中“2015 年本”涉及煤炭、电力、钢铁、有色、石油石化、化工、建材、机械、轻工、纺织、建筑、交通、通信 13 个行业，共 266 项重点节能技术。自 2009 年开始，工业和信息化部陆续评选发布了 6 批《节能机电设备（产品）推荐目录》、4 批《“能效之星”产品目录》和 1 批《通信行业节能技术推荐目录》。为拉动节能产品消费，“十二五”时期加大了高效节能产品推广力度，采取财政补贴方式，重点推广了民用领域高效照明、节能家用电器、节能与新能源汽车等产品，商用领域单元式空调器等产品，工业领域高效电动机等产品，共发布了 6 批《高效电机推广目录》和 8 批《节能汽车推广目录》。

七、强化建筑节能

《节能减排“十二五”规划》明确提出到 2015 年累计完成北方采暖地区既有居住建筑供热计量和节能改造 4 亿平方米以上，夏热冬冷地区既有居住建筑节能改造 5000 万平方米，公共建筑节能改造 6000 万平方米。2012 年住房城乡建设部印发了《“十二五”建筑节能专项规划》，提出了政策法规、体制机制、规划设计、标准规范、科技推广、建设运营和产业支撑等政策举措。2012 年 4 月住房城乡建设部会同财政部联合印发了《关于推进夏热冬冷地区既有居住建筑节能改造的实施意见》。2014 年国管局、质检总局印发了《关于切实加强公共机构能源资源计量工作有关事项的通知》。

通过加强监督管理，全国城镇新建建筑执行节能强制性标准比例持续提高，目前执

[1] 数据来源：国家发展改革委公告《能效标识制度实施十周年研讨会在京召开》

行比例基本达到 100%。截至 2015 年，全国城镇累计建成节能建筑面积超过 120 亿平方米，节能建筑占城镇民用建筑面积比例超过 40%，共形成每年节约超过 1 亿吨标准煤节能能力；全国累计完成北方采暖地区既有居住建筑供热计量及节能改造 11.8 亿平方米，超额完成国务院确定的改造任务；“十二五”期间夏热冬冷地区既有居住建筑节能完成改造面积 7090 万平方米。截至 2015 年底，全国共有 3979 个项目获得了绿色建筑评价标识，建筑面积超过 4.5 亿平方米。绿色建筑强制推广工作不断推进，北京、天津、上海、重庆、江苏、浙江、山东、深圳等地开始在城镇新建建筑中全面执行绿色建筑标准，累计推广绿色建筑面积超过 10 亿平方米。不断扩大超低能耗建筑试点示范规模，截至 2015 年底，全国在严寒、寒冷、夏热冬冷、夏热冬暖 4 个气候区 12 个省共有 60 余个被动式超低能耗绿色建筑试点项目。截至 2015 年，共有 97 个城市、198 个县、6 个区、16 个镇被确定为可再生能源建筑应用示范市（县、区、镇），全国城镇太阳能光热应用面积近 30 亿平方米，浅层地能应用面积近 5 亿平方米。

2011 年国管局印发了《公共机构节能“十二五”规划》，提出到 2015 年公共机构人均能耗下降 15%、单位建筑面积能耗下降 12%的量化目标，建立起比较完善的组织管理、政策法规、计量监测考核、技术支撑、宣传培训和市场化服务体系的管理目标。“十二五”期间，国管局会同发展改革委、财政部等部门印发了《关于推进公共机构节约能源资源促进生态文明建设的实施意见》、《公共机构能源审计管理暂行办法》。组织创建了国家级节约型公共机构示范单位 2050 个。全国公共机构人均能耗、单位建筑面积能耗分别下降了 17.14%、13.88%，顺利完成了规划目标（见图 3-3）。

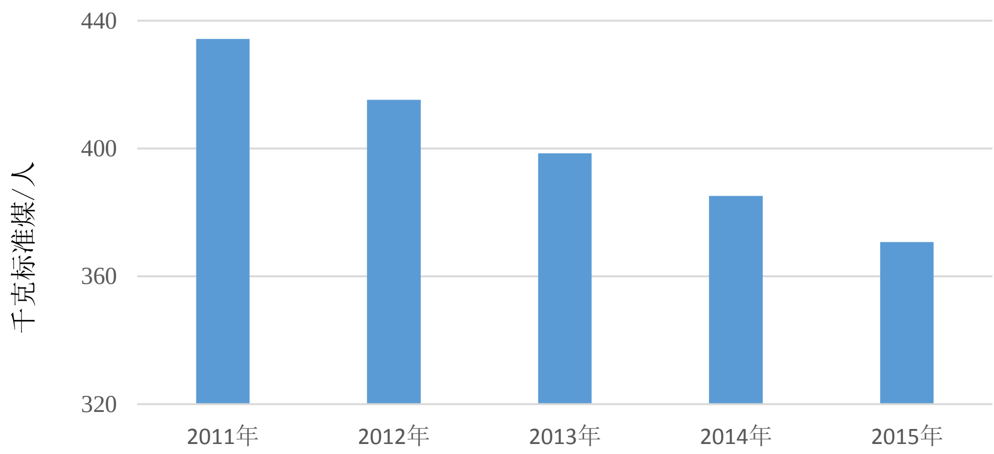

图 3-3 2011-2015 年全国公共机构人均综合能耗变化情况

八、推动交通运输节能

2011 年交通运输部印发了《交通运输“十二五”发展规划》，提出到 2015 年营运车辆单位运输周转量的能耗与 2005 年相比下降 10%、营运船舶单位运输周转量的能耗下降 15%、“十二五”时期民航运输吨公里的能耗下降 3%以上的目标。2011 年起先后印发了《交通运输行业“十二五”控制温室气体排放工作方案》、《交通运输行业应对气候变化行动方案（2012-2020）》，颁布了《绿色循环低碳交通发展指导意见》、《建设低碳交通运输体系指导意见》、《关于交通运输行业贯彻落实<2014-2015 年节能减排低碳发展行动方案>的实施意见》等政策文件，提出加强绿色基础设施建设、推广应用绿色交通运输装备、加快构建绿色交通运输组织体系、推进交通运输信息化智能化建设、深入开展试点示范和专项行动等措施。“十二五”规划设定的能耗强度降低目标顺利完成，2015 年与 2005 年相比，营运车辆和营运船舶单位运输周转量能耗分别下降 15.9%和 20%。中国铁路运输能源消费变化情况见图 3-4。

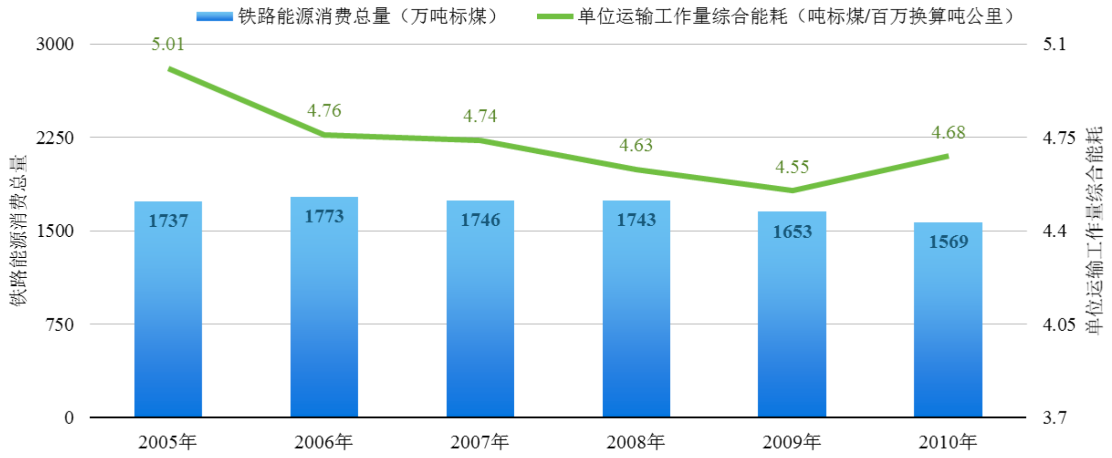

图 3-4 2010-2015 年中国铁路运输能源消费变化情况[1]

第三章 优化能源结构

通过严格控制煤炭消费总量、加快发展天然气等清洁能源、推动非化石能源发展等措施，中国煤炭占能源消费总量比重从 2005 年的 72.4%下降至 2015 年的 64.0%，降幅达到 8.4 个百分点；天然气占能源消费总量比重从 2005 年的 2.4%上升至 2015 年的 5.9%，增幅达到 3.5 个百分点；非化石能源占能源消费总量比重从 2005 年的 7.4%上升至 2015 年的 12.0%（见图 3-5），增幅达到 4.6 个百分点；中国目前的低碳能源（包括非化石能源和天然气）消费占比已经达到 17.9%。

[1] 数据来源：《2010、2011、2012、2013、2014、2015 铁路统计公报》

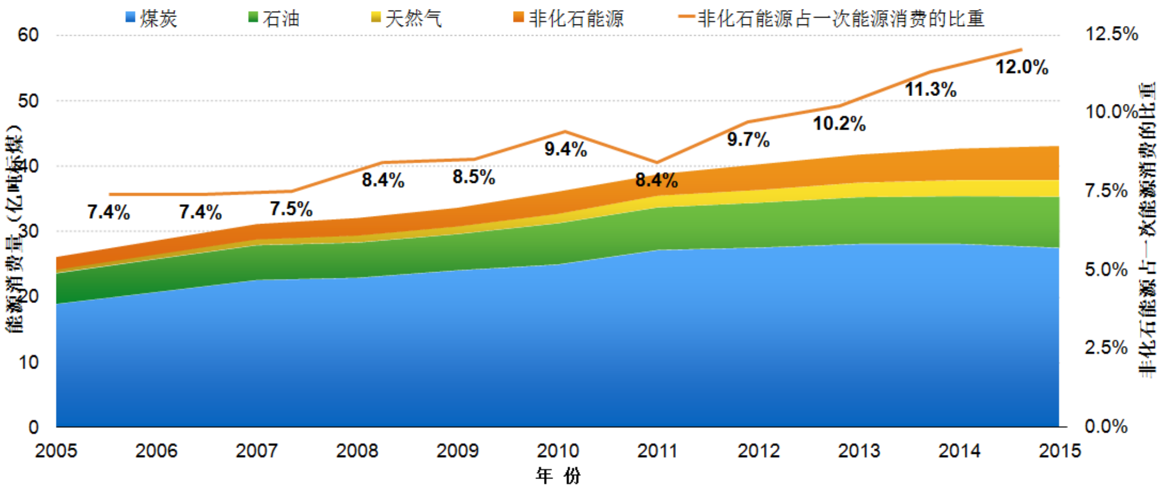

图 3-5 中国能源消费结构

一、严格控制煤炭消费总量

2014 年国务院印发了《能源发展战略行动计划（2014-2020 年）》，明确提出 2020 年中国能源发展目标，实施煤炭消费减量替代，降低煤炭消费比重，京津冀鲁、长三角和珠三角等要削减区域煤炭消费总量。为贯彻落实《大气污染防治行动计划》，2013 年环境保护部、国家发展改革委等有关部门联合印发了《京津冀及周边地区落实大气污染防治行动计划实施细则》，明确提出到 2017 年底，北京市、天津市、河北省和山东省压减煤炭消费总量 8300 万吨，四省市分别削减 1300 万吨、1000 万吨、4000 万吨和 2000 万吨。2014 年 12 月，国家发展改革委会同工业和信息化部、财政部、环境保护部、统计局、国家能源局等有关部门印发了《重点地区煤炭消费减量替代管理暂行办法》，对北京市、天津市、河北省、山东省、上海市、江苏省、浙江省和广东省的珠三角地区提出煤炭消费减量替代工作目标及方案。2015 年国家发展改革委、环境保护部、国家能源局印发了《加强大气污染治理重点城市煤炭消费总量控制工作方案》，提出空气质量相对较差前 10 位城市煤炭消费总量较上一年度实现负增长的目标。2014 年国家发展改革委、国家能源局及环境保护部还联合印发了《能源行业加强大气污染防治工作方案》，提出逐步降低煤炭消费比重，制定国家煤炭消费总量中长期控制目标。

2015 年中国煤炭消费量为 27.5 亿吨标准煤，已经呈现增长放缓甚至下降的趋势，煤炭占能源消费总量的比重相比 2010 年下降了 5.2 个百分点，火电产量 2014 年、2015 年连续两年出现负增长。中国目前已有超过 20 个省（区、市），以及 30 多个城市制定了不同形式的煤炭消费总量控制目标。

二、加快发展天然气等清洁能源

2012 年国家发展改革委印发了《天然气发展“十二五”规划》，提出了 2015 年国产天然气供应能力达到 1760 亿立方米左右、进口天然气量约 935 亿立方米的目标，并相应提出了常规天然气、煤制天然气、煤层气、页岩气、用气普及率、基础设施能力建设等相关目标。2014 年国家发展改革委、国家能源局和环境保护部联合印发了《能源行业加强大气污染防治工作方案》，提出天然气（不包含煤制气）消费比重在 2015 年和 2017 年分别达到 7%和 9%以上。2014 年国家发展改革委印发了《关于建立保障天然气稳定供应长效机制的若干意见》，提出保障天然气长期稳定供应的任务及措施。国家发展改革委会同有关部门发布了《关于发展天然气分布式能源的指导意见》及《天然气分布式能源示范项目实施细则》，进一步推动天然气分布式能源发展，出台财政补贴、发电上网、电价补贴等政策。2014 年国家能源局发布了《关于规范煤制油、煤制天然气产业科学有序发展的通知》，规范煤制油、煤制气项目，提出了能源转化效率、能耗、水耗、二氧化碳排放和污染物排放等准入值。2012 年财政部、国家能源局联合发布了《关于出台页岩气开发利用补贴政策的通知》，安排专项财政资金支持页岩气开发，2012 年国家发展改革委会同财政部等组织制定了《页岩气发展规划（2011- 2015 年）》。2011 年国家发展改革委、国家能源局组织制定了《煤层气（煤矿瓦斯）开发利用“十二五”规划》，提出了实施煤矿瓦斯治理和利用总体方案，引导和鼓励煤矿瓦斯利用和地面煤层气开发。

2015 年，中国天然气产量 1346 亿立方米，天然气进口量 639 亿立方米，天然气消费量 1931 亿立方米，天然气占能源消费总量的比重从 2010 年的 4.0%提升至 5.9%，保持了持续增长的势头。截至 2015 年，国内已建成天然气管道 6.4 万公里，初步形成全国性的输气管网框架。

三、推动非化石能源发展

国家发展改革委、国家能源局、住房城乡建设部、财政部等先后发布了《可再生能源发展“十二五”规划》、《太阳能发电发展“十二五”规划》、《生物质能发展“十二五”规划》、《可再生能源发展专项资金管理暂行办法》、《可再生能源电价附加补助资金管理暂行办法》、《关于进一步推进可再生能源建筑应用的通知》等几十项政策文件，明确了发展目标、规划布局和建设重点，制定和完善了可再生能源优先上电网、全额收购、价格优惠及社会分摊的政策，建立可再生能源发展专项资金，支持资源评价与调查、技术研发、试点示范工程建设和农村可再生能源开发利用。2015 年国家发展改革委印发了《关于降低燃煤发电上网电价和一般工商业用电价格的通知》，决定对除居民生活和农业生产以外其他用电征收的可再生能源电价附加征收标准，提高到 1.9 分/千瓦时，比之前实施的标准增加了 0.4 分/千瓦时。

2015 年，中国非化石能源发电装机比 2010 年增加了 26539 万千瓦，在全国总发电装机中占比提高了 7.3 个百分点，非化石能源发电量比 2010 年增加了 7255.0 亿千瓦时，在全国总发电量中占比提高了 7.4 个百分点，如表 3-5 所示。中国是世界利用新能源和可再生能源第一大国，中国可再生能源装机容量占全球总量的 25%，新增装机占全球增量的 42%。2014 年中国可再生能源电价附加收入决算数为 491.38 亿元，其中用于光伏发电、风力发电、生物质发电的补助分别为 52 亿元、275 亿元和 74 亿元。

各减缓行动及效果汇总见表 3-6。

表 3-5 非化石能源发电装机容量和发电量[1]

	单位	2005	2010	2014	2015
一、发电装机容量					
水电（含抽蓄）	万千瓦	11739.0	21606.0	30486.0	31954.0
风力发电（并网）	万千瓦	127.0	3131.0	9657.0	13075.0
太阳能发电（并网）	万千瓦	7.0	86.0	2486.0	4218.0
生物质能发电（并网）	万千瓦	200.0	550.0	981.0	1030.0
地热海洋能发电	万千瓦	2.5	2.8	3.0	3.0
可再生能源（合计）	万千瓦	12075.5	25375.8	43613.0	50280.0
核电	万千瓦	685.0	1082.0	2008.0	2717.0
非化石能源（合计）	万千瓦	12760.5	26457.8	45621.0	52997.0
二、发电量					
水电（含抽蓄）	亿千瓦时	3964.0	6867.0	10601.0	11127.0
风力发电（并网）	亿千瓦时	16.0	490.0	1598.0	1856.0
太阳能发电（并网）	亿千瓦时	0.0	5.0	235.0	395.0
生物质能发电（并网）	亿千瓦时	52.0	248.0	461.0	520.0
地热海洋能发电	亿千瓦时	1.0	1.5	1.5	1.5
可再生能源（合计）	亿千瓦时	4033.0	7611.5	12896.5	13899.5
核电	亿千瓦时	531.0	747.0	1332.0	1714.0
非化石能源（合计）	亿千瓦时	4564.0	8358.5	14228.5	15613.5
三、非化石能源占比					
全国总发电装机	万千瓦	51718.0	96641.0	137018.0	152527.0
全国总发电量	亿千瓦时	24975.0	42278.0	56801.0	57399.0
非化石能源发电装机占比	%	24.7	27.4	33.2	34.7
非化石能源发电量占比	%	18.3	19.8	25.0	27.2

第四章 控制非能源活动温室气体排放

“十二五”以来，中国强化了对工业生产过程、农业活动、废弃物处理等领域的温室气体排放控制，积极开展了非二氧化碳类温室气体等相关专题研究，推动应对气候变化

[1] 数据来源：《中国统计年鉴 2016》和国家能源局

与大气污染治理协同控制。

一、控制工业生产过程温室气体排放

2015 年国家发展改革委会同外交部、财政部、环境保护部等有关部门，积极组织开展控制氢氟碳化物的重点行动，下发《关于组织开展氢氟碳化物处置相关工作的通知》，分两批下达了氢氟碳化物削减重大示范项目中央预算内投资计划，组织已投产运行且未获得 CDM 项目支持的 HCFC-22 生产装置实施 HFC-23 销毁工作。2015 年环境保护部出台了《关于严格控制新建、改建、扩建含氢氯氟烃生产项目的补充通知》，要求新建的 HCFC-22 生产设施需同时配套建设并同时投产运行副产品 HFC-23 的无害化处理设施，对副产的 HFC-23 全部进行无害化处置，禁止向大气直接排放。工业和信息化部组织有关行业协会与企业应用电石渣替代石灰石生产水泥熟料等原料替代技术、高炉渣和粉煤灰等作为添加混合材料生产水泥等工艺过程，采用二级处理法和三级处理法处理硝酸生产过程的氧化亚氮排放、催化分解和热氧化分解处理己二酸生产过程的氧化亚氮排放等。

二、控制农业活动温室气体排放

2012 年农业部启动实施了“百县千乡万村” 整建制推进测土配方施肥行动，开展农企合作推广配方肥试点，中央财政安排补贴资金支持开展测土配方施肥。中央财政安排专项资金及保护性耕作工程投资推广保护性耕作技术，推广以秸秆覆盖、免耕等为主要内容的保护性耕作，发展秸秆养畜、过腹还田，增加土壤有机碳含量。“十二五”期间，农业部、财政部继续实施了土壤有机质提升补贴项目，推广秸秆还田、绿肥种植、增施有机肥等技术措施。中央投入资金实施生猪、奶牛标准化规模养殖场（小区）建设项目，重点支持规模养殖场对畜禽圈舍进行标准化改造，建设贮粪池、排粪污管网等粪污处理配套设施。

三、控制废弃物处理温室气体排放

中国政府高度重视发展循环经济，积极推进资源利用减量化、再利用、资源化，从源头和生产过程减少温室气体排放。为切实加大城市生活垃圾处理工作力度，提高城市生活垃圾处理减量化、资源化和无害化水平，改善城市人居环境，2011 年国务院批转了住房城乡建设部等部门《关于进一步加强城市生活垃圾处理工作意见》的通知。2012 年国务院办公厅印发了《“十二五”全国城镇污水处理及再生利用设施建设规划》、《“十二五”全国城镇生活垃圾无害化处理设施建设规划》，积极控制城市污水、垃圾处理过程中的甲烷排放。住房城乡建设部会同有关部门完善了城市废弃物标准，实施了生活垃圾处理收费制度，推广利用先进的垃圾焚烧技术，制定促进填埋气体回收利用的激励政策。

截至 2015 年底，中国城市污水处理能力达 1.4 亿立方米/日，年处理污水总量达 429 亿立方米，城市污水处理率达 91.9%；中国城市生活垃圾无害化处理设施 890 座，其中卫生填埋场 640 座，垃圾焚烧厂 220 座，城市生活垃圾无害化处理率达 94.1%。

第五章 努力增加碳汇

"十二五"时期，围绕落实《"十二五"控制温室气体排放工作方案》、《林业发展"十二五"规划》、《林业应对气候变化"十二五"行动要点》确定的目标任务，林业应对气候变化各项工作扎实推进，取得重要进展。五年来，通过大力造林、科学经营、严格保护，森林资源稳定增长，增汇减排能力稳步提升。

一、加快推进造林绿化

全面实施《全国造林绿化规划纲要（2011-2020 年）》，深入开展全面义务植树，着力推进旱区、京津冀等重点区域造林绿化，加快退耕还林、石漠化综合治理、京津风沙源治理、三北及长江流域等重点防护林体系建设、天然林资源保护等林业重点工程。"十二五"期间，全国共完成造林 4.6 亿亩，比"十一五"增长 28%，2015 年森林覆盖率提高到 21.63%，森林蓄积量增加到 151.37 亿立方米，全面完成"十二五"规划任务。

天然林资源保护工程。2011 年 2 月国家林业局会同相关部门联合印发了《关于继续组织实施长江上游、黄河上中游地区和东北内蒙古等重点国有林区天然林资源保护工程的通知》，正式启动天保工程二期，预期投入资金 2440.2 亿元，实现到 2020 年新增森林面积 520 万公顷。该工程五年来累计完成造林 249.7 万公顷[1]。

三北防护林工程。2012 年 8 月国家林业局印发《三北防护林体系建设五期工程规划（2011-2020 年）》，规划到 2020 年完成工程造林 1647.3 万公顷，新增森林面积 988.4 万公顷，森林覆盖率提高 2.27 个百分点。2015 年三北防护林体系建设工程完成造林 74.55 万公顷[2]。

"长、珠、海、太、平"防护林工程。2013 年 7 月国家林业局正式启动实施了"长、珠、太、平"三期工程建设（2011-2020 年），并于 2015 年启动沿海防护林体系建设工程三期规划（2016-2025 年）编制工作。五年来，长江中上游防护林工程、珠江流域防护林体系建设工程、沿海防护林工程、太行山绿化工程分别完成造林 83.8 万、25.3 万、73.2 万、20.9 万公顷[3]。

[1] 数据来源：《2011、2012、2013、2014、2015 中国国土绿化状况公报》
[2] 数据来源：《2015 年中国国土绿化状况公报》
[3] 数据来源：国家林业局公告《精准泼绿，构筑重点区域生态安全屏障——"长、珠、海、太、平"防护林工程建设综述》

退耕还林工程。2014 年 8 月国家发展改革委、国家林业局会同相关部门联合印发了《关于印发新一轮退耕还林还草总体方案的通知》[1]，2015 年中国完成退耕还林 53.3 万公顷，荒山荒地造林 5.5 万公顷[2]。

京津风沙源治理工程。2012 年 5 月国家林业局会同相关部门联合印发了《京津风沙源治理二期工程规划（2013-2022 年）》，加大力度推进京津风沙源治理工作。五年来，京津风沙源治理工程累计完成造林 219.1 万公顷[3]。

二、开展森林抚育经营

2011 年国家林业局和各省（区、市）成立森林抚育经营工作领导小组，强化目标管理和绩效考核，合力推进森林经营工作。2012 年国家林业局修订印发了《森林抚育作业设计规定》和《森林抚育检查验收办法》，完成了《森林抚育规程》，进一步强化标准制度建设。2013 年中国政府正式批复 15 个全国森林经营样板基地。2014 年国家林业局发布《中国北方国有林近自然经营方案编制指南》和《南方国有林场工业原料林培育与利用指南》，2015 年国家林业局印发了《全国森林经营人才培训计划（2015-2020 年）》，指导开展国家级、省级、县级森林经营人才培训工作。2015 年国家林业局编制完成了《全国森林经营规划（2016-2050 年）》。五年间，中国累计完成森林抚育面积 4086 万公顷，促进了森林结构改善和森林资源增长，带动了林区职工和林农就业增收。

三、强化森林灾害防控

严格实施林地保护利用规划，开展了非法侵占林地清理排查和重点国有林区开垦林地清查，严厉打击非法侵占林地行为，遏制了林地流失势头。加强天然林资源保护，完善保护政策，扩大天然林资源保护范围，停止天然林商业性采伐。2015 年底，天然林资源保护工程区管护天然林面积达到 17.32 亿亩，碳汇等生态功能明显增强。加强林业灾害防控。加强森林防火工作，“十二五”全国森林火灾受害率稳定控制在 1‰以下，年均发生森林火灾次数、受害森林面积、人员伤亡数比“十一五”分别下降 58%、85%和 43%，继续呈现“三下降”态势。加强林业有害生物综合防控。2015 年，全国主要林业有害生物成灾率控制在 4.5‰以下，松材线虫病、美国白蛾等重大有害生物严重危害势头得到有效控制，减少了因害造成的碳排放。

四、发展海洋蓝色碳汇

“十二五”期间，中国开展了浅海贝藻养殖固碳技术、固碳潜力评估理论和技术研究，

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[1] 数据来源：国家林业局公告《新一轮退耕还林启动 全面深化改革又一重大突破》
[2] 数据来源：《2015 年中国国土绿化状况公报》
[3] 数据来源：《2011、2012、2013、2014、2015 中国国土绿化状况公报》

初步建立了浅海贝类和藻类固碳潜力评估技术，进行了浅海贝藻养殖固碳技术集成与示范。卫星遥感技术在海洋碳通量、滨海湿地、海草床、珊瑚礁等生态系统监测方面取得了突破性进展，形成了完善的区域碳汇监测技术能力。“十三五”时期，中国政府将通过实施“南红北柳”、“蓝色海湾”、“生态岛礁”等重大工程恢复海岸带生态系统，改善水质环境，积极发展蓝色碳汇。

第六章 开展低碳发展试点示范

2010 年以来，中国陆续启动了低碳省市和碳排放权交易试点工作，扎实推进了低碳工业园区、低碳社区、低碳城（镇）、绿色交通等试点，从不同层次、不同领域探索低碳发展路径和模式。

一、开展低碳省区和低碳城市试点

2010 年国家发展改革委印发了《关于开展低碳省区和低碳城市试点工作的通知》，陆续启动了两批包括广东、辽宁、湖北、陕西、云南、海南和天津、重庆、深圳、厦门、杭州、南昌、贵阳、保定、北京、上海、石家庄、秦皇岛、晋城、呼伦贝尔、吉林、大兴安岭、苏州、淮安、镇江、宁波、温州、池州、南平、景德镇、赣州、青岛、济源、武汉、广州、桂林、广元、遵义、昆明、延安、金昌、乌鲁木齐在内的共 42 个试点省市，要求各试点地区明确工作方向和原则要求，编制低碳发展规划，制定支持低碳绿色发展的配套政策，探索适合本地区的低碳绿色发展模式，构建以低碳、绿色、环保、循环为特征的低碳产业体系，建立温室气体排放数据统计和管理体系，确立控制温室气体排放目标责任制，积极倡导低碳绿色生活方式和消费模式，并进一步强化温室气体排放总量控制和峰值目标倒逼机制。

“十二五”期间，各试点省区和城市认真落实试点通知要求，围绕国家发展改革委批复的《低碳试点工作实施方案》，成立了低碳试点工作领导小组，探索开展了城市碳排放核算与管理平台、碳排放影响评估、碳排放权交易、企业碳排放核算报告、低碳产品认证等方面的制度创新。低碳试点工作取得了积极进展，39 个试点省市编制完成了低碳发展专项规划，13 个试点省市设立了低碳发展专项资金，34 个试点省市已经编制完成了至少 1 年的温室气体清单，36 个试点省市建立了碳强度目标分解考核机制，14 个试点省市建立了低碳产品认证制度，5 个试点省市探索新建固定资产投资项目碳评价制度，34 个城市研究提出了实现碳排放峰值的年份目标，其中北京、上海、广州、杭州、青岛、吉林、苏州、镇江、宁波、温州、南平、济源共 12 个城市明确提出了在 2020 年前达到碳排放峰值。试点省市低碳发展取得了明显成效，相比于 2010 年的万元 GDP 碳排放，2014 年 42 个试点省市的平均累计下降率为 19.4%，总体快于全国平均水平和同

类地区。

二、推进地方碳排放权交易试点

2011 年国家发展改革委印发了《关于开展碳排放权交易试点工作的通知》，同意北京、天津、上海、重庆、湖北、广东及深圳开展碳排放权交易试点，要求各试点地区高度重视碳排放权交易试点工作，切实加强组织领导，建立专职工作队伍，安排试点工作专项资金，抓紧组织编制碳排放权交易试点实施方案，明确总体思路、工作目标、主要任务、保障措施及进度安排，同时要着手研究制定碳排放权交易试点管理办法，明确试点的基本规则，测算并确定本地区温室气体排放总量控制目标，研究制定温室气体排放配额分配方案，建立本地区碳排放权交易监管体系和登记注册系统，培育和建设交易平台，做好碳排放权交易试点支撑体系建设。

2013 年 6 月至 2014 年 6 月各碳排放权交易试点陆续启动。各试点地区结合本地实情，综合考虑碳强度目标、经济增长趋势、企业及行业排放水平等因素，均发布了地方碳交易管理办法，确定了参与碳交易的企业门槛，共纳入控排企业和单位 1900 多家，研究确定了覆盖的气体和行业及配额分配方法，分配碳排放配额约 12 亿吨。各试点地区针对碳排放权交易所覆盖的行业，研究建立碳排放核算方法和标准，开展企业碳排放历史数据核查，建立温室气体测量、报告和核查（MRV）制度，分配排放配额，建立交易系统和规则，开发注册登记系统，设立专门管理机构，建立市场监管体系，进行人员培训和能力建设，初步形成了全面完整的碳交易试点制度框架。试点工作开展以来，碳市场运行平稳，交易规模逐步扩大，各碳交易试点为对碳交易实行集中、统一管理，均建立了碳排放权交易机构，并规定其为辖区内碳交易指定场所。截至 2015 年底，中国七个碳市场试点二级市场配额累计成交量 5032 万吨，累计成交额 14.13 亿元，平均成交价格 28 元/吨；CCER 累计成交量 3560.5 万吨，累计成交额近 3 亿元，均价近 8 元/吨。其中，湖北、广东、深圳、北京等碳市场交易规模占比较大，市场活跃度相对较高。值得注意的是，广东等碳交易试点的配额分配在免费基础上引入了拍卖制度，尝试探索一级市场与二级市场的价格传导模式，为构建更为合理的碳定价机制提供了经验。此外，试点碳市场的建立与运行促进了碳金融业务的发展，丰富了企业节能减排融资渠道，进一步满足了碳市场参与者日益多样化的需求。在试点过程中各地区加大对履约的监督和执法力度，2014 年和 2015 年履约率分别达到 96%和 98%以上。通过试点省市的积极探索，目前已基本形成了具有一定约束力的、由强度目标转换成绝对总量控制目标的、覆盖部分经济部门的交易和政策体系。

三、开展低碳工业园区、社区等试点

国家发展改革委组织开展低碳工业园区、低碳社区、低碳城（镇）评价指标体系和配套政策研究，探索形成适合中国国情的低碳发展模式和政策机制。

低碳工业园区。2013 年工业和信息化部会同国家发展改革委印发了《关于组织开展国家低碳工业园区试点工作的通知》，联合开展了国家低碳工业园区试点工作，研究制定相应的评价指标体系和配套政策，选择一批基础好、有特色、代表性强、依法设立的工业园区进行试点建设，推广一批适合中国国情的工业园区低碳管理模式，引导和带动工业低碳发展。2014 年审核公布了第一批 55 家国家低碳工业园区试点名单，2015 年批复同意 39 家低碳工业园区试点实施方案。各试点园区通过推广可再生能源，加快传统产业低碳化改造和新型低碳产业发展，实现园区单位工业增加值碳排放大幅下降。

低碳社区。2014 年国家发展改革委印发了《国家发展改革委关于开展低碳社区试点工作的通知》，在全国范围内启动了低碳社区试点工作，从社区规划、建筑设施建设、运营管理、环境营造、文化生活等各方面提出了低碳建设的新理念、新做法和新模式。为进一步指导和推进低碳社区试点建设工作，2015 年印发了《国家发展改革委办公厅关于印发低碳社区试点建设指南的通知》，对城市新建社区、城市既有社区和农村社区的试点选取要求、建设目标、建设内容及建设标准进行分类指导。同时，研究形成了低碳社区碳排放核算方法学，并启动了《低碳社区试点评价指标体系》研究工作，为低碳社区试点建设提供技术支撑。根据国家统一部署，全国各地积极开展了试点工作方案编制、试点社区评选、配套政策制定等一系列工作，取得了积极成效。通过开展低碳社区试点，将低碳理念融入社区规划、建设、管理和居民生活之中，探索有效控制城乡社区碳排放的途径，推动城乡社区低碳化发展。

低碳城（镇）。2011 年财政部、住房城乡建设部和国家发展改革委启动了绿色低碳重点小城镇试点示范工作，选定北京市密云县古北口镇、天津市静海县大邱庄镇、江苏省常熟市海虞镇、安徽省合肥市肥西县三河镇、福建省厦门市集美区灌口镇、广东省佛山市南海区西樵镇、重庆市巴南区木洞镇 7 个镇为第一批试点示范绿色低碳重点小城镇，各试点示范镇根据本地经济社会发展水平、区位特点、资源和环境基础，分类探索小城镇建设发展模式。住房城乡建设部 2011 年组织开展低碳生态城市技术研究与推广和试点示范工作，2012 年会同财政部对天津市中新生态城等 8 个绿色生态城区给予各 5000 万元中央财政资金支持。截至 2015 年底，住房城乡建设部共确定低碳生态城市、绿色生态城区试点 28 个，低碳生态城市国际合作试点 25 个。2015 年国家发展改革委印发了《国家发展改革委关于加快推进国家低碳城（镇）试点工作的通知》，提出争取用 3 年左右时间，建成一批产业发展和城区建设融合、空间布局合理、资源集约综合利

用、基础设施低碳环保、生产低碳高效、生活低碳宜居的国家低碳示范城（镇），并选定广东深圳国际低碳城、广东珠海横琴新区、山东青岛中德生态园、江苏镇江官塘低碳新城、江苏无锡中瑞低碳生态城、云南昆明呈贡低碳新区、湖北武汉花山生态新城、福建三明生态新城作为首批国家低碳城（镇）试点。

四、推进其它领域低碳试点示范

低碳交通试点。交通运输部 2011 年启动了低碳交通运输体系建设试点工作，以公路、水路交通运输和城市客运为主，选定天津、重庆、深圳、厦门、杭州、南昌、贵阳、保定、无锡、武汉 10 个城市开展首批试点，2012 年又选定北京、昆明、西安、宁波、广州、沈阳、哈尔滨、淮安、烟台、海口、成都、青岛、株洲、蚌埠、十堰、济源 16 个城市开展低碳交通运输体系建设第二批城市试点工作，组织开展了低碳交通城市、低碳港口、低碳航道建设、低碳公路建设等评价指标体系研究。各试点城市通过建设低碳型交通基础设施，推广应用低碳型交通运输装备，优化交通运输组织模式及操作方法，建设智能交通工程，完善交通公众信息服务，建立健全交通运输碳排放管理体系，加快建设以低碳排放为特征的交通运输体系。

低碳产品认证。2013 年国家发展改革委与国家认监委联合建立了低碳产品认证制度，2015 年印发了《节能低碳产品认证管理办法》，开展了低碳产品认证试点，组织研究产品碳排放计算方法；国家认监委发布了低碳产品认证机构审批要求。第一批认证目录包括通用硅酸盐水泥、平板玻璃、铝合金建筑型材、中小型三相异步电动机 4 种产品，第二批认证目录包括建筑陶瓷砖（板）、轮胎、纺织面料 3 种产品，并在广东省和重庆市开展低碳产品认证试点工作，探索鼓励企业生产、社会消费低碳产品的良好制度环境。截至 2015 年底，14 个省（区、市）共 981 项低碳产品获得认证证书。

碳捕集、利用和封存（CCUS）。2013 年 4 月国家发展改革委印发了《关于推动碳捕集、利用和封存试验示范的通知》，明确了近期推动 CCUS 的试验示范工作，积极开展 CCUS 工程应用，启动中国石油化工集团公司的国内首个燃煤电厂烟气 CCUS 全流程示范工程。国土资源部初步完成了 417 个盆地的二氧化碳地质储存潜力与适应性评估，并与神华集团合作在内蒙古鄂尔多斯市伊金霍洛旗实施了我国首个二氧化碳地质储存示范工程。2013 年科技部发布《“十二五”碳捕集、利用与封存科技发展专项规划》，开展了二氧化碳化工利用关键技术研发与示范、二氧化碳矿化利用技术研发与工程示范、燃煤电厂二氧化碳捕集、驱替煤层气利用与封存技术研究与试验示范等 CCUS 科技支撑计划项目，成立了由国内 40 多家相关企业、高校、科研院所参加的 CCUS 产业技术创新联盟。

第七章 国际市场机制（CDM）

为进一步推进清洁发展机制项目在中国的有序开展，促进清洁发展机制市场的健康发展，2011 年 8 月，国家发展改革委会同科技部、外交部、财政部对《清洁发展机制项目运行管理办法》进行了修订。中国清洁发展机制网 CDM 项目数据库数据显示，“十二五”期间，国家发展改革委共批准 CDM 项目 2226 个，其中 2115 个项目在清洁发展机制执行理事会注册，项目获签发数达 3468 次（包括“十二五”之前已注册的项目），签发的减排量约为 6.95 亿吨二氧化碳当量，其中，1135 个项目系首次获得签发，签发的减排量约为 1.07 亿吨二氧化碳当量。

表 3-6 减缓行动及效果汇总表

序号	行动名称	行动目标或主要内容	覆盖部门/温室气体	时间尺度	行动性质(强制/自愿,政府/市场)	监管部门	状态(计划/执行中/已完成)	进展信息	方法学[1]和假设	预估减排效果[2]	获得支持
1	中国全社会减缓行动	2020 年单位国内生产总值二氧化碳排放比 2005 年下降 40%-45%	全社会能源活动/二氧化碳	2006-2020	强制/政府	国家发展改革委	执行中	2015 年单位国内生产总值二氧化碳排放比 2005 年下降了 38.6%	碳排放强度下降率=（1-目标年碳强度/基年碳强度）×100%	/	
节能与提高能效											
2	中国全社会节能行动	2015 年单位国内生产总值能耗比 2010 年下降 16%	全社会/二氧化碳等	2011-2015	强制/政府	国家发展改革委及其他相关部门	已完成	2015 年单位 GDP 能耗比 2010 年的下降了 18.4%，五年累计节能约 8.7 亿吨标准煤	碳排放量=节能量×能源消费综合排放因子	五年累计减排约 19 亿吨 CO_2 左右	
3	万家企业节能低碳行动	2011-2015 年累计节能 2.5 亿吨标准煤	工业等/二氧化碳等	2011-2015	强制/政府	国家发展改革委、工业和信息化部等	已完成	2011-2014 年行动实现累计节能约 3.09 亿吨标准煤	碳排放量=节能量×能源消费综合排放因子	四年累计减排约 6.8 亿吨 CO_2	

[1] 煤炭、石油、天然气和能源消费综合排放因子根据《中华人民共和国第二次国家信息通报》温室气体清单数据计算得到，电力排放因子采用电网平均排放因子

[2] “减排量”相互有叠加，不能累加

序号	行动名称	行动目标或主要内容	覆盖部门/温室气体	时间尺度	行动性质	监管部门	状态	进展信息	方法学和假设	预估减排效果	获得支持
4	锅炉窑炉改造工程	2015 年工业锅炉、窑炉平均运行效率分别比 2010 年提高 5 个和 2 个百分点	工业/二氧化碳等	2005-2015	政府	国家发展改革委及其他相关部门	已完成	估算 2011-2015 年间实现累计节能 7500 万吨标准煤左右	碳排放量=节能量×能源消费综合排放因子	估算 2011-2015 年间实现累计减排 1.6 亿吨 CO_2	
5	电机系统节能工程	2015 年电机系统运行效率比 2010 年提高 2－3 个百分点	工业/二氧化碳等	2005-2015	政府	国家发展改革委及其他相关部门	已完成	估算 2011-2015 年间实现累计节电约 800 亿千瓦时	碳排放量=节电量×电力排放因子	估算 2011-2015 年间实现累计减排 0.5 亿吨 CO_2	
6	能源系统优化工程	加强电力、钢铁、有色金属、合成氨、炼油、乙烯等行业企业能量梯级利用和能源系统整体优化改造	工业/二氧化碳等	2005-2015	政府	国家发展改革委及其他相关部门	执行中	估算 2011-2015 年间实现累计节能约 4600 万吨标准煤	碳排放量=节能量×能源消费综合排放因子	估算 2011-2015 年间实现累计减排 1 亿吨 CO_2	
7	余热余压利用工程	到 2015 年新增余热余压发电能力 2000 万千瓦	工业/二氧化碳等	2005-2015	政府	国家发展改革委及其他相关部门	已完成	估算 2011-2015 年间实现累计节能约 5700 万吨标准煤	碳排放量=节能量×能源消费综合排放因子	估算 2011-2015 年间实现累计减排 1.3 亿吨 CO_2	
8	节约和替代石油工程	2011-2015 年间节约和替代石油 800 万吨	工业、交通运输业/二氧化碳等	2005-2015	政府	国家发展改革委及其他相关部门	已完成	估算 2011-2015 年间实现累计节能约 1120 万吨标准煤	碳排放量=节能量×石油消费排放因子	估算 2011-2015 年间实现累计减排 0.2 亿吨 CO_2	

序号	行动名称	行动目标或主要内容	覆盖部门/温室气体	时间尺度	行动性质	监管部门	状态	进展信息	方法学和假设	预估减排效果	获得支持
9	绿色照明工程	分阶段淘汰普通照明用白炽灯等低效照明产品，推广节能灯具	服务业等/二氧化碳等	20 世纪 90 年代至今	政府	国家发展改革委及其他相关部门	执行中	估算 2011-2015 年间实现累计节能约 2100 万吨标准煤	碳排放量=节能量×能源消费综合排放因子	估算 2011-2015 年间实现累计减排约 0.5 亿吨 CO_2	
10	节能技术产业化示范工程	产业化推广 30 项以上重大节能技术	工业、交通运输业等/二氧化碳等	2011 至今	政府	国家发展改革委及其他相关部门	执行中	估算 2011-2015 年间实现累计节能约 1500 万吨标准煤	碳排放量=节能量×能源消费综合排放因子	估算 2011-2015 年间实现累计减排 0.3 亿吨 CO_2	
11	节能产品惠民工程	对高效照明产品、高效节能空调、平板电视、电脑，以及电机、风机、水泵、汽车等产品实施补贴推广	工业、交通运输业等/二氧化碳等	2007 至今	政府	国家发展改革委及其他相关部门	执行中	到 2013 年，已经形成家电、汽车、工业产品 3 大类 15 个品种，数十万种型号的“节能产品惠民工程”推广体系。2013 年实现年节能约 2000 万吨标准煤	碳排放量=节能量×能源消费综合排放因子	2013 年实现年减排 0.4 亿吨 CO_2	
12	合同能源管理推广工程	推行合同能源管理、发展节能服务产业	节能服务业/二氧化碳等	2010 至今	政府	国家发展改革委及其他相关部门	执行中	2015 年合同能源管理项目投资达 1039.56 亿元，可实现节能 3421 万吨标准煤	碳排放量=节能量×能源消费综合排放因子	2015 年实现年减排 0.7 亿吨 CO_2	

序号	行动名称	行动目标或主要内容	覆盖部门/温室气体	时间尺度	行动性质	监管部门	状态	进展信息	方法学和假设	预估减排效果	获得支持
13	能效标识制度	对终端用能产品、生产企业和检测机构实施能效标识	全社会/二氧化碳等	2005至今	政府	国家发展改革委及其他相关部门	执行中	2005-2015 十年间累计节电 4419 亿千瓦时	碳排放量=节电量×电力排放因子	2005-2015 十年间累计减排 2.9 亿吨 CO_2	
14	工业部门节能行动	到 2015 年，单位工业增加值（规模以上）能耗比 2010 年下降 21%左右	工业/二氧化碳等	2011-2015	政府	国家发展改革委、工业和信息化部及其他相关部门	已完成	2014 年单位工业增加值（规模以上）能耗比 2010 年累计下降约 21%，2011-2014 年间累计环比节能约 5.8 亿吨标准煤	碳排放量=节能量×能源消费综合排放因子	2011-2014 四年间累计减排 12.7 亿吨 CO_2	
15	建筑用能节能行动	2011-2015 年间建筑节能形成 1.16 亿吨标准煤节能能力	建筑物/二氧化碳等	2011-2015	政府	国家发展改革委、住房城乡建设部及其他相关部门	已完成	预计 2011-2015 年间实现累计节能约 1.16 亿吨标准煤	碳排放量=节能量×能源消费综合排放因子	估算 2011-2015 五年间累计减排 2.5 亿吨 CO_2	

序号	行动名称	行动目标或主要内容	覆盖部门/温室气体	时间尺度	行动性质	监管部门	状态	进展信息	方法学和假设	预估减排效果	获得支持
优化能源结构											
16	发展非化石能源	到 2020 年和 2030 年，非化石能源占能源消费总量比重分别达到 15%和 20%左右	能源工业/二氧化碳等	2005-2030	强制/政府	国家能源局、国家发展改革委及其他相关部门	执行中	2015 年非化石能源占能源消费总量比重 12%，比 2005 年提高 4.6 个百分点。	减排量=Σ(当年非化石能源消费量-当年能源消费总量×2005 年非化石能源占比)×2005 年能源消费综合排放因子	2006 年至 2015 年已累计完成减排 17.5 亿吨 CO_2	中丹项目支持成立国家可再生能源中心(CNREC)
17	发展天然气	到 2020 年，天然气占能源消费总量比重达到 10%以上	能源工业/二氧化碳等	2005-2020	政府	国家能源局、国家发展改革委及其他相关部门	执行中	2015 年天然气占能源消费总量比重 5.9%，比 2005 年提高 3.5 个百分点。	减排量=Σ(当年天然气消费量-当年能源消费总量×2005 年天然气占比)×(2005 年能源消费综合排放因子-天然气排放因子)	2006 年至 2015 年已累计完成减排 5.2 亿吨 CO_2	
18	发展水电	到 2020 年，力争常规水电装机达到 3.5 亿千瓦左右	能源工业/二氧化碳等	2005-2020	强制/政府	国家能源局、国家发展改革委及其他相关部门	执行中	2015 年水电占总发电量比重 19.4%，比 2005 年提高了 3.5 个百分点。2015 年水电装机容量 3.2 亿千瓦，水电发电量 1.11 万亿千瓦时。	减排量=Σ(当年水电发电量-当年发电总量×2005 年水电占比)×2005 年电力排放因子	2006 年至 2015 年已累计完成减排 3.9 亿吨 CO_2	中丹项目支持成立国家可再生能源中心（CNREC）

序号	行动名称	行动目标或主要内容	覆盖部门/温室气体	时间尺度	行动性质	监管部门	状态	进展信息	方法学和假设	预估减排效果	获得支持
19	发展风电	到2020年，风电装机达到2亿千瓦，风电与煤电上网电价相当	能源工业/二氧化碳等	2005-2020	强制/政府	国家能源局、国家发展改革委及其他相关部门	执行中	2015年风电占总发电量比重3.2%，比2005年提高了3.2个百分点。2015年并网风电装机容量13075万千瓦，并网风电发电量1856亿千瓦时。	减排量=Σ(当年风电发电量-当年发电总量×2005年风电占比)×2005年电力排放因子	2006年至2015年已累计完成减排5.4亿吨CO_2	中丹项目支持成立国家可再生能源中心（CNREC）
20	发展太阳能发电	2020年，光伏装机达到1亿千瓦左右，光伏发电与电网销售电价相当	能源工业/二氧化碳等	2005-2020	强制/政府	国家能源局、国家发展改革委及其他相关部门	执行中	2015年太阳能发电占总发电量比重0.7%，比2005年提高了0.7个百分点。2015年并网太阳能发电装机容量4218万千瓦，并网太阳能发电量395亿千瓦时。	减排量=Σ(当年太阳能发电量-当年发电总量×2005年太阳能发电占比)×2005年电力排放因子	2006年至2015年已累计完成减排0.6亿吨CO_2	中丹项目支持成立国家可再生能源中心（CNREC）

第四部分 资金、技术和能力建设需求及获得的资助

资金、技术和能力建设是应对气候变化的一项重要内容，发达国家切实兑现向发展中国家提供资金、技术转让和能力建设支持是发展中国家有效应对气候变化的重要保障。中国正处在工业化、城镇化深入发展阶段，面临着发展经济、消除贫困、改善民生、保护环境、应对气候变化等多重挑战。全面落实中国控制温室气体排放行动目标和国家自主贡献目标，不仅需要国内付出艰苦努力，也需要附件一缔约方按照《公约》的要求，在资金、技术和能力建设等方面提供支持，以提高中国应对气候变化的能力。

第一章 应对气候变化资金需求和获得的支持

一、国内资金投入

《“十二五”控制温室气体排放工作方案》明确提出强化资金保障落实，从节能减排和可再生能源发展等财政资金中安排资金，支持应对气候变化相关工作。充分利用中国清洁发展机制基金资金，拓宽多元化投融资渠道，积极引导社会资金、外资投入低碳技术研发、低碳产业发展和控制温室气体排放重点工程。调整和优化信贷结构，积极做好控制温室气体排放、促进低碳产业发展的金融支持和配套服务工作。在利用国际金融组织和外国政府优惠贷款安排中，加大对控制温室气体排放项目的支持力度。

“十二五”时期，中国积极推进低碳发展和绿色发展战略，开展应对气候变化减缓和适应行动，并为此投入了大量资金。2010 年至 2014 年间，国家财政用于支持减缓和适应气候变化的相关行动，包括能源节约、可再生能源、能源管理、自然生态保护、天然林保护、退耕还林、风沙荒漠化治理、退耕还草等，支出资金 8210.69 亿元人民币[1]。2011 年至 2014 年间，国资委累计安排 200 亿元左右的国有资本经营预算用于支持各企业节能减排工作，中央企业节能减排降碳投入达 2000 亿元以上，累计实现节能量约 1.46 亿吨标准煤，相当于减少二氧化碳排放约 3.5 亿吨[2]。通过中国清洁发展机制基金支持中央和地方开展应对气候变化政策研究、能力建设和提高公众意识等活动。“十二五”期间，基金累计安排 11 亿元赠款资金，支持开展了 505 个赠款项目，开展有偿使用业务，审核通过了 210 个委托贷款项目，安排贷款资金达到了 130.36 亿元，撬动社会资金 640.43 亿元。2015 年，财政部还首次将应对气候变化管理事务纳入“政府收支分类科目”，在政

[1] 数据来源：《中国财政年鉴 2011》、《中国财政年鉴 2012》、《中国财政年鉴 2013》、《中国财政年鉴 2014》、《中国财政年鉴 2015》。截止到目前，2016 年年鉴尚未公开出版发行。

[2] 数据来源：《中国应对气候变化的政策与行动 2015 年度报告》

府年度预算中为应对气候变化工作安排相关资金。为促进能源节约，提高能源利用效率，财政部于 2015 年印发了《节能减排补助资金管理暂行办法》。同时，积极鼓励企业参与，发挥市场机制作用，截止至 2014 年，新兴产业创投计划支持设立创业投资基金已达 190 支，其中投资于节能环保和新能源领域的基金有 44 支，投资规模约 126 亿元[1]。

二、获得的国际支持

（一）从公约资金机制运营实体全球环境基金获得的支持

作为发展中国家，中国符合《公约》气候资金支持的受援国条件，具有申请使用《公约》资金机制运营实体资金支持的权利。在全球环境基金（GEF）的 2010 至 2014 财年，中国获得 GEF 赠款承诺支持的气候变化领域国别项目共计 20 个（表 4-1），合计获得赠款资金约 1.49 亿美元，主要涉及领域包括能效提升、低碳交通、建筑节能、低碳城市示范和农作物土壤碳封存等。

[1] 数据来源：《中国应对气候变化的政策与行动 2014 年度报告》

表 4-1 2010 财年-2014 财年中国气候变化项目获得 GEF 赠款承诺[1]（万美元）

序号	GEF 项目代　　码	项目名称	GEF 赠款
1	3824	中国-新加坡天津绿色低碳生态城项目	616
2	4109	中国工业能源效率促进项目	400
3	4156	城市群生态交通：模式开发与示范项目	480
4	4188	气候变化技术需求评估项目	500
5	4488	中国上海低碳城市绿色能源方案	435
6	4493	中国可再生能源加强（二期）	2728
7	4500	大城市交通堵塞与碳减排项目	1818
8	4621	河北能源效率改进与减排	364
9	4866	工业供热系统与高耗能设备提高能效项目	538
10	4869	城市建筑节能与可再生能源项目	1200
11	4882	中国第三次信息通报和双年报准备项目	728
12	4947	中国市场化能效开发项目	1780
13	5121	节能减排和主要农作物生产的土壤碳封存项目	510
14	5360	中国电动汽车工业节能推进项目	350
15	5373	浙江绿色物流项目	291
16	5411	江西和福州城市综合基础设施改进	255
17	5582	江西和济南可持续城市交通项目	255
18	5627	中国清洁汽车租赁项目	232
19	5669	固态照明市场转换和发光二极管照明项目	624
20	5728	中国燃料电池汽车开发和商业化促进项目	823

（二）与附件一缔约方和相关国际组织合作获得支持

中国高度重视气候变化双边和多边国际合作。在过去几年间，中国致力于同《公约》附件一缔约方和相关国际组织在减缓和适应气候变化行动及相关能力建设领域开展友好合作，从国家和地方层面与国际社会共同探索促进全球绿色低碳发展路径创新与转型，并得到了一定的资金支持，主要项目支持情况见表 4-2。

[1] 数据来源：全球环境基金官网

表 4-2 中国应对气候变化获得的主要双边和多边国际合作项目支持情况

序号	项目名称	合作伙伴	资金额度	项目周期
1	中国省级应对气候变化方案项目	联合国开发计划署（UNDP）/挪威/欧盟	410 万美元	2008-2012
2	中意气候变化合作计划	意大利	280 万欧元	2010-2016
3	中国基于“十二五”的适应气候变化战略应用研究	挪威	91 万挪威克朗	2010-2016
4	中挪生物多样性与气候变化项目	挪威	1943 万挪威克朗	2011-2014
5	省级温室气体清单能力建设和企业温室气体核算项目	UNDP/挪威	300 万美元	2012-2015
6	国家碳排放权交易及自愿减排交易登记注册系统建立及相关能力建设项目	UNDP/挪威	406 万美元	2012-2016
7	重庆市、广东省低碳产品认证项目	欧盟/UNDP	96 万美元	2013-2014
8	碳市场伙伴关系项目前期准备	世界银行	38 万美元	2013-2015
9	中欧碳交易能力建设项目	欧盟	500 万欧元	2014-2017
10	碳市场伙伴关系项目	世界银行	800 万美元	2015-2018
11	中欧低碳生态城市合作项目	欧盟	936 万欧元	2014-2017
12	中德公共建筑节能项目	德国	300 万欧元	2011-2015
13	建筑节能与气候保护：中国北方既有居住建筑采暖能耗基准线研究项目	德国	200 万欧元	2010-2013
14	中国建筑节能领域关键参与者能力建设项目	德国	195 万欧元	2013-2016

（三）编制双年报获得的资助

作为《公约》非附件一缔约方，中国通过向作为《公约》资金机制运行实体的 GEF 申请资助，用于准备第三次国家信息通报和第一次两年更新报告。2015 年获得了 GEF 的赠款，其中用于支持编制两年更新报告的预算约为 90 万美元。在收到 GEF 赠款后，中国政府积极部署，由国家发展改革委牵头成立项目指导委员会，组织有关单位和专家进行撰写，用一年多时间完成了两年更新报告的编制、讨论、征求意见、送审、提交等工作。

三、未来资金需求

为实现 2030 年中国控制温室气体排放自主行动目标，有效实施国家自主贡献文件提出的完善应对气候变化区域战略、构建低碳能源体系、形成节能低碳的产业体系、控制建筑和交通领域排放、努力增加碳汇、全面提高适应气候变化能力、强化科技支撑等 15 项重大行动，中国应对气候变化仍存在很大的资金需求。据国家气候战略中心研究

测算，未来 15 年的新增低碳投资需求约为 30 万亿人民币，其中新增节能投资约为 10 万亿、新增低碳能源投资约为 20 万亿，平均每年约为 2 万亿。为满足上述资金需求，一方面需要国内政府、企业和社会团体增加投入，另一方面也需要继续开展多双边国际合作，特别是争取发达国家提供的“新的、额外的”气候资金支持。

第二章 应对气候变化技术需求

一、国内政策与行动

2011年国务院发布的《“十二五”控制温室气体排放工作方案》明确提出加强低碳技术研发和推广应用，在重点行业和重点领域实施低碳技术创新及产业化示范工程，重点发展经济适用的低碳建材、低碳交通、绿色照明、煤炭清洁高效利用等低碳技术；开发高性价比太阳能光伏电池技术、太阳能建筑一体化技术、大功率风能发电、天然气分布式能源、地热发电、海洋能发电、智能及绿色电网、新能源汽车和储电技术等关键低碳技术；研究具有自主知识产权的碳捕集、利用和封存等新技术。推进低碳技术国家重点实验室和国家工程中心建设。编制低碳技术推广目录，实施低碳技术产业化示范项目。

2011年12月国家能源局印发了《国家能源科技“十二五”规划》，确定先进核能发电技术、大型风力发电技术、高效大规模太阳能发电技术、大规模多能源互补发电技术和生物质能的高效利用技术等5个能源应用技术和工程示范重大专项。2012年5月科技部会同外交部、国家发展改革委等发布了《“十二五”国家应对气候变化科技发展专项规划》，明确提出选择一批跨部门、跨领域、可操作性强、应用前景广阔的减缓和适应气候变化技术进行重点支持、集中攻关并示范，并在减缓和适应领域分别提出重点发展的十项关键技术。2013年4月国家发展改革委印发了《关于推动碳捕集、利用和封存试验示范的通知》，明确提出结合碳捕集和封存各工艺环节实际情况开展相关试验示范项目，重点开展示范项目和基地建设，探索建立相关政策激励机制，推动相关标准规范的制定。国家发展改革委分别于2014年和2015年发布了两批《国家重点推广的低碳技术目录》，共62项低碳技术（表4-3），科技部编制并发布了《节能减排与低碳技术成果转化推广清单》，共19项技术。

二、国际合作与进展

《中华人民共和国气候变化第二次国家信息通报》在减缓与适应气候变化方面均提出了明确的技术需求清单，其中减缓技术需求集中在能源、钢铁、交通、建筑以及通用技术等五个方面，包括IGCC发电技术、大规模海上风力发电技术、氢能与燃料电池技术、智能电网与储能技术、碳捕集与封存、高效纯电动汽车技术等较为详细的技术需求；适应技术需求集中在综合观测、数值预报、农业领域、海岸带防护和生态系统五个领域。

“十二五”时期，中国积极推动和实践气候技术国际合作。在《公约》框架下，中国积极参与技术议题谈判与磋商，作为发展中国家的代表参加技术执行委员会、气候技术中心与网络咨询理事会等工作。在多边和区域合作领域，参与了电动汽车倡议、碳收集领导人论坛、国际智能电网行动网络倡议、国际氢能经济和燃料电池伙伴计划等多个国际倡议，2015年11月由中国等20个国家共同发起的“创新使命”倡议提出参与国寻求5年内清洁能源研发的政府投资翻倍。在双边合作领域，推动中美、中欧、中英、中德、中韩等在气候变化领域的务实技术合作，在载重汽车和其他汽车减排、电力系统、碳捕集、利用和封存、建筑和工业能效、森林碳汇、温室气体测量、工业锅炉效率和燃料转换、绿色港口和船舶等方面取得积极进展（表4-4）。

表 4-3 国家重点推广的低碳技术目录

第一批	第二批
非化石能源类技术	
基于微结构通孔阵列平板热管的太阳能集热器技术、多能源互补的分布式能源技术、太阳能热泵分布式中央采暖系统技术、太阳能热利用与建筑一体化技术、高效光伏逆变器技术、直驱永磁风力发电技术、低风速风力发电技术、生物质成型燃料规模化利用技术、生物燃气高效制备热电联产技术、农作物秸秆规模化收集装备技术、生物质热解炭气油联产技术、微电网并网运行及接入控制关键技术	风电场、光伏电站集群控制技术、基于免蓄电池风光互补扬水灌溉技术、生物质气化燃气替代窑炉燃料技术、基于二次燃烧的高效生物质气化燃烧技术、基于氢氧化钠湿式固态常温预处理工艺的生物天然气制备技术、基于无机械搅拌厌氧系统的生物天然气制备技术、基于亚临界水热反应生物质废弃物资源化利用技术、工业生物质废弃物能源化（热解）利用集成技术
燃料及原材料替代类技术	
生活垃圾焚烧发电技术、有机废气吸附回收技术、有机废弃物厌氧发酵制备车用燃气技术、低碳喷射混凝土技术、低水泥用量堆石混凝土技术、电石渣制水泥规模化应用技术、发动机再制造技术、全生物二氧化碳基降解塑料制造技术、废聚酯瓶片回收 直纺工业丝技术、沥青混凝土拌合站天然气替代燃油改造技术、罐式煅烧炉密封改造技术	基于双膨胀自深冷分离的石油化工尾气高效回收技术、乙烯氧化生产环氧乙烷高性能银催化剂技术、粘度时变材料可控灌浆技术、新型干法水泥窑无害化协同处置污泥技术、全生物降解材料聚羟基脂肪酸酯（PHA）的制作技术、竹缠绕复合压力管技术、利用废聚酯类纺织品生产再生涤纶短纤维关键技术、PH 型智能化扩容蒸发器技术、环保型 PAG 水溶性介质淬火技术、车用锂离子动力电池系统开发技术、基于能源作物蓖麻的全产业链高值化利用技术、餐厨废弃物资源化利用生产生物腐植酸技术
工艺过程等非二氧化碳减排类技术	
低浓度瓦斯真空变压吸附提浓技术、降低铝电解生产全过程全氟化碳（PFCs）排放技术、等离子体焚烧处理三氟甲烷(HFC-23)技术、HFC-23 高温焚烧分解技术、应用副产四氯化碳制备含氟单体三氟丙烯技术	煤层瓦斯增透解吸技术、六氟化硫（SF_6）气体循环再利用技术、电力开关设备 SF_6 气体替代技术、利用 CO_2 替代 HFCs 发泡生产挤塑板的技术、低充灌量 R290 空调压缩机技术
碳捕集、利用与封存类技术	
二氧化碳的捕集驱油及封存技术、二氧化碳捕集生产小苏打技术	低碳低盐无氨氮分离提纯稀土化合物新技术、半碳法制糖工艺技术
碳汇类技术	
秸秆生物质炭农业应用技术、杉木人工林增汇减排经营技术、油料植物能源化利用过程的 CO_2 减排技术	公益性人工林小林窗疏伐经营技术、秸秆清洁制浆及其废液肥料资源化利用技术

表 4-4 中美应对气候变化工作组下的技术合作

领域	技术合作内容	进展
载重汽车和其他汽车	提高载重汽车和其他汽车的燃油效率标准，加强清洁燃料和机动车排放控制技术领域交流与合作，推广高效、清洁的货运。	启动了"零排放竞赛"（R2ZE）项目以及零排放竞赛官网，推广部署电动和其他零排放公交车的成功经验；制定了中美载重汽车发动机实验室循环测试方案；进一步合作推进"中国绿色货运行动倡议"（CGFI）以提高货运效率。
电力系统	加强在智能电网以及电力消费、需求和竞争等领域的经验分享。	继续推动"智能电网倡议"的落实；交流了制度创新和政策行动方面的最佳实践经验，以推动电力系统低碳化、增强气候适应力和可持续发展能力。
碳捕集、利用与封存	通过组织召开研讨会、支持互派技术专家等形式加强在大型项目示范、国际标准制定、政策制定与项目管理经验分享等领域开展交流与合作。	确认了 6 个对口 CCUS 合作项目，旨在推动两国建设大规模 CCUS 示范项目，以降低未来技术部署的成本。
建筑和工业能效	在利用合同能源管理（EPC）以及评选和推广最佳节能实践和最佳节能技术方面加强合作。	推动和评估了符合两国一致推行标准的中美合同能源管理试点项目。
气候变化和森林	加强林业测量、报告和监管方面的技术合作，在森林的减缓和适应气候变化协同效应领域开展试点经验交流与分享。	举办林业相关温室气体评估和报告研讨会，组织中方专家考察美国土地领域国家级温室气体检测体系和技术体系。
气候智慧型/低碳城市	开展气候智慧型/低碳城市相关技术和服务展览，推动技术交流。	在洛杉矶和北京各召开一届"中美气候智慧型/低碳城市峰会"。
工业锅炉效率和燃料转换	分享锅炉系统追踪、监控和标准化经验。	选择宁波和西安做为试点城市，并为解决两城市工业锅炉能源和环境挑战制定中美协作分析和实施路线图。双方于 2016 年 1 月组织融资伙伴和美国技术提供方赴宁波和西安的考察，促成其与希望参与改造或代替小规模锅炉的地方利益相关方会面。
温室气体测量	中国计量科学研究院与美利坚合众国国家标准与技术研究院将在重要领域开展测量科学与标准方面互利共赢的合作，支撑 2014 年 11 月 12 日两国元首宣布的《中美气候变化联合声明》的实施，同时支持产业发展和环境保护，提高两国国民的健康水平和生活质量。	中美双方已于 2015 年 9 月习近平总书记访美期间正式签订《中华人民共和国国家计量科学研究院与美利坚合众国国家标准与技术研究院关于温室气体测量和精准医疗领域标准的合作意向书》。

三、技术需求清单

关键技术的开发与转让对中国实现国家自主贡献目标至关重要。中国国家自主贡献文件明确提出加强对节能降耗、可再生能源和先进核能、碳捕集利用和封存等低碳技术的研发和产业化示范，推广利用二氧化碳驱油、驱煤层气技术；研发极端天气预报预警技术，开发生物固氮、病虫害绿色防控、设施农业技术，加强综合节水、海水淡化等技术研发，并提出健全应对气候变化科技支撑体系，建立政产学研有效结合机制，加强应对气候变化专业人才培养。

基于第二次国家信息通报提出的技术需求，国家发展改革委利用世界银行中国应对气候变化技术需求评估项目，结合中国近期出台的应对气候变化相关技术战略规划与行动方案，对中国应对气候变化技术需求进行了更新（表4-5、表4-6）。

表 4-5 中国减缓技术需求清单

部门/行业	技术名称
能源部门	先进煤气化技术、先进低阶煤热解技术、高效超超临界燃煤发电技术、超临界二氧化碳循环发电技术、整体煤气化燃料电池联合循环(IGFC-CC)发电技术、磁流体发电联合循环(MHD-CC)发电技术、高效燃气轮机技术
	快堆及燃料元件设计与工程化技术、超高温气冷堆关键技术及高温热工程应用技术、先进小型堆关键技术及工程化
	新型高效太阳能电池产业化关键技术、高效和低成本晶体硅电池产业化关键技术、薄膜太阳能电池产业化关键技术、高参数太阳能热发电技术、分布式太阳能热电联供系统技术、太阳能热化学制取清洁燃料关键技术、智能化分布式光伏及微电网应用技术、高能效和低成本智能光伏电站关键技术、大型槽式太阳能热发电站仿真与系统集成技术、50-100MW级大型太阳能光热电站关键技术
	100米级及以上叶片设计制造技术、大功率陆上风电机组及部件设计与优化关键技术、陆上不同类型风电场运行优化及运维技术、10MW级及以上海上风电机组及关键部件设计制造关键技术、10MW级及以上海上风电机组控制系统与变流器关键技术、远海风电场设计建设技术、大型海上风电机组基础设计建设技术、大型海上风电基地群控技术、海上风电场实时监测与运维技术
	大规模制氢技术、分布式制氢技术、氢气储运技术、氢气/空气聚合物电解质膜燃料电池(PEMFC)技术、甲醇/空气聚合物电解质膜燃料电池(MFC)技术、燃料电池分布式发电技术
	生物航油制取关键技术、绿色生物炼制技术、生态能源农场、生物质能源开发利用探索技术、波浪能利用技术、潮流能利用技术、温(盐)差能利用技术、干热岩开发利用技术、水热型地热系统改造与增产技术
	储热/储冷技术、新型压缩空气储能技术、飞轮储能技术、高温超导储能技术、大容量超级电容储能技术、电池储能技术、先进输变电装备技术、直流电网技术、电动汽车无线充电技术、新型大容量高压电力电子元器件及系统集成、高效电力线载波通信技术、可再生能源并网与消纳技术、现代复杂大电网安全稳定技术
	新一代大规模低能耗CO_2捕集技术、基于IGCC系统的CO_2捕集技术、大容量富氧燃烧锅炉关键技术、CO_2驱油利用与封存技术、CO_2驱煤层气与封存技术、CO_2驱水利用与封存技术、CO_2矿物转化、固定和利用技术、CO_2矿化发电技术、CO_2化学转化利用技术、CO_2生物转化利用技术、CO_2安全可靠封存与监测及运输技术
钢铁部门	炼焦煤预热技术、新型炼焦技术、炼焦荒煤气余热回收技术、利用废弃物代替炼焦煤技术、低碳排放炼铁技术、电炉炼钢节能技术、高效铸轧技术、低热值煤气高效利用发电技术

表 4-5 中国减缓技术需求清单（续）

部门/行业	技术名称
交通	先进高速重载轨道交通装备、城市轨道交通牵引供电系统制动能量回馈技术、轨道车辆直流供电变频空调技术、缸内汽油直喷发动机技术、车用燃油清洁增效技术、基于减小螺旋桨运动阻力的船舶推进系统、数字化岸电系统、沥青路面冷再生技术、LED智能照明技术、大功率氙气灯照明技术、港口优化技术
建筑	建筑工业化技术、装配式住宅技术、超低能耗建筑技术、高效能热泵技术、磁悬浮变频离心式中央空调技术、温湿度独立控制空调系统技术、排风余热与制冷机组冷凝热回收、高防火性墙体保温技术、热反射镀膜玻璃技术、低辐射(Low-E)玻璃技术、建筑遮阳技术
建材	利用玻璃熔窑烟气余热发电技术、计算机工艺控制技术、浮法玻璃熔窑0#喷枪纯氧助燃技术、熔窑全保温技术、利用玻璃窑烟气余热预热配合料技术、全氧燃烧技术
化工	高含CO_2天然气制甲醇技术、液力透平节能技术、压缩机Hydro COM无级气量调节系统、开式热泵技术、无CO_2排放型粉煤加压输送技术、离子交换膜技术
有色金属	富氧顶吹熔炼技术、闪速富氧熔池熔炼技术、烟气余热回收技术
农林和土地利用	碧晶尿素增产减排高效利用技术、高产低排放水稻品种选育技术、农林复合系统营建技术、最佳森林经营方案确定技术、土地利用综合管理技术
废弃物	焚烧-燃气发电-蒸汽联合循环系统（WtE-GT）、烟气换热（gas-gas heating，GGH）技术、填埋气高效收集与利用技术、填埋场生物覆盖层减排技术
海洋	波浪能利用技术、潮流能利用技术、温（盐）差能利用技术、蓝色碳汇调查评估技术体系、蓝色碳汇贮藏能力提升技术体系、海洋二氧化碳海底封存技术
通用	高效工业锅(窑)炉技术、新型节能电机及拖动设备、工业余能深度回收利用技术、工业系统优化节能技术

表 4-6 中国适应技术需求清单

领域	技术名称
农业	水稻耐热育种技术、水稻抗稻瘟育种技术、水稻抗白叶枯病育种技术、水稻抗条纹叶枯病育种技术、玉米耐旱育种技术、南方玉米锈病技术、小麦耐旱性育种技术、小麦抗白粉病育种技术、小麦抗赤霉病育种技术、抗虫棉育种技术、精准肥水技术、可降解的覆盖保墒技术、膜下滴灌技术、膜面集雨技术
林业	干旱半干旱石质山地困难立地植被恢复技术、荒漠植被快速恢复技术、干旱地区微水造林技术、山地脆弱生态区植被恢复技术、森林火灾致灾机理与综合防控技术、基于森林健康理念的采伐作业技术措施、低效林改造对策和措施、人工复层林经营技术、北方针叶林采伐管理技术、权衡森林商品和服务的管理技术
水资源	太阳能光伏提水灌溉节水技术、橡胶坝供水技术、大型喷灌机技术、干旱适应性技术、雨水集蓄利用技术、贫水层水开发集成利用技术、复合流人工湿地净化污水技术、中水回用处理设备及技术、处理分散生活污水腐殖填料滤池工艺技术、低温膜蒸馏技术、海水或苦咸水淡化膜技术、水资源优化配置技术、跨流域调水技术、水资源应急调配技术、水生态保护与修复技术、基于风险管理的水资源规划技术
城市	基于大排水系统全过程调控的城市内涝防控技术、长距离高扬程大流量引水工程关键技术、基于污水源分离的半集中式分质供排水技术、城市能源基础设施的“水、气、热三网”协同技术、被动式超低能耗绿色建筑建设技术、屋顶绿化技术、透水路面应用技术、大型城市地下管网抗灾可靠性优化设计技术、基于气候适应的城市基础设施设计和建设标准体系提升及支撑技术、城市基础设施运行风险仿真预警与综合防灾改造技术、城镇交通基础设施智能化监控与维护技术、地下管线周边空洞等病害体快速探测、风险评估和绿色修复技术、城市气候变化适应性规划体系构建技术、城市绿地布局优化技术、公共交通基础设施优化布局与智能运行技术
防灾减灾	能源供应战略方案及其环境综合影响模型、区域数值天气预报技术、环境气象数值模式技术、自动气象站技术、气象探空仪技术、雷电探测技术、天气雷达监测技术、气象卫星遥感技术、高性能计算机技术、气象观测资料质量控制技术、气象资料再分析技术、气象卫星资料同化技术、全球数值天气预报技术、灾害天气预报技术、全球及区域气候系统模式技术、气候及气候变化综合影响评估技术、极端洪旱灾害早期识别预警技术、气候变化对我国极端洪水事件影响模式技术、防洪减灾适应性技术、海洋生态系统对气候变化的脆弱性与适应性技术、气候变化对沿海地区经济社会发展影响评估技术、海岸带适应气候变化措施和技术

第三章 应对气候变化能力建设需求

一、国内政策与行动

2011年发布的《“十二五”控制温室气体排放工作方案》提出进一步完善应对气候变化政策体系和体制机制，逐步建立温室气体排放统计核算体系。2014年9月国务院印发的《国家应对气候变化规划（2014-2020年）》明确要求能力建设取得重要成果，应对气候变化的法规体系基本形成，基础理论研究、技术研发和示范推广取得明显进展，区域气候变化科学研究、观测和影响评估水平显著提高，气候变化相关统计、核算和考核体系逐步健全，人才队伍不断壮大，全社会应对气候变化意识进一步增强，应对气候变化管理体制和政策体系更加完备等。

“十二五”时期，中国政府利用国内资源不断提高应对气候变化能力，推动应对气候变化法制建设和重大政策制定，加强低碳发展顶层设计，完善管理体制和工作机制，加强低碳技术研发与应用，完善统计核算体系建设，提升应对气候变化基础能力。在法律体系建设方面，稳步推进应对气候变化立法的相关研究工作，2015年国家发展改革委会同有关部门完成了《应对气候变化法（初稿）》，并征求了地方政府、企业和非政府组织的意见，2014年国家发展改革委发布了《碳排放权交易管理暂行办法》，并在研究论证的基础上，向国务院法制办提交了《碳排放权交易管理条例（送审稿）》；在管理体制方面，2013年根据国务院机构设置及人员变动情况和工作需要，国务院办公厅调整了国家应对气候变化领导小组，完善了由国家发展改革委归口管理、有关部门和地方分工负责、全社会广泛参与的应对气候变化管理体制和工作机制；在统计核算方面，2013年国家发展改革委会同国家统计局发布了《关于加强应对气候变化统计工作意见》，进一步加强了应对气候变化统计的能力建设。

二、国际合作与进展

中国注重通过国际合作提高应对气候变化能力。在中美气候变化工作组温室气体数据管理合作倡议下，两国开展了一系列同企业温室气体核算与报告相关的合作交流活动，增加了双方温室气体排放信息透明度。在挪威政府和联合国开发计划署的共同支持下，中国开展了六大重点行业企业核算方法研究以及全部行业指南的培训活动，并派代表赴瑞典参加了欧盟“小型排放者”温室气体MRV研讨会。在澳大利亚政府支持下，中国有关机构开展了油气系统及石油炼制、煤炭生产、炼焦行业企业温室气体核算方法学和报告格式研究。在世界银行和欧盟的支持下，中国组织开展了关于中国碳排放权交易市场制度的一系列研究和准备活动。

三、能力建设需求清单

帮助发展中国家提高应对气候变化的能力是发达国家承担历史责任的主要手段之一，也是加强公约实施的重要内容。自第二次国家信息通报发布以来，中国利用有限的国内和国际资源加强应对气候变化能力建设，在温室气体清单编制和统计考核、适应气候变化、提高地方决策能力等方面取得了一定成效。中国近年来陆续发布的《国家适应气候变化战略》、《国家应对气候变化规划（2014-2020年）》以及国家自主贡献等规划性文件，对中国未来一段时期的工作作出了全面安排，也为中国全方位提升应对气候变化能力提出了要求。在第二次国家信息通报提出的能力建设需求的基础上，国家发展改革委对中国应对气候变化能力建设需求清单进行了更新（表4-7）。

表 4-7 中国能力建设需求清单

领域	具体需求名称
温室气体清单编制	加强温室气体清单编制的国际交流，包括活动水平数据收集、排放因子监测和测试、准确分解国内和国际的航空航海燃料消费量、估算化石燃料非能源利用排放方法学等； 交流温室气体清单编制数据库建设经验； 在开发地方温室气体清单编制指南方面加强交流。
温室气体统计核算体系	交流温室气体排放核算要求的基础统计体系建设情况； 交流温室气体排放数据报送平台建设的国际经验。
适应气候变化	利用国际先进经验，加强地方制定适应战略和规划的能力；在节水灌溉农业、水资源配置和海岸带综合管理和防护方面加强国际合作；加强城市适应气候变化管理能力； 在气候变化综合评估和风险管理、气候变化监测预警信息发布体系、极端天气气候事件应急响应机制、防灾减灾应急管理体系建设方面加强国际合作；加强蓝色碳汇国际交流，海洋领域温室气体监测体系建设，海平面上升预测、影响调查、综合评估、适应技术的国际交流。
地方政府气候变化领导能力	通过国际合作，加大对各级决策和基层工作人员的培训力度，提高利益相关方对于低碳发展重要性的认识； 利用国际先进经验，加强对地方在碳排放数据统计、分析及决策等方面的指导，加强地方低碳发展规划的能力。
碳排放权交易制度	加强与国际上已开展碳排放权交易地区的合作与交流，在碳排放权分配、核算核证、交易规则、奖惩机制、监管体系等制度设计方面吸取国际先进经验； 通过国际合作，加快对碳排放权交易专业人才培养； 通过交流探讨中国碳排放权交易市场与国外碳排放权交易市场衔接可行性，以及探索中国与其他地区开展双边和多边碳排放权交易活动相关合作机制。
培训和人才培养	需要通过国际合作，开展对政府官员、企业管理人员、媒体从业人员及相关专业人员应对气候变化方面的培训，提升意识和工作能力； 鼓励科学家和研究人员参与国际研究计划，通过国际合作加强对新闻宣传、战略与政策专家的队伍建设。

第五部分 国内测量、报告和核查相关信息

国内测量、报告和核查（MRV）能力建设对于发展中国家有效应对气候变化至关重要。作为一个负责任的发展中国家，中国政府重视应对气候变化相关基础工作和能力建设，早在 2009 年 11 月，国务院常务会议研究决定将碳强度下降目标作为约束性指标纳入国民经济和社会发展中长期规划，并制定相应的国内统计、监测、考核办法。通过“十二五”时期的不断探索和持续推进，中国应对气候变化的统计指标及基础统计体系、温室气体排放的核算报告体系以及二氧化碳排放控制目标的评价考核体系已经基本建立。

第一章 综述

第二次国家信息通报有关资金、技术和能力建设需求篇章明确指出，建立和完善中国温室气体排放统计制度，有助于提高国家温室气体清单的权威性和数据透明度，促进温室气体清单编制工作的规范化、标准化和常态化。《中华人民共和国国民经济和社会发展第十二个五年规划纲要》明确要求建立完善温室气体排放统计核算制度，加强应对气候变化统计工作。

为加快制度和体系建设，完善相应工作机制，中国政府及有关部门出台了一系列政策性文件（表 5-1）。2011 年 11 月，中国国务院印发了《“十二五”控制温室气体排放工作方案》，要求构建国家、地方、企业三级温室气体排放基础统计和核算工作体系，加强对各省（区、市）“十二五”二氧化碳排放强度下降目标完成情况的评估考核。2013 年 5 月，报请国务院同意，国家发展改革委会同国家统计局制定了《关于加强应对气候变化统计工作的意见》，明确要求各地区、各部门应高度重视应对气候变化统计工作，加强组织领导，健全管理体制，加大资金投入，加强能力建设。2013 年 11 月，国家统计局会同国家发展改革委印发了《关于开展应对气候变化统计工作的通知》，研究制定了《应对气候变化部门统计报表制度（试行）》。2014 年 1 月，国家统计局印发了《应对气候变化统计工作方案》的通知，研究制定了《政府综合统计系统应对气候变化统计数据需求表》。2014 年，国家发展改革委先后印发了《关于组织开展重点企（事）业单位温室气体排放报告工作的通知》、《单位国内生产总值二氧化碳排放降低目标责任考核评估办法》等相关文件。国家林业局编制并实施了《全国林业碳汇计量监测体系建设总体方案》等技术规范。

经过各方的共同努力，“十二五”时期中国应对气候变化及控制温室气体排放的基础统计、核算报告与评价考核三大制度设计、体系建设及工作机制取得重大进展（表 5-2），为推动建立公平合理的国际“可测量、可报告和可核实”制度，开创中国应对气候变化事业新局面奠定了良好基础。

表 5-1 中国应对气候变化相关统计、核算、考核政策性文件汇总

发布时间	发布机构	文件名称
2011.3	国家发展改革委办公厅	《关于印发省级温室气体清单编制指南（试行）的通知》（发改办气候[2011]1041 号）
2012.6	国家发展改革委	《温室气体自愿减排交易管理暂行办法》（发改气候[2012]1668 号）
2013.5	国家发展改革委 国家统计局	《关于加强应对气候变化统计工作的意见》（发改气候[2013]937 号）
2013.10	国家发展改革委办公厅	《关于印发首批 10 个行业企业温室气体排放核算方法与报告指南(试行)的通知》（发改办气候〔2013〕2526 号）
2013.11	国家统计局 国家发展改革委	《关于开展应对气候变化统计工作的通知》（国统字[2013]80 号）
2014.1	国家统计局	《应对气候变化统计工作方案》（国统办字[2014]7 号）
2014.1	国家发展改革委	《关于组织开展重点企（事）业单位温室气体排放报告工作的通知》（发改气候[2014]63 号）
2014.8	国家发展改革委	《单位国内生产总值二氧化碳排放降低目标责任考核评估办法》（发改气候[2014]1828 号）
2014.12	国家发展改革委办公厅	《关于印发第二批 4 个行业企业温室气体排放核算方法与报告指南（试行）的通知》（发改办气候[2014]2920 号）
2015.1	国家发展改革委办公厅	《关于开展下一阶段省级温室气体清单编制工作的通知》（发改办气候[2015]202 号）
2015.7	国家发展改革委办公厅	《关于印发第三批 10 个行业企业温室气体排放核算方法与报告指南（试行）的通知》（发改办气候[2015]1722 号）

表 5-2 中国应对气候变化相关统计、核算、考核工作一览

	国家	地方	企业
基础统计	温室气体排放基础统计制度及部门特性参数调查制度	温室气体排放基础统计制度	能源消费与温室气体排放台帐制度
	应对气候变化统计指标体系及部门统计报表制度	应对气候变化统计指标体系及统计报表制度	温室气体排放监测计划
	应对气候变化统计工作领导小组等工作机制	应对气候变化统计职责分工等工作机制	
核算报告	温室气体清单定期编制与报告制度及年度二氧化碳排放核算制度	温室气体清单定期编制与报告制度	重点企业年度温室气体排放报告制度
	温室气体清单数据管理系统	温室气体清单编制指南	重点企业温室气体排放核算方法与报告指南
	重点企业温室气体排放直报平台	重点企业温室气体排放在线报送系统	
评价考核	碳强度下降目标年度及进度目标评估	省级温室气体清单质量评估与联审制度	重点企业温室气体排放核查与自愿减排项目温室气体排放核证制度
	单位国内生产总值二氧化碳排放降低目标责任考核评估办法	地市州人民政府碳强度降低目标责任考核评估办法	
	单位国内生产总值二氧化碳排放降低目标责任考核评估指标体系		

第二章 应对气候变化统计指标与基础统计体系

通过建立应对气候变化统计指标体系，建立健全覆盖能源活动、工业生产过程、农业、土地利用变化和林业、废弃物处理等领域的温室气体基础统计和调查制度，中国应对气候变化的部门及地方统计报表制度及统计体系初步形成，应对气候变化统计的能力和水平逐步得到提高。

一、温室气体排放基础统计制度

为支撑温室气体清单编制工作，国家统计局在现有统计制度基础上，将温室气体排放基础统计指标纳入政府统计指标体系，建立健全了与温室气体清单编制相匹配的基础统计体系。一是进一步完善了能源统计制度，细化和增加了能源统计品种指标，将原煤细分为烟煤、无烟煤、褐煤、其它煤炭，修改完善了能源平衡表，完善或修订了工业、服务业以及公共机构的能源统计制度，组织开展了交通运输企业能耗统计监测试点等。二是初步构建了工业、农业、土地利用变化和林业、废弃物处理等相关领域与温室气体排放紧密关联的活动量及排放特征参数的统计与调查制度。

二、应对气候变化统计指标体系

为加强应对气候变化统计工作，科学设置反映气候变化特征和应对气候变化状况的统计指标，综合反映中国应对气候变化的努力和成效，在国家发展改革委会同国家统计局印发的《关于加强应对气候变化统计工作的意见》中，首次提出了中国应对气候变化统计指标体系，包括气候变化及影响、适应气候变化、控制温室气体排放、应对气候变化的资金投入以及应对气候变化相关管理等 5 大类，涵盖 19 个小类，共计 36 项指标（表 5-3），并在此基础上建立了应对气候变化统计报表制度。

三、应对气候变化统计工作机制

2014 年，国家统计局会同国家发展改革委等有关单位成立了由 23 个部门组成的应对气候变化统计工作领导小组，建立了以政府综合统计为核心、相关部门分工协作的工作机制。2014 年以来，国家统计局印发了《应对气候变化统计指标体系》、《应对气候变化部门统计报表制度（试行）》和《政府综合统计系统应对气候变化统计数据需求表》等文件，并在全国 15 个省（区、市）开展了应对气候变化统计工作试点，应对气候变化统计队伍能力得到加强。

专栏 5-1 中国应对气候变化部门统计报表制度（试行）

（一）为加强我国应对气候变化统计工作，为国家温室气体清单编制和排放核算提供基础统计资料，依照《中华人民共和国统计法》，根据国家发展改革委、国家统计局《关于加强应对气候变化统计工作的意见》（发改气候〔2013〕937 号），制定本制度。

（二）本制度是国家统计报表制度的一部分，是国家统计局对国务院有关部门（协会）的综合要求。各有关部门（协会）应按照全国统一规定的计算方法、统计口径、统计范围和填报目录，认真组织实施，按时报送数据。

（三）本制度涉及的应对气候变化统计内容包括：应对气候变化统计指标和涵盖能源活动、工业生产过程、农业、土地利用变化与林业、废弃物处理等五个领域的活动水平指标。

（四）本制度是国务院各有关部门（协会）报送的综合年报报表，各有关部门（协会）按规定时间向国家统计局报送数据。专题调查报送周期为五年一次，调查年份根据清单编制需要确定，调查方法由组织调查的部门自行确定，在调查年份次年向国家统计局报送，其他年份免报。

来源：国家统计局，2015 年 1 月 5 日。

表 5-3 中国应对气候变化统计指标体系

领域	活动	指标	数据来源
一、气候变化及影响	1.温室气体浓度	（1）二氧化碳浓度	气象局
	2.气候变化	（2）各省（区、市）年平均气温 （3）各省（区、市）平均年降水量 （4）全国沿海各省海平面较上年变化	气象局 气象局 海洋局
	3.气候变化影响	（5）洪涝干旱农作物受灾面积 （6）气象灾害引发的直接经济损失	减灾委、民政部、农业部、水利部 减灾委、民政部、气象局
二、适应气候变化	1.农业	（1）保护性耕作面积 （2）新增草原改良面积	农业部 农业部
	2.林业	（3）新增沙化土地治理面积	林业局
	3.水资源	（4）农业灌溉用水有效利用系数 （5）节水灌溉面积	水利部 水利部
	4.海岸带	（6）近岸及海岸湿地面积	海洋局
三、控制温室气体排放	1.综合	（1）单位国内生产总值二氧化碳排放降低率	发展改革委
	2.温室气体排放	（2）温室气体排放总量 （3）分领域温室气体排放量（5 个领域六类温室气体分别的排放量）	发展改革委、统计局 发展改革委、统计局、工业和信息化部、环境保护部
	3.调整产业结构	（4）第三产业增加值占 GDP 的比重 （5）战略性新兴产业增加值占 GDP 的比重	统计局 统计局
	4.节约能源与提高能效	（6）单位 GDP 能源消耗降低率 （7）规模以上单位工业增加值能耗降低率 （8）单位建筑面积能耗降低率	统计局 统计局 住房城乡建设部
	5.发展非化石能源	（9）非化石能源占能源消费总量比重	统计局、国家能源局
	6. 增加森林碳汇	（10）森林覆盖率 （11）森林蓄积量 （12）新增森林面积	林业局 林业局 林业局
	7. 控制工业、农业等部门温室气体排放	（13）水泥原料配料中废物替代比 （14）废钢入炉比 （15）测土配方施肥面积 （16）沼气年产气量	工业和信息化部 工业和信息化部 农业部 农业部
四、应对气候变化的资金投入	1.科技	（1）应对气候变化科学研究投入	财政部、科技部
	2.适应	（2）大江大河防洪工程建设投入	水利部、财政部
	3.减缓	（3）节能投入 （4）发展非化石能源投入 （5）增加森林碳汇投入	发展改革委、财政部 国家能源局、财政部 林业局、财政部
	4.其他	（6）温室气体排放统计、核算和考核及其能力建设投入	发展改革委、财政部
五、应对气候变化相关管理	1.计量、标准与认证	（1）碳排放标准数量 （2）低碳产品认证数量	质检总局、发展改革委、工业和信息化部 质检总局、发展改革委、工业和信息化部、环境保护部

第三章 温室气体排放核算与报告体系

通过定期编制国家和省级温室气体清单，开展二氧化碳排放控制目标的年度核算及形势分析，研究制定地方温室气体清单编制指南和重点行业企业温室气体排放核算指南，开展国家重点企业直接报送温室气体排放数据平台及地方在线报送系统建设，初步构建了国家、地方和企业三级温室气体排放核算与报告体系。

一、国家温室气体清单编制及二氧化碳排放核算制度

中国已经初步形成了由国家发展改革委组织开展，国家气候战略中心、清华大学、中国科学院、中国农业科学院、中国林业科学院和中国环境科学研究院等单位为主体的国家温室气体清单编制国家体系，着手开展了 2010 年和 2012 年清单编制相关工作，并通过进一步完善国家温室气体清单数据管理系统，为清单编制常态化和规范化提供技术支撑。

为加强对年度二氧化碳排放核算及碳排放强度下降目标完成情况的监测分析，确保完成“十二五”国家碳排放强度降低 17%这一约束性目标，中国也已经初步形成了由国家发展改革委牵头组织，国家气候战略中心等单位参加的国家年度能源活动二氧化碳排放及碳强度下降指标的核算工作体系。从 2013 年起，碳强度测算及形势分析工作频率已由年度逐渐提高为半年度和季度，以便更加及时把握二氧化碳排放状况，评估相关政策实施效果，同时对短期内下降趋势和目标完成情况进行预判。

二、地方温室气体清单编制指南及清单编制

2011 年 3 月，国家发展改革委发布了《关于印发省级温室气体清单编制指南（试行）的通知》，明确了省级温室气体清单编制的工作流程，主要包括：排放源与吸收汇的界定、确定估算方法、收集活动水平和排放因子数据、估算排放量和清除量、核查和验证、评估不确定性及报告清单结果等。该指南的制定不仅加强了省级清单编制的科学性、规范性和可操作性，也为编制方法科学、数据透明、格式一致、结果可比的省级温室气体清单提供了具体指导。北京市发展改革委也研究制定了《北京市区县温室气体清单指南》。

通过全方位、多层次对地方清单编制机构人员进行培训、指导和交流，全国 31 个省（区、市）和新疆生产建设兵团于 2014 年底完成并向国家发展改革委报告了 2005 年及 2010 年两年的清单。2015 年 1 月，国家发展改革委办公厅又下发了《关于开展下一阶段省级温室气体清单编制工作的通知》，要求各地区开展 2012 年和 2014 年省级温室气体清单编制工作。据不完全统计，目前已有约 150 个城市完成了城市温室气体清单编制工作。各地区还以开展省级人民政府单位地区生产总值二氧化碳排放降低目标责任评估考核为契机，加强对本地区碳排放强度目标的评估及跟踪分析。

三、重点企业温室气体排放核算与报告

国家发展改革委组织开展了化工、钢铁、电力、水泥等重点行业企业温室气体排放核算方法与报告指南研究工作，自 2013 年 10 月分三批陆续发布了 23 个重点行业及 1 个工业其他行业企业温室气体排放核算方法与报告指南（表 5-4），并对全国 31 个省（区、市）及新疆生产建设兵团发改系统及技术支撑单位开展能力建设培训。在此基础上，2015 年 11 月，国家质检总局和国家标准化管理委员会发布了《工业企业温室气体排放核算和报告通则》等 11 项国家标准。北京、上海、天津、重庆、广东、深圳和湖北 7 个碳排放权交易试点地区，率先编制了纳入本地区交易的重点行业企业温室气体排放核算方法，并完成了纳入交易企业的温室气体排放相关年度报告。

国家发展改革委发布的《关于组织开展重点企（事）业单位温室气体排放报告工作的通知》明确规定，开展重点单位温室气体排放报告的责任主体为：2010 年温室气体排放达到 13000 吨二氧化碳当量，或 2010 年综合能源消费总量达到 5000 吨标准煤的法人企（事）业单位或视同法人的独立核算单位，并要求应采用国家主管部门统一出台的重点企业温室气体排放核算与报告指南。国家发展改革委还组织开展了重点企业温室气体排放数据直报系统的研究及建设，建立覆盖企业温室气体核算、报告、监测、核查、发布等环节和功能的直报业务系统。

第四章 控制温室气体排放目标责任考核与评估体系

通过不断完善省级人民政府碳强度目标责任评价考核体系，逐步建立省级温室气体清单质量评估体系，探索建立重点行业企业温室气体排放核查体系，进一步强化了目标导向，形成上下联动、职责分明的压力传导机制，提升了省级和企业层面的排放数据质量。

一、省级人民政府碳强度目标责任评价考核

2013 年，国家发展改革委会同有关部门研究制定了“十二五”单位 GDP 二氧化碳排放降低目标责任考核体系实施方案，围绕目标完成情况、任务与措施落实情况、基础工作与能力建设落实情况及体制机制开创性探索等四个方面，提出了由 12 项基础指标及 1 项加分指标构成的“十二五”省级人民政府控制温室气体排放目标责任评价考核指标体系（表 5-5）。2014 年，国家发展改革委发布了《单位国内生产总值二氧化碳排放降低目标责任考核评估办法》。依据上述实施方案和考核评估办法，国家发展改革委组织有关部门及专家对全国 31 个省（区、市）人民政府单位地区生产总值二氧化碳排放降低目标责任进行了年度考核评估。2015 年 10 月，国家发展改革委公布了各省（区、市）2014 年度单位地区生产总值二氧化碳排放降低目标责任考核评估结果，北京、河北、江苏等 19 个地区获优秀等级。

表 5-4 中国已经发布的重点行业企业温室气体排放核算方法与报告指南目录

序号	指南名称	时间
1	《中国发电企业温室气体排放核算方法与报告指南（试行）》	2013 年 10 月
2	《中国电网企业温室气体排放核算方法与报告指南（试行）》	2013 年 10 月
3	《中国钢铁生产企业温室气体排放核算方法与报告指南（试行）》	2013 年 10 月
4	《中国化工生产企业温室气体排放核算方法与报告指南（试行）》	2013 年 10 月
5	《中国电解铝生产企业温室气体排放核算方法与报告指南（试行）》	2013 年 10 月
6	《中国镁冶炼企业温室气体排放核算方法与报告指南（试行）》	2013 年 10 月
7	《中国平板玻璃生产企业温室气体排放核算方法与报告指南（试行）》	2013 年 10 月
8	《中国水泥生产企业温室气体排放核算方法与报告指南（试行）》	2013 年 10 月
9	《中国陶瓷生产企业温室气体排放核算方法与报告指南（试行）》	2013 年 10 月
10	《中国民航企业温室气体排放核算方法与报告格式指南（试行）	2013 年 10 月
11	《中国石油和天然气生产企业温室气体排放核算方法与报告指南（试行）》	2014 年 12 月
12	《中国石油化工企业温室气体排放核算方法与报告指南（试行）》	2014 年 12 月
13	《中国独立焦化企业温室气体排放核算方法与报告指南（试行）》	2014 年 12 月
14	《中国煤炭生产企业温室气体排放核算方法与报告指南（试行）》	2014 年 12 月
15	《造纸和纸制品生产企业温室气体排放核算方法与报告指南（试行）》	2015 年 7 月
16	《其他有色金属冶炼和压延加工业企业温室气体排放核算方法与报告指南（试行）》	2015 年 7 月
17	《电子设备制造企业温室气体排放核算方法与报告指南（试行）》	2015 年 7 月
18	《机械设备制造企业温室气体排放核算方法与报告指南（试行）》	2015 年 7 月
19	《矿山企业温室气体排放核算方法与报告指南（试行）》	2015 年 7 月
20	《食品、烟草及酒、饮料和精制茶企业温室气体排放核算方法与报告指南（试行）》	2015 年 7 月
21	《公共建筑运营单位（企业）温室气体排放核算方法和报告指南（试行）》	2015 年 7 月
22	《陆上交通运输企业温室气体排放核算方法与报告指南（试行）》	2015 年 7 月
23	《氟化工企业温室气体排放核算方法与报告指南（试行）》	2015 年 7 月
24	《工业其他行业企业温室气体排放核算方法与报告指南（试行）》	2015 年 7 月

二、省级温室气体清单数据质量评估与联审

为了提高省级温室气体清单质量，确保温室气体清单结果的可比性，国家发展改革委组织有关单位编制了一套供各省填报的省级温室气体清单通用报告格式（CRF）表格，同时还设计了由 42 个指标构成的省级温室气体清单数据质量及结果可比性联审指标体系，建立了由国家和地方清单编制机构专家以及第三方专家组成的联审专家组。通过对省级温室气体清单的评估和联审，切实提高了省级清单质量和编制能力。

表 5-5　省级人民政府单位地区生产总值二氧化碳排放降低目标责任评价考核指标

考核评估内容	考核评估指标	分值	评分依据
一、目标完成（50 分）	1．单位地区生产总值二氧化碳排放年度降低目标	25	年度计划目标；核定的各地区年度降低目标完成率
	2．"十二五"单位地区生产总值二氧化碳排放累计进度目标	25	当年应达到的累计进度目标；核定的累计进度目标完成率
二、任务与措施（24 分）	3．调整产业结构任务完成情况	4	同期主管部门的考核结果；或第三产业增加值比重比上年变化情况
	4．节能和提高能效任务完成情况	4	同期主管部门的考核结果
	5．调整能源结构任务完成情况	4	同期主管部门的考核结果；或水电、核电、风电和太阳能发电占能源消费总量比重比上年变化情况及煤炭占能源消费总量比重比上年变化情况
	6．增加森林碳汇任务完成情况	4	同期主管部门的考核结果；或年度新增造林合格面积及年度森林抚育合格面积
	7．低碳试点示范建设情况	8	相关的正式文件材料；实地核查
三、基础工作与能力建设（26 分）	8．对所辖地市州或行业目标分解落实与评价考核情况	4	相关的正式文件材料；实地核查
	9．温室气体排放统计核算制度建设及清单编制情况	6	相关的正式文件材料；实地核查
	10.低碳产品标准、标识和认证制度执行情况	4	相关的正式文件材料；实地核查
	11.资金支持情况	6	相关的正式文件材料；实地核查
	12.组织领导和公众参与情况	6	相关的正式文件材料；实地核查
四、其他*（6 分）	体制机制等开创性探索	6	相关的正式文件材料；实地核查
小计		100	

* 此项为参考分数，不计入总分，主要反映地方的工作状况，在总体评价中予以考虑。

三、重点企业温室气体排放核查与自愿减排项目核证

国家发展改革委下发的《关于组织开展重点企（事）业单位温室气体排放报告工作的通知》明确要求，省级主管部门组织对企（事）业单位温室气体报告内容进行评估和核查，核查可采用抽查等各种形式，包括组织第三方机构对重点单位报告的数据信息进行核查。2014 年 12 月，国家发展改革委发布的《碳排放权交易管理暂行办法》进一步明确国务院碳交易主管部门会同有关部门，对核查机构进行管理，核查机构应按照国务院碳交易主管部门公布的核查指南开展碳排放核查工作。碳排放权交易试点地区也都制订了相应的核查指南或管理办法。为保证自愿减排项目的审定与核证工作，2012 年 10 月，国家发展改革委发布了《温室气体自愿减排项目审定与核证指南》，明确了温室气体自愿减排项目审定与核证机构的备案要求、工作程序和报告格式。截至 2015 年年底，中国共有 141 个项目的减排量获得备案签发，备案减排量超过 3750 万吨二氧化碳当量。

第六部分 其他信息

《中华人民共和国国民经济和社会发展第十二个五年规划纲要》明确提出要坚持减缓和适应气候变化并重，加强气候变化科学研究、观测和影响评估，加强气候变化领域国际交流与政策对话，提高应对气候变化能力。《国家应对气候变化规划（2014-2020）》进一步提出了强化科技支撑，加强教育培训和舆论引导，加强与国际组织、发达国家合作，大力开展南南合作等重要任务。

第一章 气候系统观测

一、大气观测

中国已初步建立了地基、空基和天基相结合，布局基本合理的综合气候观测系统，拥有 2000 多个国家级地面气象观测站。“十二五”期间，新建 4000 多个区域级自动气象站，乡镇覆盖率达 96%，实现了极轨和静止两个系列气象卫星的业务化运行，在 16 个气候关键区中选择了 18 个具有代表性典型地表特征的区域开展了基本气候变量和辅助变量的观测，拓展和完善了包括全球和区域的大气本底站、大气成分观测站、沙尘暴站、酸雨观测站及环境气象观测站在内的大气成分观测网络（表 6-1）。其中，青海瓦里关、北京上甸子、浙江临安、黑龙江龙凤山、云南香格里拉等 5 个大气本底站实现了主要温室气体（二氧化碳、甲烷、氧化亚氮、六氟化硫等）浓度的在线观测，北京上甸子大气本底站实现了卤代烃温室气体（HFCs、PFCs 等）浓度的在线观测。开展的主要温室气体的瓶（罐）采样与分析和在线观测覆盖了青藏高原主体地区、京津冀经济圈、长江三角州经济圈、东北平原、云贵高原及西南经济区、北疆经济区和长江中游两湖平原区 7 个关键区。2011 年开始每年发布《中国气候变化监测公报》，2012 年开始每年发布《中国温室气体公报》。

二、海洋和生态观测

“十二五”期间，中国海洋观测能力进一步提升。截至 2015 年，海洋观测站点数量达到 124 个，较“十一五”末增长 17%；各类浮标达到 57 个，增长 63%（表 6-2）。每年发布《海平面变化公报》，全面介绍我国海平面上升及对沿海地区的影响情况。2012 年，组织编制了《海平面上升影响专题评估报告》，对 2020 年、2050 年和 2100 年中国海平面上升状况及影响进行了预测评估和风险评估。逐步建立了近海海-气界面二氧化碳交换通量监测业务，已布设 20 余条船基走航监测断面，正在建设 6 个岸/岛基站和 5 个浮标站。不断加强海岛海岸带和海洋生态的修复，设置了 21 个海洋生态监控区，开展了气候变化海洋生态敏感区试点监测工作。组织实施了 5 次南极科学考察、2 次北冰洋综合科学考察，2015 年组织开展了 34 航次大洋调查，积累了大量认知极地和全球气候变

化的基础数据。

表 6-1 “十二五”期间主要的综合气象观测设施发展

序号	站点(设施)		数量		变化量
			2010 年	2015 年	
1	国家级地面基准气象观测站		143	212	69
2	国家级无人自动气象站		346	463	117
3	区域自动气象站		30347	55680	25333
4	新一代天气雷达		130	181	51
5	农业气象观测站		653	653	0
6	自动土壤水分观测站		1210	2075	865
7	风能观测站		400	345	-55
8	太阳辐射观测站		100	100	0
9	大气本底观测站		7	7	0
10	沙尘暴观测站		29	29	0
11	风廓线雷达		24	69	45
12	GNSS/MET 观测站(含陆态网)		433	950	517
13	气象卫星	风云二号	3	4	1
14		风云三号	2	3	1

表 6-2 “十二五”期间主要的海洋观测设施发展

序号	站点(设施)	数量		变化量
		2010 年	2015 年	
1	海洋观测站（点）	102	124	22
2	各类浮标	35	57	22
3	海上油气平台观测系统	4	6	2
4	雷达观测站	38	38	0
5	移动应急观测平台	11	13	2
6	GPS 观测站	56	56	0

三、差距与发展前景

为深入认识气候变化规律，开展气候变化研究和应用服务，中国加强了对观测资料的收集、整编、质量控制和数据共享。但是，在对气候系统综合观测的系统化、业务化、规范化和标准化等方面仍需要进一步完善和提高：一是各部门围绕气候变化观测的标准不统一，观测要素不齐全，观测精度不够，观测布局不够合理，海洋气候观测及次地表廓线观测能力薄弱；二是对研究和认识气候变化特别重要的多圈层相互作用的各变量的观测尚不全面，在不少受气候变化影响的关键地区以及典型地表特征及人类活动地区还

缺少相互作用过程的观测；三是没有形成较为完善的气候系统多圈层科学数据共享体系和机制。此外，观测资料的质量控制以及多源观测资料的融合、综合应用能力有待加强。

中国未来将进一步加强国家气候系统观测的规划和建设，完善与优化现有气候系统各组成部分的观测网络布局，加强气候系统敏感区、典型区、关键区和空白地区的基本气候变量观测，提高基本气候变量的观测技术与观测准确率，观测精度达到全球气候观测系统标准。同时，积极参加地球系统观测和预测协调研究计划、世界气象组织综合全球观测系统设计、全球大气和海洋观测计划等各类国际计划和活动。加强多部门观测数据信息的统筹管理和高效利用，建立以部门联合中心为核心，覆盖面广泛的部门与应用单位群体的气候变化信息共享与服务体系。

第二章 气候变化研究进展

一、气候变化基础科学研究

“十二五”时期，重点围绕气候变化观测与历史重建、全球气候变化的规律与机理、气候变化综合观测数据分析、地球系统模式研发、气候变化地质记录等方向开展的研究工作取得了一系列研究成果；在气候变化的影响与适应方面，重点围绕水资源、农业、林业、海洋、人体健康、生态系统、重大工程、防灾减灾等领域着力提升气候变化影响的机理与评估方法研究水平，增强适应理论与技术研发能力，推动气候变化领域的科技进步和创新。在应对气候变化战略与政策研究方面，重点研究了与应对气候变化相适应的国际贸易战略与政策，研究建立中国碳排放权交易市场的技术支撑体系、制定气候变化适应战略措施与行动计划、提出中国应对气候变化的重大前沿科技发展战略等。

中国开展的具有中国特色又兼具全球意义的气候变化基础科学研究取得了一批国际公认的研究成果，“十二五”以来相继发布了《第二次气候变化国家评估报告》、《第三次气候变化国家评估报告》、《中国极端天气气候事件和灾害风险管理与适应国家评估报告》等科学评估报告，在近百年来中国区域气候变化事实、未来气候变化预估、气候变化对自然生态系统和社会经济系统的影响和风险、气候变化背景下极端天气气候事件变化规律及其应对措施、温室气体排放及其减排潜力、技术进步对节能减碳的作用、中国参与国际气候治理等方面获得重要科学发现。中国科学家发表的学术论文在国际科学界的影响不断加大，研究成果被 IPCC 第五次评估报告大量引用，在大气观测和区域气候变化及影响、古气候、云和气溶胶、气候模式、淡水资源、粮食系统和粮食安全、减缓气候变化的路径等领域都占了相当大的比例。

《第三次气候变化国家评估报告》表明，近百年来（1909-2011 年）中国陆地区域平均增温 0.9-1.5℃，沿海海平面 1980-2012 年期间上升速率为 2.9 毫米/年，高于全球平均速率。上世纪 70 年代至本世纪初，冰川面积退缩约 10.1%，冻土面积减少约 18.6%。

未来极端事件增加，暴雨、强风暴潮、大范围干旱等发生的频次和强度增加，洪涝灾害的强度呈上升趋势，海平面将继续上升。气候变化对中国影响利弊共存，但总体弊大于利，对粮食产量与品质、水资源、海洋环境与生态、城市等为不利影响。中国自然灾害风险等级处于全球较高水平，对气候变化敏感性高，气候变化不利影响呈现向经济社会系统深入的显著趋势。

二、应对气候变化低碳技术研发

中国加快了节能减排共性和关键技术研发，涉及高参数超超临界发电技术、整体煤气化联合循环技术、非常规天然气资源的勘探与开发技术、大规模可再生能源发电、储能和并网技术、新能源汽车技术及低碳替代燃料技术、城市能源供应侧和终端侧的节能减排技术、建筑节能技术、钢铁、冶金、化工和建材生产过程中节能与余能余热规模利用技术、农林牧业及湿地固碳增汇技术以及碳捕获利用及封存技术等。为促进和加强低碳技术成果的转化与推广，优先在电力、石化、水泥、钢铁、有色金属、交通、农林业等主要温室气体排放行业建立工程示范，并推广效果良好的技术。

通过推动应对气候变化低碳技术研发，中国提高了减缓领域核心技术和关键技术水平，在能源清洁高效利用技术、重点行业（工业、建筑、交通）节能技术与装备开发、以及低碳经济产业发展模式和关键技术集成应用等方面取得了一批具有自主知识产权的发明专利和重要成果。经济适用的低碳建材、低碳交通、绿色照明、煤炭清洁高效利用等低碳技术已得到广泛应用；高性价比太阳能光伏电池技术、太阳能建筑一体化技术、大功率风能发电、天然气分布式能源、地热发电、海洋能发电、智能及绿色电网、新能源汽车和储电技术以及具有自主知识产权的碳捕集、利用和封存等新技术正在推广；组建了一批国家级节能减排工程实验室，推动建立节能减排技术与装备产业联盟。

中国的气候变化科学研究虽然取得了较快的发展，但与国际上先进水平相比，尚有一定的差距。一是基础研究滞后，综合性研究欠缺，对气候系统变化机制的理解还不够深入；二是模型工具与研究方法有待创新，缺乏气候变化综合评估模型；三是在减缓和适应气候变化的核心技术方面仍需进一步加强。未来中国将在气候变化的科学基础、影响与适应、减缓和社会经济可持续发展等方面进一步开展研究。

第三章 气候变化适应

2011 年公布的《中华人民共和国国民经济和社会发展第十二个五年规划纲要》中明确要求加强适应气候变化特别是应对极端气候事件的能力建设，加快适应技术研发推广，提高农业、林业、水资源等重点领域适应气候变化水平。在农业、林业、海洋、气象、防灾减灾、卫生健康等领域也都相继出台了与适应气候变化直接或间接相关的规划和政策。

2013 年，国家发展改革委、财政部、住房城乡建设部、交通运输部、水利部、农业部、林业局、气象局、海洋局联合制定了《国家适应气候变化战略》，强调在提高适应气候变化能力方面，重视应对极端气候事件能力建设，提高农业、林业、水资源、卫生健康等重点领域和沿海、生态脆弱地区适应气候变化水平；研究制定农林业适应气候变化政策措施，保障粮食安全和生态安全；合理开发和优化配置水资源，强化各项节水政策和措施；加强海洋和海岸生态系统监测和保护，提高沿海地区抵御海洋灾害能力；完善应对极端气象灾害的应急预案、启动机制以及多灾种早期预警机制。同时，确定了上海城市基础设施极端天气气候事件防御、吉林粮食主产区黑土地保护治理、江西鄱阳湖水资源保护、海南生态修复与海洋灾害应急等 14 项适应试点示范工程。

在城市领域，国家发展改革委、住房城乡建设部联合发布了《城市适应气候变化行动方案》，指导城市从规划、基础设施、建筑、水系统、城市绿化、灾害风险管理等方面开展工作，加强城市适应气候变化能力；印发了《气候适应型城市建设试点工作方案》，组织开展气候适应型城市建设试点，计划选择 30 个左右典型城市，针对城市面临的突出问题，开展前瞻性和创新性探索，强化城市气候敏感脆弱领域、区域和人群的适应行动，提高城市适应气候变化能力。计划到 2020 年，试点城市普遍实现将适应气候变化纳入城市社会经济和产业发展规划体系、建设标准和产业发展规划，适应气候变化理念知识广泛普及，适应气候变化治理水平显著提高。

在农业领域，加快促进农业生产方式转变和现代化建设，推进保护性耕作，截至 2014 年底，全国保护性耕作面积达 1.29 亿亩，减少农田风蚀 6450 万吨；开展农田基本建设，加强土壤培肥改良，大力推广节水灌溉、旱作农业、抗旱保墒、测土配方施肥和绿色防控等技术，继续推进东北节水增粮、西北节水增效、华北节水压采、西南“五小水利”工程以及南方地区节水减排工程建设。

在水资源领域，推进水生态文明建设，继续落实最严格水资源管理制度，加强河湖管理与水资源保护，加强重大水利工程建设，加快推进水土流失综合治理，截至 2014 年底，全国共完成水土流失综合防治 7.4 万平方公里。加强防洪减灾体系建设，进一步强化中小河流治理和山洪灾害防治，加快推进应对极端暴雨事件造成洪涝灾害的能力建设。全面实施《全国抗旱规划》，系统提升应对极端干旱事件的能力。

在林业和其他生态系统领域，强化战略引导，加强森林综合治理，加强林业自然保护区建设和湿地保护；2014 年编制了《林业适应气候变化行动方案（2015—2020 年）》，明确了到 2020 年林业领域适应气候变化的目标措施。在生态和环境气象服务方面，组织了重点区域、特色产业气候变化影响评估。开展了青藏高原、东北地区、海南等典型区域气候变化对生物多样性的影响评估。加强草原生态保护建设，建立草原生态保护补助奖励机制，实施草原生态建设工程，推行草原管护基本制度，2014 年集中治理严重退化和生态脆弱草原 445 万公顷。强化湿地生态系统保护恢复，完成了第二次全国湿地资

源调查，实施了全国湿地保护工程，全国新增湿地保护面积 600 万亩，恢复湿地面积 30 万亩。截至 2015 年底，全国新制定国际重要湿地 12 处，新建国家湿地公园 561 处，恢复退化湿地 240 万亩，湿地碳汇功能逐步提升。加强荒漠化生态系统保护，完成了第五次荒漠化和沙化土地监测，启动了沙化土地封禁保护区补贴和国家沙漠公园建设试点，治理沙化土地 1.5 亿亩，土地沙化呈现整体遏制、重点治理区生态状况明显改善的趋势。

在海岸带及相关海域，加强了海洋灾害观测预警和应急管理，开展海平面变化监测，开展了面向沿海重点保障目标的精细化预报，不断完善海洋灾害风险评估；严格审查用海项目，限制占用重要海洋生态空间；加强海洋生态系统保护，截至目前，我国共建立各级、各类海洋保护区 260 处，总面积 10 多万平方公里，约占我国管辖海域总面积的 3.3%；积极推动海洋减灾综合示范区建设、海岛地区防灾减灾和应对气候变化基础设施建设，有效改善了海岛防灾减灾基础设施，提高了海岛应对气候变化的能力。

在极端天气气候事件和灾害预测预警方面，进一步完善了国家、省、市、县四级气象灾害风险预警业务体系建设，编制了《国家突发事件预警信息发布系统管理办法》。逐步开展了面向适应的气候灾害风险评估与管理机制研究，探索制定中国主要气候灾害的风险评估与管理技术方法、评估流程与技术规范等。编制了《中国灾害性天气气候气象灾害图集》（1961-2013 年），逐步开展了县一级的暴雨洪涝灾害和风险普查，开展了主要灾害（台风、暴雨、干旱）的风险评估和风险区划，完成了流域和区域的气候变化综合影响评估报告，提出了适应气候变化的相关政策措施。

在人体健康领域，开展了与气候变化密切相关的疾病防控工作，加强了适应气候变化及气候变化相关的健康问题研究，开展了“适应气候变化保护人类健康”项目。根据不同的城市气候风险、城市规模、城市功能，在全国选择了 30 个典型城市开展气候适应型城市建设试点，针对城市在气候变化条件下的突出问题，进行前瞻创新性探索。强化城市气候敏感脆弱领域、区域和人群的适应行动，加强城市适应气候变化能力，总结和推广相关领域和区域的适应气候变化经验做法，开展城市气候变化脆弱性评估、编制各自城市适应气候变化行动方案、建立完善适应气候变化管理体系等工作。

第四章 教育、宣传与公众意识

中国积极宣传应对气候变化科学知识，提高公众应对气候变化和低碳发展意识，注重发挥民间组织、媒体等各方面的积极性，采取多渠道、多举措引导全民积极参与应对气候变化行动。形成了政府强化引导、社会组织带动、公众广泛参与的局面，从中央到地方乃至社会团体都大力开展了应对气候变化宣传教育活动，取得了显著成绩。

一、教育与宣传

中国政府制定和完善了一系列宣传和普及应对气候变化相关知识、提高全社会应对

气候变化能力和水平的政策措施。中国政府每年出版《中国应对气候变化的政策与行动》年度报告，在每年年底的《联合国气候变化框架公约》缔约方大会上组织“中国角”活动，全面介绍中国在应对气候变化领域的政策、行动与进展。各部门和各地方政府也都开展了一系列应对气候变化的教育宣传和具有地方特色的科学普及活动。2012 年 9 月，中国国务院批复同意自 2013 年起将每年“全国节能宣传周”的第三天设立为“全国低碳日”，自 2013 年以来，每年组织举办全国低碳日宣传活动，分别围绕“践行节能低碳，建设美丽家园”、“携手节能低碳，共建碧水蓝天”等主题，开展了主题口号、招贴画大赛、专家讲座等活动，增强全社会低碳意识。同时，通过“防灾减灾日”、“气象日”、“六•五”世界环境日、世界地球日、节能宣传周等，开展形式多样的主题宣教活动，加强应对气候变化和低碳发展的教育与宣传；有关部门和地方各级政府通过举办低碳知识科普大赛、主题展览、低碳案例征集、宣传低碳典型等活动，向全社会倡导低碳消费模式和生产方式，宣传地方低碳政策与行动（图 6-1）。2013 年 6 月，联合国秘书长潘基文参观了“全国低碳日”气候变化主题展览并给予了高度评价。2014 年，在天津达沃斯论坛、生态文明贵阳国际论坛中均设立了气候变化分论坛，围绕生态文明、绿色低碳发展开展主题活动。《气候变化研究进展》是国内全面反映全球变化最新的观测事实、科学认识、应对全球气候变化的适应、减缓措施和技术成果、国际气候制度与气候外交谈判信息的核心学术刊物，其英文版入选 2015-2016 年度 CSCD 收录来源期刊。

图 6-1 “全国低碳日”宣传活动

二、教育与培训

针对各级党政领导、科研人员、高等院校师生、企业和社会组织、社区群众等不同类别的公众举办应对气候变化国内外形势讲座、研讨与培训，增强公众应对气候变化的意识。国家和各省（区、市）发展和改革委系统、科技部以及相关部委每年举办应对气候变化和低碳发展干部培训，五年间人数达上万人。开展了碳市场企业专业培训，培训了一批熟悉碳市场政策法规，熟练操作报送、登记和交易系统的专业人才。通过举办“千名青年环境友好使者行动”培训活动，向 1200 多名青年环境友好使者讲授气候变化科学知识。依托国家环境宣传教育示范基地，通过时光穿梭机电子互动展项等积极开展面向

公众尤其是青少年的气候变化教育。开展了“中国公众补天行动—含氢氯氟烃（HCFCs）淘汰社区宣传活动”，向 500 多名社区居民及环保志愿者讲授了控制 HCFCs、保护臭氧层和应对气候变化的知识。举办了多次 IPCC 第五次评估报告宣讲会，围绕《管理极端事件和灾害风险推进气候变化适应特别报告》、三个工作组报告和综合报告的主要内容普及气候变化科学、适应、低碳发展和极端气候事件风险管理的理念和政策措施（图 6-2）。多部门联合举办的年度“气候系统与气候变化国际讲习班”吸引了上千名中国及发展中国家的年轻学者参加。

图 6-2　IPCC 第五次评估报告解读宣传册

三、媒体宣传

中国各传媒集团和各级媒体配合政府不断加大应对气候变化与节能低碳宣传报道力度，制作相关电视片及宣传画册，在电视台、公交移动电视、户外大屏幕和主流网站循环播放，并在各大国际会议和公众活动中播放和传播，起到了很好的宣教作用。每年 11 月，国务院新闻办公室召开“中国应对气候变化的政策与行动”发布会，由主管部门领导介绍中国政府应对气候变化有关情况，并阐述国际谈判基本立场。中央电视台等媒体制作完成了《面对气候变化》、《变暖的地球》、《关注气候变化》、《环球同此凉热》等纪录片，其中《变暖的地球》获第 28 届中国电影金鸡奖最佳科教片奖，受众达上亿人。2014 年以来，新华社、人民日报、中央电视台、中国国际广播电台、中国日报、中国新闻社等多家新闻媒体，对联合国气候峰会、中美气候变化联合声明、利马气候大会、中国提交国家自主贡献文件等应对气候变化领域的重大事件给予高度关注，充分利用图片、文字、视频等多种形式进行全方位报道。开发建设了中国气候变化信息网，作为传播国际和中国应对气候变化信息的政府网站，2012 年通过网站改版，加强了网站能力建设，更好地面向国内外开展气候变化宣传。

四、公众参与

中国民间组织和社会公众也积极参与了应对气候变化及相关活动，以实际行动积极

应对气候变化。2011 年，国家发展改革委就应对气候变化立法工作公开征求意见。中国公众广泛参与自备购物袋、双面使用纸张、控制空调温度、不使用一次性筷子、购买节能产品、低碳出行、低碳饮食、低碳居住等节能低碳活动，从日常生活衣、食、住、行、用等细微之处，实践低碳生活消费方式。中国各地的大、中、小学积极宣传低碳生活、保护环境，一些高校提出建设“绿色大学”等目标，得到广泛响应。各地公众积极参与“地球一小时”活动，呼吁每个人采取积极行动应对气候变化，共同表达保护全球气候的意愿（图 6-3）。此外，依托微信、微博等网络平台，公众通过微信公众号以及微博话题讨论的方式，了解应对气候变化知识，践行低碳发展理念。社会各界公众通过参加多种形式的气候变化教育培训等活动，增进了对应对气候变化、践行低碳发展以及节能减排的认识，提升了积极参与应对气候变化的自觉性。

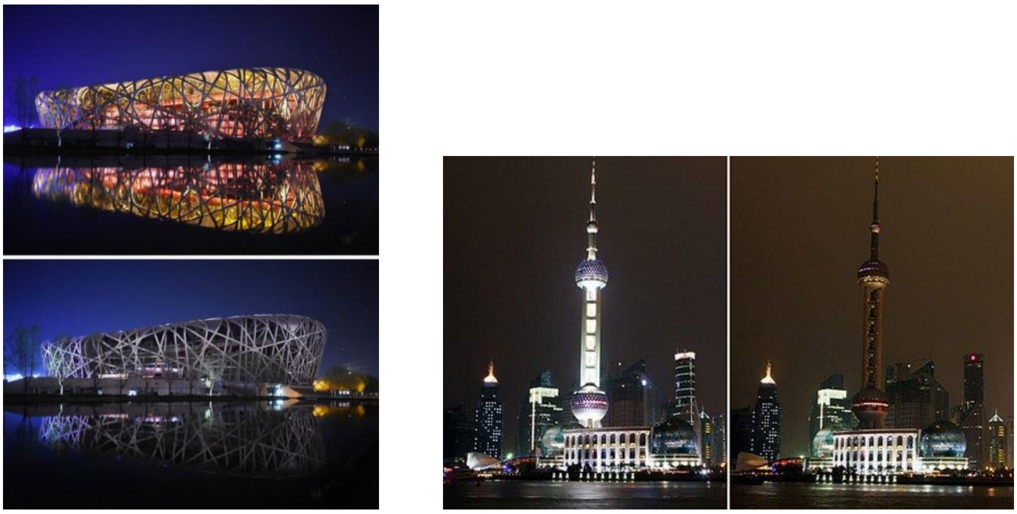

图 6-3 “地球一小时”活动（左：鸟巢；右：上海东方明珠电视塔）

第五章 国际交流与合作

中国高度重视应对气候变化国际交流与合作，通过国际合作加强对气候变化科学问题的认识，增强应对气候变化技术的研发储备和应用能力，培育和推动低碳产业发展，逐步实现低碳经济转型。中国本着“互利共赢，务实有效”的原则积极参加和推动与各国政府、国际组织、国际机构的务实合作，签署了一系列合作协议，实施了一批研究项目，内容涉及气候变化的科学问题、减缓和适应、气候智慧/低碳城市、应对政策和措施等。

一、开展高层对话与双边合作

“十二五”期间，中国利用高层互访以及气候变化工作组建立的契机，分别与美国、欧盟、法国、英国等国发表气候变化联合声明，增进各国理解，扩大共识，为推动气候变化谈判多边进程，特别是《巴黎协定》的达成做出了重要贡献。加强气候变化双边交流与对话，与美国、欧盟、澳大利亚、新西兰、英国、德国等国开展部长级和工作层的

气候变化对话磋商，与巴西、南非和印度每年举办基础四国气候变化部长级会议，发表联合声明，并建立了专家交流机制。借助国家气候变化专家委员会平台，推动中美、中欧、中英、中法、中印等专家层面的对话交流。深化与发达国家在气候变化领域的双边合作，推进技术、研究、节能以及替代能源和可再生能源等领域合作。中美于 2013 年成立气候变化工作组，成为中美增进理解和应对气候变化的全面框架，工作组内容不断拓展，迄今为止已在载重汽车和其他汽车减排、电力系统、碳捕集、利用和封存、建筑和工业能效、温室气体数据收集和管理、气候变化和森林、气候智慧型/低碳城市、温室气体测量、工业锅炉效率和燃料转换、绿色港口和船舶等领域开展务实合作，并召开中美气候智慧型/低碳城市峰会，围绕城市绿色低碳发展、低碳城市规划、碳市场、低碳交通、低碳建筑、低碳能源和适应气候变化开展交流。中欧开展了碳交易能力建设项目合作。中德签署《关于应对气候变化合作的谅解备忘录》，建立电动汽车战略伙伴关系，并开展太阳能、风能等新能源领域以及建筑能效和低碳生态城市等领域的合作。中日加强节能环保科技合作，开展低碳发展能力建设合作；中澳开展二氧化碳地质封存合作；中欧、中英、中意开展碳捕获封存示范项目合作，深化能源和能效领域的合作。中国还与澳大利亚、新西兰、瑞典、瑞士等国签署双边气候变化谅解备忘录，启动与瑞士合作的中国适应气候变化二期项目，与韩国就气候变化协定达成一致，推动双边合作迈上新台阶。

二、与国际组织合作

中国广泛开展与国际组织的务实合作。与联合国环境规划署签署在应对气候变化南南合作方面加强合作的谅解备忘录；与世界银行开展“市场伙伴准备基金”项目合作，共同启动全球环境基金“通过国际合作促进中国清洁绿色低碳城市发展”项目，稳步执行由世界银行担任项目指定机构的全球环境基金的“增强对脆弱发展中国家气候适应力的能力、知识和技术支持”项目及“中国应对气候变化技术需求评估”赠款项目；与亚洲开发银行签署双边气候变化合作谅解备忘录，共同组织召开“城市适应气候变化国际研讨会”，开展由其支持的“碳捕集和封存路线图”技术援助项目；积极参与《联合国气候变化框架公约》资金机制运营实体绿色气候基金和全球环境基金、适应基金、技术执行委员会等相关会议，参与全球甲烷行动倡议、R20 国际区域气候行动组织等多边组织的活动；参加由联合国基金会、全球清洁炉灶联盟秘书处召开的“全球清洁炉灶联盟”相关会议并开展国内试点活动；与全球碳捕集和封存研究院等相关组织举办碳捕集、利用与封存技术现场研讨会和实地考察活动；与国际能源署建立联盟关系，在能源安全、能源数据和统计、能源政策分析等领域加强合作。积极参加政府间气候变化专门委员会（IPCC）有关工作，多层面开展第五次评估报告的成果解读工作，并在第六次评估报告主席团成员的提名和竞选工作中发挥了积极作用。

中国还积极参与全球环境变化的国际科技合作，如地球科学系统联盟（ESSP）框架

下的世界气候研究计划（WCRP）、国际地圈-生物圈计划（IGBP)、国际全球变化人文因素计划（IHDP）和生物多样性计划（DIVERSITAS）等国际科研计划，以及全球对地观测政府间协调组织（GEO）、全球气候系统观测计划（GCOS）、未来地球计划等，开展了具有中国特色又兼具全球意义的全球变化基础研究。中国与各国全方位、多层次的合作推动了国际气候变化的政治共识、科学进步和技术应用。

第六章 南南合作

2011-2015 年，中国政府与亚洲、非洲、拉丁美洲、南太平洋等地区近 100 个发展中国家，在紧急救灾、卫星气象监测、清洁能源开发利用、农业抗旱技术、森林和野生动物保护、水资源利用和管理、沙漠化防治等领域开展了形式多样的合作，实施了近 500 个成套、物资、技术合作、紧急救灾等各类应对气候变化项目。中国与南非、印度、巴西、韩国等国签署了有关气候变化的联合声明、谅解备忘录和合作协议，建立气候变化合作机制，加强在气象卫星监测、新能源开发利用等领域的合作，为发展中国家援建数百个清洁能源和环保项目。2014 年，与赞比亚、加纳分别签订了中赞、中加可再生能源技术转移项目，旨在支持非洲可再生能源技术的能力和推广应用。与非洲加强科技合作，实施了 100 个中非联合科技研究示范项目，援建农业示范中心，派遣农业技术专家，培训农业技术人员，提高非洲实现粮食安全能力。向南太平洋、加勒比等地区小岛屿国家提供支持与帮助，先后为太平洋岛屿国家援建 130 多个项目，提高其减缓和适应气候变化的能力。发布《南南科技合作应对气候变化适用技术手册》，支持 13 个面向发展中国家与应对气候变化直接相关的国际培训班，涉及生物质、太阳能、沼气、荒漠化防治、节水高效农业开发等领域。积极实施了一批援外项目，重点支持可再生能源利用与海洋灾害预警研究及能力建设、LED 照明产品开发推广应用、秸秆综合利用技术示范等项目，帮助发展中国家提高应对气候变化的适应能力。2011-2012 年发放的《国际科技合作应对气候变化实现可持续发展平台网络》、《中国-联合国-非洲水资源科技合作行动》、《南南合作应对气候变化教材》、《中非科技伙伴计划》等各类宣传资料，受到了广大发展中国家的广泛欢迎。

2012 年，中国在“里约+20”会议上宣布将安排 2 亿元人民币开展为期三年的应对气候变化“南南合作”，与 41 个发展中国家建立了联系渠道。自 2014 年以来，中国积极推动与马尔代夫、玻利维亚、汤加、萨摩亚、斐济、安提瓜和巴布达、加纳、巴巴多斯、缅甸、巴基斯坦签署谅解备忘录，并根据发展中国家需求扩大赠送产品种类。2014 年，中国宣布将大力推进应对气候变化南南合作，从 2015 年开始在现有基础上把每年的资金支持翻一番，建立气候变化南南合作基金。中国已经提供 600 万美元资金支持联合国秘书长推动应对气候变化南南合作。本着“平等互信、包容互鉴、合作共赢”的精神，中国与 24 个发展中国家签署了《关于应对气候变化物资赠送的谅解备忘录》，向发展中国家赠送节能灯、节能空调、太阳能路灯、太阳能光伏发电系统等绿色低碳产品。

“十二五”期间，中国举办了 300 多期应对气候变化与绿色低碳发展研修班，为发展中国家培训了 5000 多名应对气候变化领域的官员、专家学者和技术人员。组织气候变化框架下毁林与土地退化监测和评估南南合作、气候变化与极端天气气候事件、多灾种早期预警、气候服务系统、海洋灾害监测与预警等技术培训，累计培训 1000 余人。2015 年 11 月，习近平主席在气候变化巴黎大会上宣布设立 200 亿元人民币的中国气候变化南南合作基金，并宣布于 2016 年启动“十百千”项目，即在发展中国家开展 10 个低碳示范区、100 个减缓和适应气候变化项目及 1000 个应对气候变化培训名额合作项目的新举措，并继续推进清洁能源、防灾减灾、生态保护、气候适应型农业、低碳智慧型城市建设等领域的国际合作。通过制定完善“十百千”项目实施方案，以项目活动为支撑，为最不发达国家、小岛屿国家和非洲国家应对气候变化提供资金、技术和能力建设支持，目前中国已制订项目实施方案并已陆续启动实施。

第七部分 香港特别行政区应对气候变化基本信息

香港是中华人民共和国成立的特别行政区，是一个气候温和、资源短缺、人口密度较高、服务业高度发展、充满活力的城市，也是举世知名的国际金融、贸易和航运中心。2010 年以来，特区政府在应对气候变化方面采取了一系列的政策与行动，并取得积极成效。

第一章 基本区情

一、自然条件与资源

香港特别行政区（以下简称“香港”）位于中国南部，北邻广东省深圳市，三面环海。陆地面积 1105 平方公里，主要分为港岛、九龙、新界及离岛，地势多山，作为市民生活和工作的土地面积少于 300 平方公里，有超过 500 平方公里的土地已划为“受保护地区”，其中包括郊野公园、特别地区与保育有关地带。香港位于亚热带，气候温和，年平均气温为 23.3℃，平均最高为 25.6℃，最低为 21.4℃，年平均降雨量约 2400 毫米。常见的极端天气包括热带气旋、强季风、季风槽及强对流天气等。亚热带常绿阔叶林是香港的主要植被，海洋环境适合热带和温带动植物生长，鱼类、甲壳类等海洋生物物种丰富，但淡水资源较为匮乏，主要依靠广东省东江供应。

二、人口与社会

2014 年香港人口约为 724.2 万人，从 2010 年到 2014 年，人口平均年增长率为 0.8%。2014 年香港劳动人口约有 388 万人，其中男性占 51.3%，女性占 48.7%。2014 年香港就读于公立和资助小学的儿童约有 28 万人，就读于公立和资助中学的学生约有 35 万人。在 2014 至 2015 财政年度，香港教育方面的总开支达 737 亿港元，占政府开支总额的 18.6%。

三、经济发展

香港是高度城市化的经济体。2014 年香港本地生产总值（GDP）约为 2.26 万亿港元，人均约 311835 港元（以当年价格计算）。香港经济以第三产业为主，2014 年三产比重为 92.7%，2014 年对外贸易中商品贸易总额达 7.89 万亿港元，进口贸易总值为 4.22 万亿港元，而转口贸易总值为 3.62 万亿港元。2014 年第一产业占 GDP 比重较低，第一产业从业人数占总就业人数的比重也较低。

香港是国际金融中心。2014 年年底有 1752 家公司在香港联交所上市，总市值约为

25.07 万亿港元。香港也是全球贸易、航运、金融和电讯中心，客货运量居世界前列。香港的直接投资负债总额和直接投资资产总额巨大，截至 2014 年年底的市值分别为 12.7 万亿港元和 12.4 万亿港元，相当于 2014 年 GDP 的 5.63 倍和 5.47 倍。

香港本地基本没有一次能源生产。2014 年香港能源消费为 2055.86 万吨标准煤，其中煤和油产品分别为 1165.46 万吨标准煤及 778.90 万吨标准煤。香港的电力以本地火电为主，广东核电是重要补充，煤电、气电和核电分别占 2014 年发电量的 59%、19%和 22%。

2014 年香港公交系统平均每天载客 1251 万人次，占载客总数的 90%，其中轨道交通达 526 万人次。2014 年香港共有登记机动车辆约 77 万辆，其中私家车约 54 万辆。

旅游业是香港主要经济支柱之一。2014 年访港游客 6084 万人次，其中内地游客 4725 万人次。

香港农业和渔业的规模较小，2014 年香港农业和渔业增加价值为 14 亿港元，农业和渔业的从业人员总共约有 17000 人。鲜鱼是香港最主要的原产品之一，2014 年捕捞量和养殖量合计约为 16.4 万吨，总价值为 27 亿港元。

表 7-1 给出了 2012 年和 2014 年香港的基本情况的统计数据。

表 7-1　2012/2014 年香港基本情况

指标	2012	2014
人口（万人、年中人口数）	715.5	724.2
面积（平方公里）	1104	1105
以当时市价计算的本地生产总值(以亿港元计）	20370.59	22582.15
以当时市价计算的人均本地生产总值（以港元计，以年中人口计算）	284720	311835
工业占本地生产总值的百分比[1]	6.9	7.2
服务业占本地生产总值的百分比	93.0	92.7
农业及渔业占本地生产总值的百分比	0.1	0.1
用于农业目的的土地面积（平方公里）[2]	51	51
大牲畜总数（头、匹）		
牛（头）	1730	1616
马（匹）	2012	2030
猪（头）	70109	69511
羊 (只)	321	350
有林地面积（平方公里）	738	738
预期寿命（年）	男: 80.7 岁 女: 86.4 岁	男: 81.2 岁 女: 86.9 岁

注：1）工业包括采矿及采石、制造、电力、燃气和自来水供应及废弃物管理和建筑业；

2）采用的是耕地面积。

四、应对气候变化相关的机构安排

香港特区政府一直致力于推动应对气候变化工作。为有效管理和统筹应对气候变化工作，特区政府于 2007 年成立了气候变化跨部门工作小组（下称工作小组），工作小组通过与各相关政策局、部门和其他团体紧密合作，统筹协调当前及未来的工作及活动，以履行《联合国气候变化框架公约》的相关规定。在制订和推行控制温室气体排放及适应气候变化的措施方面，工作小组负责监察及协调相关政策局和部门的工作，并密切关注国际气候变化的最新发展，根据情况建议适当的行动。此外，工作小组还会制订和协调其他活动，以加强公众对气候变化及其影响的了解。

工作小组由环境局带领政府各相关政策局和部门开展应对气候变化的相关工作，主要政策局和部门包括: 发展局、财政司司长办公室经济分析及方便营商处、教育局、食物及卫生局、运输及房屋局、保安局、渔农自然护理署、建筑署、屋宇署、土木工程拓展署、渠务署、机电工程署、环境保护署、食物环境卫生署、卫生署、民政事务总署、香港天文台、房屋署、康乐及文化事务署、规划署、运输署及水务署共六个政策局及 16 个部门。其中，环境局/环境保护署负责统筹、编制国家信息通报及两年更新报告中香港特别行政区应对气候变化的基本信息。

第二章 2012 年香港温室气体清单

香港温室气体清单编制同时参考了《1996 年 IPCC 清单指南》以及《IPCC 优良作法指南》和《IPCC 国家温室气体清单编制指南（2006 年版）》（简称《2006 年 IPCC 清单指南》），报告的年份为 2012 年，范围包括能源活动、工业生产过程、农业活动、土地利用变化和林业、废弃物处理。估算的温室气体种类包括二氧化碳、甲烷、氧化亚氮、氢氟碳化物、全氟化碳及六氟化硫。

一、2012 年清单综述

2012 年香港温室气体排放总量（不包括土地利用变化和林业）为 4317.6 万吨二氧化碳当量，土地利用变化和林业碳吸收汇约为 46.6 万吨二氧化碳，考虑土地利用变化和林业碳吸收汇后，温室气体净排放总量约为 4271.1 万吨二氧化碳当量。2012 年香港温室气体排放总量中二氧化碳约为 3957.2 万吨，占排放总量的 91.7%；甲烷约为 220.2 万吨二氧化碳当量，占总量的 5.1%；氧化亚氮约为 34.2 万吨二氧化碳当量，占总量的 0.8%（表 7-2、表 7-3）；氢氟碳化物约为 99.0 万吨二氧化碳当量，占总量的 2.3%；六氟化硫约为 7.0 万吨，占总量的 0.2%（表 7-4）。表 7-3 给出了 2012 年香港分部门的二氧化碳、甲烷和氧化亚氮排放清单。表 7-4 给出了 2012 年香港含氟气体排放排放清单。

表 7-2 2012 年香港温室气体排放总量（万吨二氧化碳当量）

	二氧化碳	甲烷	氧化亚氮	氢氟碳化物	全氟化碳	六氟化硫	合计
能源活动	3894.9	3.8	14.3				3913.0
工业生产过程	60.7	NE	NE	99.0	0.0	7.0	166.7
农业活动		1.2	1.8				3.0
废弃物处置	1.6	215.2	18.1				235.0
土地利用变化和林业	-46.6	NE	NE				-46.6
总量（不包括土地利用变化和林业）	3957.2	220.2	34.2	99.0	0.0	7.0	4317.6
总量（包括土地利用变化和林业）	3910.6	220.2	34.2	99.0	0.0	7.0	4271.1

注：1）阴影部分不需填写；

2）由于四舍五入的原因，表中各分项之和与总计可能有微小的出入；

3）NE（未估算），对现有源排放量和汇清除量没有估计。

表 7-3 2012 年香港二氧化碳、甲烷和氧化亚氮排放（万吨）

温室气体排放源与吸收汇种类	二氧化碳	甲烷	氧化亚氮
总量（包括土地利用变化和林业）	**3910.6**	**10.5**	**0.1**
总量（不包括土地利用变化和林业）	**3957.2**	**10.5**	**0.1**
1. 能源活动	**3894.9**	**0.2**	**0.0**
燃料燃烧	3894.9	0.1	0.0
能源生产和加工转换	2931.5	0.1	0.0
制造业和建筑业	75.6	0.0	0.0
交通	738.4	0.0	0.0
其他部门	149.4	0.0	0.0
逃逸排放		0.1	
油气系统		0.1	
煤炭开采		NO	
2. 工业生产过程	**60.7**	**NE**	**NE**
3. 农业活动		**0.1**	**0.0**
动物肠道发酵		0.0	
动物粪便管理		0.0	0.0
水稻种植		NO	
农用地		NO	NO
限定性热带草原烧荒		0.0	0.0
4. 土地利用变化和林业	**-46.6**	**NE**	**NE**
森林和其他木质生物质储量变化	-46.6		
森林转化	NE	NE	NE
5. 废弃物	**1.6**	**10.2**	**0.1**
固体废物处理		10.0	NO
污水处理		0.2	0.1
废弃物焚烧处理	1.6	NE	NE
信息项			
特殊地区航空	174.6	0.0	0.0
特殊地区航海	969.7	0.1	0.0
国际航空	1260.8	0.0	0.0
国际航海	1679.8	0.1	0.0

注：1）阴影部分不需填写，由于四舍五入的原因，表中各分项之和与总计可能有微小的出入，0.0 表示有计算结果，但因数字太小显示为 0.0;

2）NO (未发生)表示在境内没有发生的温室气体排放和汇清除;

3）NE (未估算)表示对现有源排放量和汇清除没有估计;

4）信息项不计入排放总量;

5）特殊地区航空、特殊地区航海为香港与大陆之间的航空、航海，已作为国内航空、航海排放计入中国温室气体清单总量。

表 7-4 2012 年香港含氟气体排放量(万吨二氧化碳当量)

温室气体排放源与吸收汇类别	HFCs					PFCs				SF_6	合计
	HFC-134a	HFC-404a	HFC-407c	HFC-410a	HFC-227ea	$C_8F_{16}O$	$C_{12}F_{27}N$	$C_{15}F_{33}N$	$C_9F_{21}N$		
工业生产过程	87.8	3.2	2.2	0.4	5.3	0.0	0.0	0.0	0.0	7.0	105.9
其中：卤烃和六氟化硫消费	87.8	3.2	2.2	0.4	5.3	0.0	0.0	0.0	0.0	7.0	105.9

能源活动是香港温室气体的主要排放源。2012 年能源活动温室气体排放量占总排放量的 90.6%，其他依次为废弃物处理、工业生产过程和农业活动排放，所占比重分别为 5.4%、3.9%和 0.1%。 图 7-1 给出了香港温室气体排放部门构成。

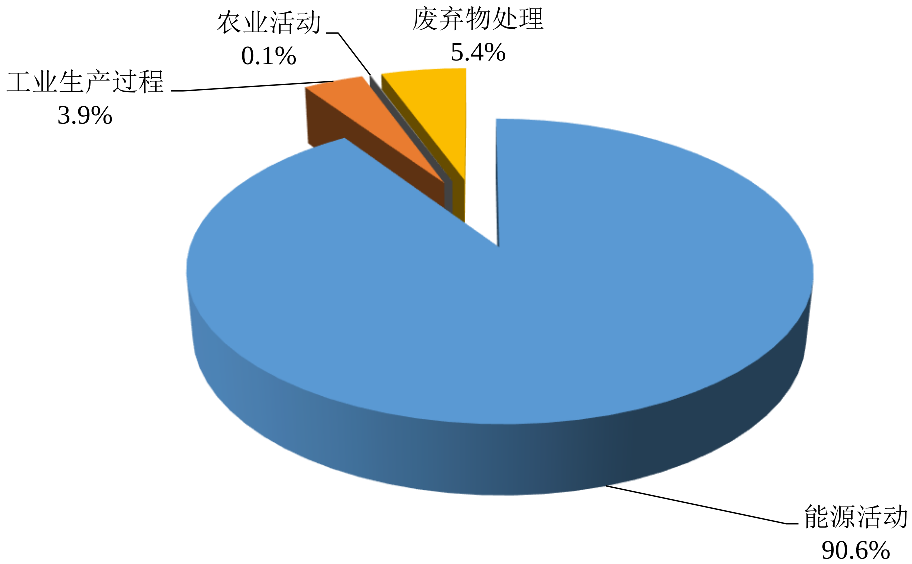

图 7-1 2012 年香港温室气体排放部门构成

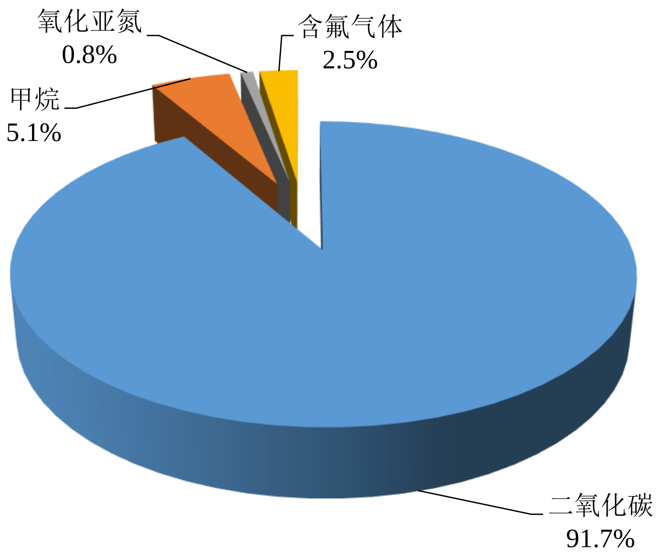

图 7-2 2012 年香港温室气体排放种类构成

二氧化碳排放是香港温室气体的主要排放源。2012 年二氧化碳的排放占总排放量的 91.7%，其他依次为甲烷、含氟气体和氧化亚氮，所占比重分别为 5.1%、2.5%和 0.8%（见图 7-2）。

2012 年香港特殊地区航线和国际燃料舱温室气体排放量约为 4111.6 万吨二氧化碳当量，其中特殊地区航海和航空运输排放 1154.1 万吨二氧化碳当量，国际航海和航空运输排放 2957.5 万吨二氧化碳当量，上述排放均作为信息项单列，不计入香港排放总量，但特殊地区航海和航空运输已作为国内航空、航海排放计入中国温室气体清单总量。

二、能源活动

（一）清单报告范围

能源活动的报告范围主要包括：能源工业、制造业和建筑业、交通运输和其他部门化石燃料燃烧的二氧化碳、甲烷和氧化亚氮排放；油气系统甲烷逃逸排放。

（二）清单编制方法

香港能源活动排放计算主要依据《2006 年 IPCC 清单指南》，电力生产的二氧化碳、甲烷和氧化亚氮排放采用层级 3 方法计算。煤气生产的二氧化碳排放采用层级 2 方法计算，甲烷和氧化亚氮排放采用层级 1 方法计算。填埋气体作为能源用途的二氧化碳排放采用层级 2 方法计算，甲烷和氧化亚氮排放采用层级 1 方法计算。制造和建筑业及其他部门的二氧化碳排放采用层级 2 方法估算，甲烷和氧化亚氮排放采用层级 1 方法进行估算。

对于本地航空、本地水运、铁路、非道路和道路运输移动源的二氧化碳、甲烷和氧化亚氮排放，采用层级 1 方法和层级 2 方法计算。

特殊地区运输是指出发地为香港，目的地为中国其他地区的航空及海上运输活动；国际运输是指出发地为香港，目的地为中国以外其他地区的航空及海上运输活动。特殊地区及国际航空的二氧化碳、甲烷和氧化亚氮排放采用层级 3 方法（a）估算，特殊地区及国际海运的二氧化碳、甲烷和氧化亚氮排放采用层级 1 方法估算。

除燃气管道输送的甲烷逃逸排放采用层级 1 方法估算外，其他甲烷逃逸排放均采用层级 3 方法估算。

（三）排放清单

2012 年香港能源活动温室气体排放量约为 3913 万吨二氧化碳当量，占香港排放总量的 90.6%。其中二氧化碳、甲烷和氧化亚氮排放量分别为 3894.9 万吨、3.8 万吨和 14.3 万吨二氧化碳当量。能源活动排放的二氧化碳量占二氧化碳排放总量的 98.4%。

2012 年香港能源活动排放中，能源工业（发电及煤气生产）排放 2942.7 万吨二氧化碳当量，占 75.3%；交通运输排放 742.4 万吨二氧化碳当量，占 19.0%；其他部门（包

括商业和住宅）排放量 149.7 万吨二氧化碳当量，占 3.8%；制造业和建筑业部门排放 76.0 万吨二氧化碳当量，占 1.9%；甲烷逃逸排放约为 2.2 万吨二氧化碳当量，约占 0.1%。

三、工业生产过程

（一）清单报告范围

工业生产过程的报告范围主要包括：水泥生产过程中的二氧化碳排放；制冷、空调和灭火设备中氢氟碳化物和全氟化碳排放；电气设备的六氟化硫排放。

（二）清单编制方法

基于香港熟料产量和相关数据，采用《1996 年 IPCC 清单指南》层级 2 方法，并同时参考《2006 年 IPCC 清单指南》相关参数，计算水泥生产过程的二氧化碳排放；巴士、铁路列车空调和大型商业、政府建筑空调以及工业制冷的氢氟碳化物排放采用《2006 年 IPCC 清单指南》层级 2 方法（b）计算；汽车、货车空调和工商业楼宇空调以及家用、商业制冷氢氟碳化物的排放采用层级 2 方法（a）计算；溶剂的全氟化碳排放采用《2006 年 IPCC 清单指南》层级 1 方法计算；灭火设备的氢氟碳化物和全氟化碳排放采用《2006 年 IPCC 清单指南》层级 1 方法（a）计算；电气设备应用的六氟化硫排放采用《2006 年 IPCC 清单指南》层级 3 方法计算。

（三）排放清单

2012 年香港工业生产过程温室气体排放量约为 166.7 万吨二氧化碳当量，占香港排放总量的 3.9%。其中，水泥生产过程的二氧化碳排放为 60.7 万吨二氧化碳当量，占 36.4%，制冷和空调、灭火及电气设备使用的氢氟化碳、全氟化碳和六氟化硫排放分别为 99.0 万吨、0.0 万吨和 7.0 万吨二氧化碳当量。

四、农业活动

（一）清单报告范围

农业活动的报告范围主要包括：牲畜肠道发酵、粪便管理的甲烷和氧化亚氮排放；农业土壤的氧化亚氮排放和草原烧荒的二氧化碳、甲烷和氧化亚氮排放。

（二）清单编制方法

肠道内发酵的甲烷排放采用《1996 年 IPCC 清单指南》层级 1 方法，并参考《2006 年 IPCC 清单指南》的缺省排放因子计算；农用地直接和间接氧化亚氮排放采用《2006 年 IPCC 清单指南》层级 1 方法计算；限定性热带草原烧荒的甲烷和氧化亚氮排放采用《2006 年 IPCC 清单指南》层级 1 方法计算。

（三）排放清单

2012 年香港农业活动排放约 3.0 万吨二氧化碳当量，占香港排放总量的 0.1%。牲

畜的肠道发酵及粪便管理的甲烷和氧化亚氮排放共 1.6 万吨二氧化碳当量，而农业土壤氧化亚氮排放约为 1.4 万吨二氧化碳当量。

五、土地利用变化和林业

（一）清单报告范围

土地利用变化和林业活动的报告范围主要包括：林地、农田和草地转化所引起的生物量碳储量的变化。

（二）清单编制方法

林地、农田和草地转化所引起的生物量碳储量变化的二氧化碳排放采用《2006 年 IPCC 清单指南》层级 1 方法，并参考相关的排放因子计算；森林和其他木本生物量储量变化的二氧化碳排放或吸收也采用层级 1 方法计算。

（三）排放清单

2012 年香港土地利用变化和林业活动为碳汇，净吸收二氧化碳约 46.6 万吨，全部来自林地及草地转化所引起的森林和其他木质生物量贮量变化的碳吸收。

六、废弃物处理

（一）清单报告范围

废弃物处理的报告范围主要包括：固体废弃物填埋处理的甲烷排放；生活污水和工业废水处理的甲烷和氧化亚氮排放；废弃物焚烧的二氧化碳排放。

（二）清单编制方法

废弃物处理排放计算主要是基于《2006 年 IPCC 清单指南》，固体废弃物填埋处理的甲烷排放采用层级 2 方法计算，废水处理的甲烷和氧化亚氮排放采用层级 1 方法计算，化学废料处理的二氧化碳排放也采用层级 1 方法计算。

（三）排放清单

2012 年香港废弃物处理共排放 235 万吨二氧化碳当量，占香港排放总量的 5.4%。其中大部分为甲烷，排放量为 215.2 万吨二氧化碳当量，占香港甲烷排放总量的 97.8%。

七、质量保证和质量控制

（一）本次清单编制过程中开展的质量保证和质量控制工作

清单编制机构在清单编制过程中，时时注意加强清单编制质量保证和质量控制工作，以提高清单编制质量。开展的活动主要包括：

1. 在编制方法的选择上，严格按照 IPCC 提供的指南进行编制，以保障清单编制的

科学性、可比性和透明性；

2. 在活动水平数据的收集和分析过程中，与相关部门密切配合，获取权威的第一手官方资料，并有专门的人员管理、校核和检查，以保证所采用数据的权威性和合理性。

3. 在确定排放因子时，尽量使用符合香港实际情况的排放因子，如没有香港特征排放因子，则参考 IPCC 指南提供的缺省排放因子，以确保清单结果的准确性。

（二）本次清单存在的不确定性分析

为减少不确定性所开展的工作。降低不确定性所采取的措施主要包括以下两个方面：一是完善数据收集。利用官方公布的统计数据、本地实测排放因子及参数，同时参考《2006 年 IPCC 清单指南》最新的有关参数；二是选择适当方法学。根据数据的可获得性，选用高层级方法进行清单计算。

清单的不确定性。根据《2006 年 IPCC 清单指南》的误差传递法分析，2012 年香港温室气体清单的不确定性约为 4.3%。由于电厂煤耗的品种、数量等数据统计的局限导致发电过程燃煤排放成为清单编制不确定性的最大来源。

八、历年香港温室气体信息

香港在中国气候变化第二次国家信息通报中已经报告了 2005 年香港温室气体清单。为了与报告的其他部分维持一致性，本节会同时列出第一及第二次国家信息通报的两次历史年份，即 1994 年及 2005 年的清单信息概要。为确保不同年度清单在排放源范围、数据来源等方面具有更好的可比性，香港正在准备的第三次国家信息通报香港特别行政区应对气候变化基本信息中将对 2005 年香港温室气体清单进行重新计算和更新。

（一）1994 年香港温室气体清单

1994 年香港温室气体排放总量（不包括土地利用变化和林业）约为 3572.9 万吨二氧化碳当量，其中二氧化碳、甲烷、氧化亚氮和含氟气体所占的比重分别为 94.3%、4.3%、1.1%和 0.4%（表 7-5）；土地利用变化和林业领域的温室气体吸收汇约为 46.9 万吨二氧化碳当量。考虑温室气体吸收汇后，1994 年香港温室气体净排放总量约为 3526.0 万吨二氧化碳当量，其中二氧化碳、甲烷、氧化亚氮和含氟气体的所占的比重分别为 94.2%、4.4%、1.1%和 0.4%。

表 7-5 1994 年香港温室气体排放构成

温室气体	不包括土地利用变化和林业		包括土地利用变化和林业	
	二氧化碳当量(万吨)	比重(%)	二氧化碳当量(万吨)	比重(%)
二氧化碳	3367.7	94.3	3320.9	94.2
甲烷	154.7	4.3	154.7	4.4
氧化亚氮	37.7	1.1	37.7	1.1
含氟气体	12.7	0.4	12.7	0.4
合计	3572.9		3526.0	

（二）2005 年香港温室气体清单

2005 年香港温室气体排放总量（不包括土地利用变化和林业）约为 4156.5 万吨二氧化碳当量，其中二氧化碳、甲烷、氧化亚氮和含氟气体所占的比重分别为 91.7%、5.2%、1.0%和 2.1%（表 7-6）；土地利用变化和林业领域的温室气体吸收汇约为 41.2 万吨二氧化碳当量，考虑温室气体吸收汇后，2005 年中国温室气体净排放总量约为 4115.3 万吨二氧化碳当量，其中二氧化碳、甲烷、氧化亚氮和含氟气体所占比重分别为 91.6%、5.3%、1.0%和 2.1%。

表 7-6 2005 年香港温室气体排放构成

温室气体	不包括土地利用变化和林业		包括土地利用变化和林业	
	二氧化碳当量(万吨)	比重(%)	二氧化碳当量(万吨)	比重(%)
二氧化碳	3812.0	91.7	3770.8	91.6
甲烷	217.8	5.2	217.8	5.3
氧化亚氮	39.9	1.0	39.9	1.0
含氟气体	86.8	2.1	86.8	2.1
合计	4156.5		4115.3	

第三章 减缓行动及其效果

作为国际化大都市，香港一向关注气候变化问题，并配合国家，通过改变发电燃料组合、改善能源效益、推广环保陆路运输、推广汽车使用清洁燃料、转废为能及大力开展植树造林等方面的政策和措施，积极推动绿色低碳社区，有效地控制温室气体排放，以减缓气候变化。

香港实行的一系列减缓温室气体排放的措施，得到了社会大众的支持和广泛参与，居民的节能减碳意识不断提高，使得香港近年的能源消费增长速度逐渐放缓。从 2005 至 2012 年间，香港人口增长 5.0%，本地生产总值实质增长 29.2%，但同期间香港的用电量只增加了 7.4%。从 2005 至 2012 年，人均温室气体排放量维持在 6 吨二氧化碳当量左右，香港单位本地生产总值二氧化碳排放下降了 20%左右。量化的减排措施详见表

7-7。

一、能源工业减排

电力生产是香港能源活动二氧化碳的主要排放源。香港电力部门采取的减缓政策和行动主要包括：改变发电燃料组成、积极开发可再生能源及强化电力企业温室气体排放管理。在改变发电燃料组成方面，香港政府于 2015 年发布了 2020 年更清洁发电燃料组合方案，即将本地天然气发电比例增加至 50％，输入核电占整体燃料组成约 25%，香港政府还准备开发更多可再生能源及加强节能宣传工作。此外，尽管受地理及气候条件限制，现有科技水平下香港可开发的可再生能源潜力有限，但电力企业还是积极推进，并于 2013 年建设完成香港最大规模（容量达 1 兆瓦）的太阳能光伏发电系统。

二、建筑物减排

建筑物耗电量约占香港总用电量的 90%，香港建筑物的减缓政策和行动主要包括：

提高建筑物能源效益。为提高住宅的节能能力，屋宇署已于 2014 年 9 月推出《住宅楼宇能源效益设计和建造规定指引》，要求涉及宽免住宅楼宇的环保/适意设施及非强制性/非必要机房及设备的楼面面积的新发展项目，楼宇的屋顶及外墙设计及建筑必须符合指引内的住宅热转送值。《建筑物能源效益条例》于 2010 年推出并于 2012 年 9 月全面生效。《建筑物能源效益条例》要求空调、照明、电力、升降机及自动梯等主要楼宇装备装置符合《建筑物能源效益守则》内的节能要求和《能源审核守则》中所明确的个别种类建筑物的能源审计要求。《建筑物能源效益守则》和《能源审核守则》已完成第一次全面检查，并于 2015 年 12 月对公众公布。香港特区政府于 2011 年 1 月推出可持续建筑设计指引，规范建筑物间距及绿化覆盖率，以及倡导楼宇按照香港建筑环境评估法最新版本《绿建环评》进行认证注册登记。

提升电器能源效益。推行自愿参与的《能源效益标签计划》，计划涵盖 13 种家具器具、2 种气体设备、7 种办公室器材、1 种汽油私家车，此计划方便大众选用能效高的产品。香港特区政府通过于 2008 年实施《能源效益（产品标签）条例》（第 598 章）推行《强制性能源效益标签计划》。目前，该计划涵盖了房间空气调节器、电冰箱、自镇流荧光灯、洗衣机和抽湿机。2015 年 11 月已完成房间空气调节器、电冰箱和洗衣机的等级标准修订，目前新标准已全面实施。

开展建筑物温室气体排放核算。香港特区政府编制了《香港建筑物（商业、住宅或公共用途）的温室气体排放及减除的审计和报告指引》，提供系统及科学的温室气体排放核算方法和报告规范，从而推行自愿计划以降低或抵消建筑物的温室气体排放。政府也已于 2015 年完成了一项历时 3 年的计划，为 120 所政府建筑物及公共设施进行了能源及碳排放审计，其中包括公众街市、公众泳池、室内体育馆、中学、办公大楼、医疗设施、社区会堂及市场等。为鼓励更多政策局及部门为其政府建筑物及公共设施定期进

行碳排放审计，在 2015 年已举办了 10 场碳审计研讨会。

三、交通运输减排

交通运输行业采取的减缓政策和行动主要包括：

推动电动车广泛使用。主要措施包括: 豁免电动车辆的首次登记税至 2017 年 3 月 31 日；设置超过 1300 个电动车充电器供公众使用；香港特区政府率先使用电动车辆；2011 年 3 月成立 3 亿元的“绿色运输试验基金”，以资助适用于公共运输业界及货车的绿色创新技术；以及拨款 1.8 亿元资助专营巴士公司购买 36 部单层电动巴士在特区作试验行驶，以评估它们在本地环境下的运作效能及表现。

减免环保汽油私家车登记税。自 2007 年 4 月起至 2015 年 3 月底，香港特区政府对新登记低排放、高燃料效益的环保汽油私家车提供汽车首次登记税的税务宽减[1]。

四、废弃物处理减排

香港社会倡导节约资源，减少丢弃，并鼓励绿色生活方式。废弃物处理的减缓政策和行动主要包括：

提倡废弃物减量化。香港特区政府推行家居废弃物源头分类计划，鼓励减少废弃物、提倡回收及循环再造。2014 年的香港城市固体废物回收率已达到 52%。

强化资源回收利用。目前香港所有填埋场均利用填埋气体作为发电机组的燃料生产能源，用于提供填埋场所基础设施的使用，同时也为渗滤液处理设施提供能源。香港现有四家大型二级污水处理厂产生的甲烷气体直接被用作内燃机的燃料，其产生的电力可供厂内设施使用，也可用作热水锅炉的燃料，用于厂内供热。

加大废弃物资源化。香港首个处理厨余废弃物的试验设施预计将在 2017 年左右建成，成为香港第一期有机资源回收中心。该中心采用生物处理技术，把工商业厨余废弃物转化成生物气体和堆肥产品等有用资源。香港特区政府已启用一处采用先进焚烧技术的污泥处理设施，并计划发展第 1 期焚烧技术的综合废物管理设施，实现转废为能。

五、植树及市区绿化

自 2010 年以来，香港已种植大约 3600 万棵树木和灌木，其中约 400 万棵为树木。近年来，香港特区政府推动以全面和可持续的作业方式处理优质的城市景观设计和树木管理倡议，包括制定和实施绿化总纲图，并推行垂直园境、屋顶园境，采用透水铺地物料和雨水收集等。到 2014 年初，香港共设立了 24 个郊野公园及 22 个特别地区，总面积约达 443 平方公里，约占全港土地的 40%。这些受保护地区不但有利于维持丰富的生

[1] 环保汽油私家车首次登记税的税务宽减已于 2015 年 4 月 1 日终止。

物多样性，也可进一步提高香港的二氧化碳吸收能力。

六、已取得的成效

香港实行的一系列减缓温室气体排放的措施，得到了社会大众的支持和广泛参与，居民的节能减碳意识不断提高，香港近年的能源消费增长速度逐渐放缓。可量化的减排措施详见表 7-7。从 2005 至 2012 年，香港单位本地生产总值二氧化碳排放下降了 20%左右。

七、国际市场机制

特区政府于 2009 年 12 月 1 日发布《港资企业在中国内地开展清洁发展机制项目的补充说明》，列出港资企业在内地开展清洁发展机制项目的明确要求及相关的申请办法。符合条件的港资公司，可出具环保署发出的“《清洁发展机制项目运行管理办法》港资企业证明函”，以中资身份向国家发展改革委申请开展清洁发展机制项目。符合资格的港资企业可利用由外国机构提供的额外资金和技术在国内开展清洁发展机制项目。环境保护署已发出 73 份港资企业证明函，国家发展改革委批准了其中 50 个项目，其中 48 个项目已在联合国注册。减排主要包括风能、水力发电、余热再利用、太阳能、生物质热能和废弃物焚烧领域，项目广泛分布在全国 24 个省份，包括山东、辽宁、江苏、广东、吉林、湖北、四川和内蒙古等。

八、减缓行动的 MRV 相关信息

有关香港的减缓行动，气候变化跨部门工作小组秘书处已整合并记录政策局及相关部门推行的减缓行动的进展情况。香港特区政府已于 2016 年第一季度举办了研讨会以提高政策局及相关部门对减缓行动的测量、报告和核实的理解。

为了促进温室气体核证和核实领域的发展，香港在 2012 年 12 月推出温室气体核证/核实机构的认可服务，获得认可的机构可以按照 ISO14064 认证标准开展温室气体排放报告核实工作。

第四章 资金、技术和能力建设需求及资助

一、资金需求

主要资金需求包括编制温室气体清单、组织能力建设研讨会和讲习班、实施减缓和适应措施，以及参与国际会议和培训等。目前，有关支出和人力投入均由香港特区政府经常性开支负责。

二、技术需求

在减缓气候变化方面技术需求主要包括：建筑节能系列产品技术、新型墙体材料技术、混合动力和电动汽车（包括大型公共汽车）技术、高效能快速汽车充电技术、高性能电池及材料技术、可再生能源（特别是建筑光伏一体化系统）技术等。

在适应气候变化方面技术需求主要包括：环境和生态系统保护技术、为建筑环境及基建开发气候风险评估技术、能源需求及供应变化预测技术、及对食物链影响、食物危害和水资源影响的分析技术等。

三、能力建设需求

在能力建设方面的需求主要包括：加强信息通报和温室气体清单编制的队伍建设和相关培训、强化现行法例及管理、制定新法例、加强监测、强化政府及企业能力、更新灾害管理及应变计划、开展研究及调查和提升政府及社会各界对应对气候变化的了解及应对能力。

第五章 其他相关信息

香港在加强气候系统观测与研究，开展气候变化教育、宣传和培训，鼓励公众参与，提高气候变化意识，拓展国内外合作与交流等方面也开展了一系列活动。

一、气候系统观测与研究

香港的气候变化系统观测与研究工作由香港天文台承担，多年来一直进行气象及气候的观测及相关研究工作，提供包括香港天气预测、即时天气、热带气旋消息、天气图、雷达图及卫星云图等服务，以及发出极端天气预警。香港天文台也从事气候变化研究，分析天气及气候对社会的影响，预测全年降雨量和影响香港的热带气旋数目等。利用最新的气候模式研究进展及观测数据，香港天文台已更新了对香港年气温、雨量和极端天气事件的估算。

二、教育、宣传与公众意识

香港一直重视环境与气候变化领域的教育及宣传工作，积极提高公众意识。气候变化内容已包含于中、小学的常识、地理、科学、科技教育及通识教育等科目的课程之中。为提高各中、小学生对气候变化的认识，香港还出版了一系列读物。香港特区政府不同部门也通过各种渠道，致力于提高各阶层在气候变化、极端天气、节能和绿化等方面的公众意识，并积极引导生活模式及行为方式的改变。

在公众教育及推广气候变化的认知方面，香港天文台已更新气候变化网页，并在网

站发表多篇有关气候变化的网络文章和教育资源文章，提供关于极端天气事件和气候预估的数据，与市民分享最新信息和研究成果。香港天文台也和其它政府部门及团体合作为公众、学校、大学、政府部门及专业机构举办气候变化讲座。此外，香港天文台也出版了气候变化小册子，并且推出网上气候问答游戏，以提升社会各界对气候变化的认识。

环境保护署举办“绿色香港•碳审计”活动，鼓励社会各界对建筑物进行碳审计并执行减碳活动，并在 2014 年 12 月推出了上市公司碳足迹资料库以鼓励私营公司走上减排之路。

香港特区政府成立环境及自然保育基金，资助本地非营利机构推行与环保和自然保育有关的项目及活动。基金资助范围包括非营利机构及学校进行天台绿化、安装可再生能源设备和节能装置等小型示范工程项目，进一步提高社区及学生对应对气候变化的认识。

三、加强国内和国际合作

研究区域清洁能源及可再生能源发展策略，推动清洁能源及可再生能源研发应用，支持企业节能减排，加强应对气候变化相关的科学研究、技术开发应用、宣传教育和基础能力建设等方面的交流和合作。

2011 年香港成为 C40（大城市气候领导集团）指导委员会成员，推动世界各大城市群策群力，共同应对气候变化和提高能源效益。2011 年成立“粤港应对气候变化联络协调小组”，由环境局局长及广东省发展和改革委员会主任共同主持，协调小组就两地有关应对气候变化事宜进行磋商，积极推动两地在温室气体排放及气候变化方面的科学研究和数据共享，以及相关的科学研究、技术开发应用和宣传教育的合作交流。

表 7-7 香港减缓行动计划一览

序号	行动名称	行动目标或主要内容	覆盖部门/温室气体	时间尺度	行动性质(强制/自愿,政府/市场)	监管部门	状态(计划/执行中/已完成)	进展信息	方法学和假设	预估减排效果	获得支持
提高能源效益											
1	《香港都市节能蓝图 2015-2025+》	这是香港首份都市节能蓝图，分析本地使用能源的情况及制订相关政策、策略、目标及主要行动计划，以配合香港达致节约能源的新目标。	所有部门/二氧化碳	2015-2025后	强制/政府	环境局	执行中	电力需求减少	减排量=节能量*排放因子	预计到2025 年减排量为1400 千吨/年	特区政府
2	《建筑物能源效益条例》	《建筑物能源效益条例》及其《建筑物能源效益守则》涵盖照明、空调、升降机及自动梯装置，并就这些装置的最低能源表现标准作出规范，该守则会定期每三年检查一次，以紧贴技术发展。	建筑/二氧化碳	2012至今	强制/政府	机电署	执行中	电力需求减少	减排量=节能量*排放因子	预计到2025 年减排量为1900 千吨/年	特区政府
3	强制性能源效益标签计划	强制性能源效益标签计划涵盖五类电器产品，包括房间空气调节器、电冰箱、自镇流荧光灯、洗衣机和抽湿机，这五类产品的用电量合共占住宅每年用电量约 60%	所有部门/二氧化碳	2009至今	强制/政府	机电署	执行中	电力需求减少	减排量=节能量*排放因子	预计到2025 年减排量为682.5 千吨/年	特区政府

序号	**行动名称**	**行动目标或主要内容**	**覆盖部门/温室气体**	**时间尺度**	**行动性质**	**监管部门**	**状态**	**进展信息**	**方法学和假设**	**预估减排效果**	**获得支持**
4	启德发展区的区域供冷系统	启德发展区的区域供冷系统是一个大型的中央空调系统，该供冷系统利用海水在中央供冷站制造冷水，并通过地下管道网络输送到启德发展区的用户樓宇，该工程项目会在2011 年至 2022 年期间分三个阶段实施。	能源 / 二氧化碳	2011-2022	<u>兴建:</u> 强制/政府 <u>使用:</u> 自愿/市场	机电署	执行中	电力需求减少	减排量=节能量*排放因子	当区域供冷系统全部启用后，预计减排量为 59.5 千吨/年	特区政府
5	广泛使用较具能源效益的淡水冷却塔水冷式空调系统	自 2000 年推出淡水冷却塔计划至 2015 年尾为止，已超过 2000 座淡水冷却塔建成并已投入运作。据估计，约 1500 座新建的淡水冷却塔将会于 2016 年至 2025 年期间完成。机电工程署会继续推动广泛使用淡水冷却塔。	能源 / 二氧化碳	2000 开始	自愿/政府	机电署 / 环境局	执行中	电力需求减少	减排量=节能量*排放因子	预计到 2025 年减排量为 500 千吨/年	特区政府
转废为能											
6	兴建一所专用的污泥处理设施	位于屯门曾咀的专用污泥处理设施第一期已于 2015 年 4 月开始运作，该设施采用先进焚化技术处理从污水处理厂产生的污水淤泥，由焚化过程产生的热能会转化成电力，以完全应付设施的电力需求，并将剩余电力输出至公众电网，作为香港小区的次级电源。	能源及废物 / 二氧化碳、甲烷	2010 至今	强制/政府	环保署	执行中	减少温室气体	减排量=替代化石能源量*排放因子	260 千吨/年	特区政府

序号	行动名称	行动目标或主要内容	覆盖部门/温室气体	时间尺度	行动性质	监管部门	状态	进展信息	方法学和假设	预估减排效果	获得支持
7	有机资源回收中心	预计有机资源回收中心第一期将于2017年左右落成启用，该设施将采取生物处理技术把工商业界的厨余转化为有用的资源，例如生物气体及堆肥产品。	能源及废物 / 二氧化碳、甲烷、氧化亚氮	2017开始	兴建: 政府 使用: 自愿/市场/政府	环保署	计划	减少温室气体	减排量=替代化石能源量*排放因子	第一期为25千吨/年	特区政府
8	综合废物管理设施 第1期	香港特区政府正规划兴建综合废物管理设施第1期，该设施将采用先进的转废为能技术，以大幅缩减废物的体积及将废物转化为能源。	能源及废物 / 二氧化碳	2023	强制/政府	环保署	执行中	减少温室气体	减排量=替代化石能源量*排放因子+避免堆填气体的产生	440 千吨/年	特区政府

第八部分 澳门特别行政区应对气候变化基本信息

澳门是中华人民共和国成立的特别行政区，是一个气候温和、资源短缺、人口密度高、博彩业高度发展、充满活力的城市，也是有名的世界旅游休闲中心。2010 年以来，特区政府在应对气候变化方面采取了一系列的政策与行动，并取得积极成效。

第一章 基本区情

一、自然条件与资源

澳门特别行政区（以下简称澳门）位于华南沿岸珠江三角洲的珠江口西侧，北接广东省珠海市，东望珠江口东侧的香港，南临中国南海，西隔水见珠海市的湾仔、横琴岛。三面环海的澳门主要由澳门半岛（以下简称本澳）、氹仔岛、路环岛和路氹填海区四部分组成。

澳门属亚热带海洋性气候，季风显著。澳门气候温和，1981 年至 2010 年 30 年间的气候资料显示，澳门年平均气温为 22.6℃，1 月最冷，月平均气温约为 15.1℃；7 月最热，月平均气温约为 28.6℃。澳门年平均降雨量约为 2058.1 毫米，降水的季节性差异显著，4～9 月是澳门的雨季，降水量占全年的 84%以上，期间出现的极端强降水事件，日降雨量可高达 300 毫米以上。影响澳门的极端天气及气候事件包括热带气旋和伴随的风暴潮、强烈季风、暴雨以及雷暴。每年约有 5～6 个热带气旋影响澳门，其中 1～2 个会导致澳门半岛风力达 8 级或以上。

澳门土地资源极为有限，历年来一直通过填海造地增加土地面积。2009 年获中央政府核批新城填海计划，填海造地共计 361.65 公顷用于建设新城区。此外，澳门大学横琴校区自 2013 年 7 月 20 日起正式交由澳门管理，校区陆地面积约 1.4 平方公里。2014 年澳门陆地面积达 30.3 平方公里，较 2010 年增加了约 2.0%。

澳门本地蓄水设施不足，超过 95%的饮用原水是由广东省珠海市输入本澳。2014 年澳门用水量达 8349 万立方米，其中工商业用水占 51%，家庭用水占 42%，其余 7%则用于政府部门和其它设施等。

二、人口与社会

澳门是世界上少有的人口高密度地区。2014 年，澳门总人口为 63.6 万人，较 2010 年增加了 27.0%，平均人口密度为每平方公里约 2.1 万人。澳门劳动人口约为 39.5 万

人，其中就业人员为38.8万人。第一产业就业人口仅占总量的0.2%，第二产业占15.7%，第三产业占84.1%。

根据教育暨青年局2014/2015学年教育数字统计，正规教育学校有74所，学生人数6.95万人。高等教育机构有10所，学生人数约有3.1万人，其中本地生占60.3%，外地生占39.7%。

2014年，澳门共有医生1592人，护士1990人，医院床位1421张。澳门2014年在医疗卫生上的开支约为53亿澳门元，占政府总开支的9.2%，相当于本地生产总值的1.2%。

三、经济发展

近年来澳门经济发展迅速，2014年本地生产总值（以当年价格计算，下同）约为4435亿澳门元，人均本地生产总值为71.3万澳门元，近十年来澳门的本地生产总值持续增长，年均增速约为11.0%。澳门本地生产总值中第一产业几乎为零，第二和第三产业比例分别为5.2%和94.8%，其中博彩业是澳门的主要经济支柱，占本地生产总值的58.3%；不动产业、批发和零售业以及建筑业也是比较重要的行业，分别占8.3%、5.2%和4.3%。旅游业对澳门经济发展也有重要作用，2014年访澳旅客人数约为3153万人次，主要客源来自内地，占总访澳旅客的67.4%。

2014年澳门能源消费总量约为71.8万吨标准煤，其中轻柴油占34.2%，煤油、汽油、重油、天然气和石油气占能源消费总量的比例分别为20.1%、15.1%、10.6%、10.5%和9.5%。在能源消费总量中，陆路运输25.1%，空路运输19.4%，能源加工转化18.7%，水路运输13.0%，商业、饮食业和酒店11.7%，工业和建筑业9.0%，家庭用户2.6%，其它0.5%。

澳门电力主要是从广东省输入，并以天然气和重油在本地发电作为补充。自2007年起，澳门持续增加电力输入，逐渐减少本地发电量，2014年澳门总输入电量为40.9亿千瓦时，本地总产电量仅为6.4亿千瓦时。

澳门的运输系统包括陆路、水路和航空三种运输方式。2014年澳门道路行车线总长度424公里，行驶车辆总数为24万多辆，客运船班次约为14.1万，按目的地和出发地统计的澳门国际机场商业航班数目总数均为2.4万。

表8-1 给出了2012年和2014年澳门的基本情况。

表 8-1 2012/2014 年澳门的基本情况

指标	2012 年	2014 年
人口（万人、年终人口数）	58.2	63.6
面积（平方公里）	29.9	30.3
本地生产总值（以亿美元计，1 美元=7.9899 元澳门元）	430.3	555.1
人均本地生产总值（以美元计）	75531	89287
工业在本地区生产总值中所占份额（百分比）[1]	4.1	5.2
服务部门在本地区生产总值中所占份额（百分比）	95.9	94.8
农业在本地区生产总值中所占份额（百分比）	0	0
用于农业目的的土地面积（平方公里）	0	0
城市人口占总人口的百分比	100	100
大牲畜总数（头、匹）	569	438
牛（头）	5	5
马（匹）	548	419
猪（头）	3	3
羊（只）	13	11
有林地面积（平方公里）	2.98	2.98
贫困人口（万人）[2]	2.8	2.3
预期寿命（年）	男 79.3 岁 女 85.8 岁	男 79.6 岁 女 86.0 岁
识字率（%）[3]	95.6	95.6

注： 1）此处工业行业包括第二产业中的采矿业、制造业、水电及气体生产供应业、建筑业；

2）此数据代表低收入的就业人口（平均月收入少于 4000 澳门元）；

3）数据是根据澳门 2011 年人口普查结果显示 15 岁以上人口的识字率。

四、应对气候变化相关的机构安排

澳门特区政府一直高度重视气候变化问题，为有效管理和统筹应对气候变化工作，澳门已于 2015 年成立应对气候变化跨部门专责小组（以下简称气候变化小组），负责协调与《联合国气候变化框架公约》履约相关的工作，包括制定“可测量、可报告、可核实”的减排行动，把减缓和适应气候变化工作推广至私营机构和广大民众，动员全民参与应对气候变化工作。

气候变化小组由运输工务司带领政府各相关部门开展应对气候变化的相关工作，主要部门包括：民政总署、经济局、统计暨普查局、卫生局、教育暨青年局、旅游局、海事及水务局、房屋局、环境保护局、民航局、交通事务局、能源业发展办公室、运输基建办公室和地球物理暨气象局共 14 个部门。其中，地球物理暨气象局负责统筹和编写国家信息通报及两年更新报告中澳门应对气候变化基本信息。

第二章 2012 年澳门温室气体清单

2012 年澳门温室气体清单编制主要采用《1996 年 IPCC 清单指南》和《IPCC 优良作法指南》提供的方法进行编制，个别计算参数及排放因子的缺省值参考《2006 年 IPCC 清单指南》。根据澳门实际情况及相关数据的可获得性，2012 年澳门温室气体清单报告范围主要包括能源活动和废弃物处理的温室气体排放。估算的温室气体种类包括二氧化碳、甲烷、氧化亚氮，氢氟碳化合物、全氟化碳和六氟化硫因数据不足，不包括在本次澳门温室气体清单计算中。

一、2012 年清单综述

2012 年澳门温室气体排放总量为 97.8 万吨二氧化碳当量（表 8-2），其中能源活动排放占总排放量的 97.6%，废弃物处理排放占总排放量的 2.4%（图 8-1）。2012 年澳门温室气体排放总量中二氧化碳约为 93.9 万吨，约占排放总量的 96.0%；甲烷约为 0.5 万吨二氧化碳当量，约占排放总量的 0.5%；氧化亚氮约为 3.4 万吨二氧化碳当量，约占排放总量 3.5%（图 8-2）。

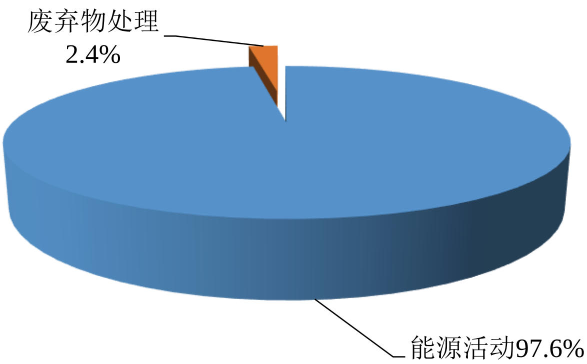

图 8-1 2012 年澳门温室气体排放部门构成

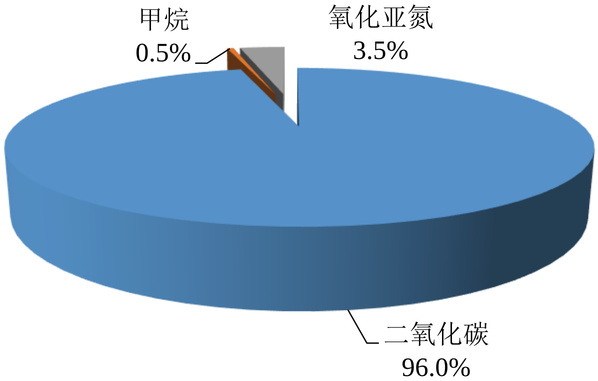

图 8-2 2012 年澳门温室气体排放种类构成

表 8-2 2012 年澳门温室气体清单（万吨二氧化碳当量）

温室气体排放源与吸收汇的种类	二氧化碳	甲烷	氧化亚氮	总计
总量（包括土地利用变化和林业）	93.9	0.5	3.4	97.8
1. 能源	93.5	0.5	1.5	95.5
燃料燃烧	93.5	0.5	1.5	95.5
能源加工和转换	28.2	0.1	0.1	28.4
制造工业和建筑业	11.3	0	0	11.3
陆路交通	33.9	0.3	1.3	35.5
其他部门	20.1	0.1	0.1	20.3
燃料的逃逸排放		NE		NE
2. 工业生产过程	NO	NO	NO	NO
3. 农业		NO	NO	NO
4. 土地利用变化和林业	NE	NO	NE	NE,NO
5. 废弃物	0.4	0	1.9	2.3
城市生活垃圾处置		NO		NO
废水处理		NE	1.8	1.8
废弃物的焚烧	0.4		0.1	0.5
其他		NO	NO	NO
6. 信息项				
特殊地区航海	19.2	0.0	0	19.2
特殊地区航空	17.7	0.0	0.2	17.9
国际水运	NO	NO	NO	NO
国际航空	18.8	0	0.2	19.0
生物质燃烧的能源活动	8.4			8.4

注：1）阴影部分不需填写；

2）由于四舍五入的原因，表中各分项之和与总计可能有微小的出入；

3）NO（未发生），在境内没有发生的温室气体源排放和汇清除；

4）NE（未计算），表示对现有源排放量和汇清除没有计算；

5）信息项不计入排放总量。其中生物质燃烧 CO_2 排放只包括生物成因的废弃物燃烧活动。

6）特殊地区航海、特殊地区航空为澳门与大陆之间的航海、航空，已作为国内航空、航海排放计入中国温室气体清单总量

2012 年澳门国际航空及特殊地区航空温室气体排放约为 36.9 万吨二氧化碳当量，特殊地区航海排放约为 19.2 万吨二氧化碳当量，均作为信息项单列，不纳入澳门温室气体清单，但特殊地区航空、航海已作为国内航空、航海排放计入中国温室气体清单总量。另外，城市废弃物中的生物质燃烧所产生的温室气体排放量约为 8.4 万吨二氧化碳当量，也列于信息项中，以上活动的温室气体排放量均未计入澳门温室气体总量。

二、能源活动

（一）清单报告范围

能源活动温室气体清单编制和报告的范围主要包括：能源加工转换、制造业和建筑业、陆路交通的化石燃料燃烧，以及其它部门的二氧化碳、甲烷和氧化亚氮排放。考虑到澳门城市废弃物主要采取焚烧形式处理，经焚烧炉产生的热量进行发电并输送至本澳电网，故将布料及塑料等化石成因废弃物焚烧发电的温室气体排放纳入能源活动计算，而城市废弃物中生物质焚烧产生的二氧化碳排放不计入排放总量，只在信息项中记录。此外，特殊地区航海、国际航空和特殊地区航空一并在信息项中列出。

（二）清单编制方法

能源活动清单中，能源加工转换、制造业和建筑业、其他部门及特殊地区航海化石燃料燃烧产生的二氧化碳、甲烷和氧化亚氮排放均采用《1996 年 IPCC 清单指南》方法 1 的部门法进行估算，而陆路交通、国际航空和特殊地区航空的二氧化碳、甲烷和氧化亚氮排放均选择采用《1996 年 IPCC 清单指南》方法 2 进行估算。

活动水平数据均为澳门公开发表的统计数据和相关行业数据，部门分类和燃料品种分类与《1996 年 IPCC 清单指南》的分类方式基本相同。排放因子主要参考《1996 年 IPCC 清单指南》，该指南中没有的排放因子则采用了《2006 年 IPCC 清单指南》中的缺省值。

（三）温室气体排放

2012 年澳门能源活动的温室气体排放量约为 95.5 万吨二氧化碳当量，占全澳排放总量的 97.6%。其中二氧化碳、甲烷和氧化亚氮排放量分别约为 93.5 万吨、0.5 万吨和 1.5 万吨二氧化碳当量。能源活动的二氧化碳排放量占全澳二氧化碳排放总量的 99.6%。

2012 年澳门能源活动的排放中，陆路运输排放约 35.5 万吨二氧化碳当量，占 37.2%；能源加工转换排放约 28.4 万吨二氧化碳当量，占 29.7%；制造业和建筑业的排放约为 11.3 万吨二氧化碳当量，占 11.8%；其它部门（包括商业、饮食业、酒店和住宅）排放约 20.3 万吨二氧化碳当量，占 21.3%。

三、废弃物处理

（一）清单报告范围

废弃物处理温室气体清单编制和报告的范围包括城市生活污水处理的甲烷和氧化亚氮排放，废弃物焚烧处理的二氧化碳和氧化亚氮排放。由于澳门城市生活污水处理都是采用好氧生物法处理，其处理过程中的甲烷排放量极小，本次清单中忽略其甲烷排放。

（二）清单编制方法

澳门废弃物处理过程的温室气体排放采用了《1996 年 IPCC 清单指南》提供的方法。

废水处理过程的氧化亚氮排放活动水平数据为澳门统计局提供的人口数量和联合国粮食及农业组织提供的 2012 年度澳门人均全年蛋白质消耗量，排放因子为 IPCC 缺省值; 废弃物焚烧产生的二氧化碳和氧化亚氮排放直接采用澳门统计局和环境保护局提供的活动水平数据和 IPCC 推荐的缺省排放因子。

（三）温室气体排放

2012 年澳门废弃物处理产生的温室气体排放约为 2.3 万吨二氧化碳当量，占澳门排放总量的 2.4%。其中废水处理和废弃物焚烧的排放分别为 1.8 万吨和 0.5 万吨二氧化碳当量，分别占废弃物处理排放量的 78.3%和 21.7%。

四、清单的不确定性分析

（一）本次清单编制过程中的质量保证和质量控制

为了降低温室气体清单结果的不确定性，在清单编制方法方面，澳门清单编制机构采用了《1996 年 IPCC 清单指南》和《IPCC 优良作法指南》，并参考《2006 年 IPCC 清单指南》的方法，保证清单编制方法学的科学性、可比性和一致性。在条件允许的情况下，根据所能获得的部门活动水平数据，尽可能选用层级较高的方法。例如陆路交通、国际航空和特殊地区航空均采用较为详细的方法 2 进行估算。在活动水平数据方面，为保证数据的权威性，尽可能采用经澳门特区政府部门核实的官方数据，包括来自澳门统计暨普查局、民航局、环境保护局和交通事务局等政府部门数据。在清单编制过程中，邀请国家温室气体清单编制团队对清单进行了评审。

（二）清单中存在的不确定性

尽管澳门清单编制机构在准备 2012 年澳门温室气体清单过程中，在报告范围、清单方法、清单质量等方面开展了大量工作，但是澳门温室气体清单仍存在一定的不确定性。

采用《IPCC 优良作法指南》提供的不确定性计算方法 1，以及参考《1996 年 IPCC 清单指南》和《2006 年 IPCC 清单指南》的排放因子不确定性计算方法，估算澳门温室气体清单总不确定性约为 3.3%。

五、历年澳门温室气体信息

澳门在中国气候变化第二次国家信息通报中已经报告了 2005 年澳门温室气体清单。2005 年澳门的温室气体排放量为 180.3 万吨二氧化碳当量。2012 年澳门的温室气体排

放总量较 2005 年下降约 82.5 万吨二氧化碳当量，下降了 45.8%。排放量降低的主要原因是外购电力增加使得本地区能源活动排放降低。

2012 年澳门温室气体清单的编制方法、温室气体种类与 2005 年相同。不同之处是 2012 年清单信息项中计算了城市废弃物生物质燃烧的二氧化碳排放。

第三章 减缓行动及其效果

澳门特区政府一直高度重视减缓气候变化的工作，致力于采取优化能源结构、节约能源、提高能效以及公交优先等政策措施，推动低碳社会建设，减缓气候变化。

一、控制温室气体排放的政策和目标

2010 年，澳门特区政府提出“构建低碳澳门、共创绿色生活”的愿景，积极支持和配合国家应对气候变化政策和行动。澳门确定的控制温室气体排放的目标为，2020 年单位澳门本地生产总值温室气体排放强度在 2005 年基础上降低 40%-45%。

2010 年制定了《澳门环境保护规划（2010-2020）》，作为澳门 2020 年之前环境保护及相关减排工作的重要纲领。该规划围绕“可持续发展、低碳发展、全民参与、区域合作”四大核心理念，以改善人居环境、保障居民健康为目标，分近期（2010-2012 年）、中期（2013-2015 年）及远期（2016-2020 年）三个阶段实施。近期目标是逐步改善环境质量，提升环境管理能力。中期目标为环境污染得到基本控制，初步形成良好的生态环境安全格局，并逐步制订环境管理规章制度与技术标准。远期目标为建立起较完善的环境保护法律法规与技术规范体系，区域环境质量得到进一步提高，基本形成和谐、健康、平衡的生态系统。

二、减缓温室气体排放行动

（一）能源工业

逐步提高天然气发电比例。随着澳门经济高速发展，电力需求不断增加，澳门特区政府从国内购入的电力呈逐年上升趋势。为减缓与电力相关的排放，澳门于 2008 年开始引入天然气发电，以逐步取代重油发电，使用天然气发电的比例由 2008 年的 34.5% 提高到 2014 年的 55.2%。

向公共房屋居民提供天然气。澳门特区政府已于 2012 年初启动了公共天然气管网的建设工程，路环接收减压站于 2013 年正式投入运作，并开始向路环公共房屋居民供气，以改善澳门能源消费结构、降低二氧化碳排放。截至 2015 年，路氹城区的主管网已完成 74.6%铺设工程，为未来提供多元的清洁能源奠定了基础。

推广光伏发电等可再生能源。澳门特区政府一直积极推广可再生能源，早于 2010

年在电力专营合同中就明确要求电力公司必须接收可再生能源电力，为太阳能光伏并网创造了条件。2010 年起已经在多个公共部门及机构应用太阳能光伏发电。2015 年 1 月《太阳能光伏并网安全和安装规章》正式生效，澳门特区政府不仅向业界提供了技术规范，还制定了上网电价制度，鼓励投资者安装光伏系统，推动了太阳能光伏并网发电。

另外，澳门特区政府还就城市能源需求与新能源应用进行了多项规划和研究，先后发布了《澳门太阳能热水应用实务指南》和《建筑物能耗优化技术指引》等技术手册，并在一些公共部门及机构测试示范中央空调系统余热回收技术。

（二）交通运输

参加“机场碳排放认可计划”。澳门国际机场于 2014 年取得了国际机场协会的“机场碳排放认可计划”的“减少”级别认证。自 2012 年起，澳门每年逐步把照明系统及地面工作车辆更换为节能照明系统及环保车辆，并于 2015 年确定了明确的目标，即 2018 年将机场每起降架次的碳排放量比 2012 年减少 20%。

实施陆路交通公交优先政策。澳门特区政府于 2010 年推出了《澳门陆路整体交通运输政策（2010-2020）》，以“公交优先”为整体核心，建设低碳和绿色的交通环境。计划按近期（2012）、中期（2015）及远期（2020）三个阶段逐步推进。该政策除构建轻轨、重整巴士、计程车、自行车及步行网络等公交系统、落实公交优先的理念外，还配合新城填海区的开发，完善澳门交通网络的建设，落实控制车辆增长及推广环保车辆等政策。

推动环保节能车辆使用。为推动环保节能车辆使用，除鼓励购车人士优先选择环保车辆外，还缩短强制性验车年期，更新在用车辆尾气排放标准；要求巴士业界采用环保巴士，到 2015 年已引入 310 辆欧四或欧五标准的环保巴士，其中 20 辆为天然气巴士。

（三）节能和提高能效

企业节能。澳门特区政府于 2011 年设立了“环保与节能基金——环保、节能产品和设备资助计划”，向澳门商业及社团提供资助，鼓励他们使用有助于改善澳门环境质量、节能减排的产品和设备。

公共部门及机构节能。澳门特区政府于 2007 年建立了能源管理机制，以提升公共部门的能源效益，至今有 50 多个部门及机构参与。2015 年还落实了公共部门及机构能源效益评估计划，制定了适合澳门情况的以部门人均耗电为指标的能耗限额标准，明确节能目标，持续改善和优化能源管理工作。

公共户外照明系统节能。2008 年发布了《澳门公共户外照明设计指引》，大力推动户外 LED 灯照明应用。2015 年在新口岸填海区进行首段路灯更换工程，将 420 支路灯更换为 LED 灯。由于节能效果显著，政府正逐步更换各区路灯，计划 2016 年更换三座跨海大桥路灯，随后相关工程将逐步推广至全澳。

酒店业节能。自 2007 年开始每年举办“澳门环保酒店奖”，以推动酒店及相关产业实现环保、低碳及清洁发展。自该奖励计划设立以来，参与的酒店数目不断增加。

（四）城市绿化

增加绿地面积。澳门特区政府持续种植树木、积极扩大绿化空间。自 1982 年起，每年举办“澳门绿化周”，通过系列活动宣传环境绿化和自然保护的重要性。其中，“澳门绿化周大步行及植树活动”每年种植逾千株树苗，2013 年澳门总绿地面积已经增加到约 859 万平方米。

探索立体绿化。为实现绿色城市目标，澳门特区政府自 2011 年起将绿化深度扩展至公共垃圾房、行车天桥桥墩及候车站等顶部及立面，并于狭窄的街道中开展了薄层式篱笆立体绿化实验，从多个方面探索增加澳门的立体绿化空间。

三、已取得成效

多年来澳门特区政府积极推广环保节能、绿色生活理念，加大外调电力比重，实施的系列减排政策及相关措施已见初步成效。《澳门特别行政区能源效益状况 2013》研究报告显示，与 2011 年行业能源消耗相比，澳门社会整体的能源效益状况呈现部分改善、部分稳定的情况。其中，零售业、饮食业和非政府机构的商业建筑物每千澳门元增加值的能源消耗量分别减少 40.4%、29.8%、和 7.2%。据估算，2012 年人均温室气体排放比 2005 年下降约 54.9%，澳门单位本地生产总值温室气体排放比 2005 年下降约 76.4%。量化的减排措施详见表 8-3。

表 8-3 减缓行动和效果表格

序号	行动名称	行动目标或主要内容	覆盖部门/温室气体	时间尺度	行动性质(强制/自愿/政府/市场)	监管部门	状态(计划/执行中/已完成)	进展信息	方法学和假设	预估减排效果	获得支持
1	逐步提高天然气发电比例	2008 年开始引入天然气发电。	能源工业/CO_2	2008 至今	政府	能源业发展办公室	执行中	天然气发电比例由 2008 年的 34.5%提高到 2014 年的 55.2%	减排量= (天然气发电量*2008-2014 年南方电网平均排放因子) 一(天然气发电用气量*天然气排放因子) 起始年：2008 年	2008 至 2014 年共减排 188.4 千吨二氧化碳	澳门特区政府
2	参加国际机场协会机场碳排放认可计划	2018 年每起降架次的碳排放量比 2012 年减少 20%。 通过提高能源和燃油效益，加强废弃物管理及回收，减少机场碳排放。	交通运输、废弃物/CO_2、CH_4、N_2O	2012-2018	自愿	民航局	执行中		每起降架次的碳减排量=当年每起降架次的碳排放量-基年每起降架次的碳排放量 基年：2012 年 排放源边界： 根据机场碳认证计划指南中二级认证要求，计算直接排放和能源间接排放的排放量	2015 年机场每起降架次的碳排放量比 2012 年下降 14.47%	澳门国际机场专营股份有限公司、澳门机场管理有限公司和环保节能基金

序号	行动名称	行动目标或主要内容	覆盖部门/温室气体	时间尺度	行动性质	监管部门	状态	进展信息	方法学和假设	预估减排效果	获得支持
3	推动环保车辆使用	对符合环保排放标准的新机动车辆提供税务优惠，主要目标是鼓励市民使用环保车辆，以减少二氧化碳和尾气污染物排放。	能源/CO_2	2012-至今	政府/自愿	环境保护局负责制订措施和标准。 财政局和交通事务局负责执行。	执行中		减排量=节油量*汽油燃烧二氧化碳排放因子 基年：2012 年	2012 至 2015 年合计减排： 14.7 千吨二氧化碳	澳门特区政府
4	环保与节能基金--《环保、节能产品和设备资助计划》	“环保与节能基金”是以改善本澳的环境质量、促进节能减排为目标，资助商业企业和社团购买或更换节能产品，主要包括：LED 照明设备、环保节能空调以及环保节能炉具。	能源/CO_2	2011 - 2015	政府/自愿	环境保护局	已完成	行政当局评估认为《环保、节能产品和设备资助计划》已经达到一定成效，因此决定不再延长计划实施。于 2015 年 12 月 31 日停止申请。	减排量=节电量*2011-2014 年南方电网平均排放因子 基年： 2011 年	2011 至 2015 年合计减排： 41 千吨二氧化碳	澳门特区政府

序号	行动名称	行动目标或主要内容	覆盖部门/温室气体	时间尺度	行动性质	监管部门	状态	进展信息	方法学和假设	预估减排效果	获得支持
5	公共部门/机构能源效益和节约能源计划	公共部门/机构通过自行制定节能计划，管理日常能源使用情况，每年能耗减少 5%。	能源/CO_2	2007 至今	政府/自愿	能源业发展办公室	执行中	此行动于 2007 年启动，至 2015 年共节省电量 6,028,345 度	减排量=节电量*2008-2014 年南方电网平均排放因子 基年：2008 年	2008 年至 2014 年合计减排： 4.3 千吨二氧化碳	澳门特区政府
6	LED 公共户外照明应用	在《澳门公共户外照明设计指引》的基础上，进行测试示范项目以明确 LED 公共户外应用效果，并计划逐步更换全澳路灯，与更换路灯前作比较，节省电量 30%。	能源/CO_2	2010 至今	政府	能源业发展办公室	执行中	2015-2016 年完成新口岸填海区路灯更换，2016 年底开始更换全澳约 13,000 支路灯	减排量=节电量*2014 年南方电网排放因子 基年：2016 年	完成工程年份之估计减排量： 4.3 千吨二氧化碳	澳门特区政府

第四章 资金、技术和能力建设需求及资助

澳门特区政府重视气候变化领域的技术和能力建设，在减缓气候变化的工作上，已投入了大量的资金，对相关领域的技术有较大的需求，需要从国内外获得更大的支持。

一、技术需求

减缓和适应的技术需求清单如表 8-4 和表 8-5。

表 8-4 减缓技术需求清单

部门	技术名称
可再生能源	海上风力发电技术、太阳能电热技术
能源	智能电网建设和应用技术
建筑	建筑物节能技术、高效能照明系统技术
交通	电动车高效能电池充电技术

表 8-5 适应技术需求清单

部门	技术名称
水资源	再生水应用技术、雨水资源再利用技术
城市	城市气候脆弱性评估技术、灾害性天气和海平面变化的评估技术、城市灾害监测和预防技术、增强城市灾后恢复力技术
生态	气候变化对生态影响的评估技术、物种保育技术

二、能力建设需求

澳门特区政府对气候变化的能力建设需求，主要可分以下五大方面：

（一）温室气体清单编制

通过调研以及与相关部门或机构协商，确立合适的工作机制，以获取更准确的活动水平数据和排放因子。另外，为支持每年的清单更新和确保清单计算结果完整、透明和可比，需要进一步优化日常的数据收集机制和建立数据库系统，以储存、管理和利用历年的活动水平数据和排放因子。

（二）减缓行动及效果评估

为进一步提升政府机构对相关减缓政策的制定和执行能力，需针对减排潜力大的排放源建立可测量、可报告和可核实减排机制（以下简称为 MRV 机制），编写实施 MRV 机制指南和用户手册，促进相关机构和人员了解和执行；邀请国家或国际 MRV 机制专家进行经验分享和研讨，加强相关政府机构和私营企业能力建设。

（三）脆弱性和适应性评估

澳门作为沿海城市易受气候变化影响，应加强城市脆弱性和适应性能力评估，并采

取相应的应对措施，主要包括：海平面上升后对澳门造成的影响和应对措施，城市灾害监测和预防的能力建设，传染性疾病与气候变化的关系和预防措施方面的能力建设。

（四）技术交流与合作

建立与国家和国际不同机构的交流合作平台，通过技术交流与合作加强澳门特区在温室气体清单编制、减缓技术和效果评估、以及灾害预警和应对等能力建设。

（五）教育、培训和公众意识

澳门特区政府在制定以及实施减缓和适应政策措施的同时，还应加强节能、环保、低碳教育和宣传，推动全民参与应对气候变化行动。

第五章 其他相关信息

澳门在加强气候系统观测和研究，开展气候变化教育、宣传和培训，提高气候变化意识和鼓励公众参与等方面也开展了一系列活动。

一、气候系统观测

澳门面积虽小，但设有密集的大气和沿岸水位观测网络，其中包括 13 个自动气象监测站、1 个气候观测站、1 个大气辐射监测站、5 个空气质量监测站、2 个潮汐监测站、1 个海浪监测站。此外，澳门特区政府分别于 2009 年和 2014 年建立了 17 个陆地自动水位监测站，监测因风暴潮和天文潮导致沿岸的海水倒灌和暴雨引起的淹浸情况。

二、气候变化研究

澳门的气象观测历史悠久，资料系统且详实，地球物理暨气象局通过整理这些资料，建立起 1901-2000 年百年数据体系，并开展了大量研究工作。如：20 世纪澳门气候变化状况分析；引进多种全球气候模式资料，通过降尺度方法评估澳门未来气温和降水的变化情况，以及热带气旋、风暴潮和强降水等极端天气事件对澳门带来的风险。

澳门除了继续加强常规气象和海平面相关的分析研究外，近年还对资料相对较少、观测时间较短的生态系统加强观测。自 2011 年起分别对澳门野生动物（昆虫）和植物展开了定期和系统的调研工作，务求通过调查动植物的种类、分布、种群密度和物候特征，结合气象观测数据，了解气候变化对动植物生态的影响。

三、教育、宣传与公众意识

气候变化教育方面。在《本地学制正规教育课程框架》和《本地学制正规教育基本学力要求》中，持续优化各教学阶段有关气候变化及其影响的教材内容，以加强学生对气候变化的关注，提升学生的节能环保意识。教育暨青年局已经编写了由小学至高中阶段的《品德与公民》和《澳门地理》初中补充教材，促进气候变化有关的教育及宣传工

作。另外，澳门特区政府自 2006 年开展能源教育，并在 2008 年鼓励校方自发组织开拓符合能源教学活动的“校园节能文化活动”。2010 年推出“绿色学校伙伴”，持续为绿色学校提供多元环保教育活动。截至 2015 年 12 月已有 66 所校部成为绿色学校，全澳参与“绿色学校伙伴”计划的师生人数已超过八成。此外，2010 年至 2014 年间，澳门特区政府与民间教育机构合作举办多次研讨会及培训课程，介绍能源管理、能源审核及节能减排技术新趋势，为企业界人员提供能源领域相关的最新技术和资讯。

气候变化宣传方面。澳门特区政府通过每年举行各种主题活动向公众宣传节能减排意识。通过“世界无车日”倡导低排放出行模式；通过“澳门绿化周”唤起将绿色元素引入生活的公众意识；通过“澳门环保周”活动凝聚社会力量，推广环保信息；通过“环保 Fun”奖励活动推动市民持续实践多样化的环保行动；通过“澳门节能周”系列活动，提高市民节能意识。另外，也利用多渠道如电子媒介、电台、报章、刊物以及宣传海报等提升公众减排意识。

交流与合作。为了促进泛珠三角地区与国际市场间的环保商务、技术及资讯的交流，澳门特区政府除了与香港及国内邻近城市合办大型环保宣教活动，增进本澳与邻近地区的环保交流外，自 2008 年开始每年举办“澳门国际环保合作发展论坛与展览（MIECF）”活动，推动构建环保产业平台，围绕气候变化、节能减排及碳交易等议题，推广环保信息、引进先进的环保及节能技术和产品等。

2014 年“澳门公众环境意识调查”的结果显示，本澳居民的环保意识正呈逐年上升趋势。

The People's Republic of China
First Biennial Update Report on Climate Change

December 2016

Foreword

Recalling Articles 4 and 12 of the *United Nations Framework Convention on Climate Change* (UNFCCC), each Party shall submit its national communication. As a non-Annex I party to the Convention, the People's Republic of China (hereafter referred to as China) has attached great importance to its international obligations. China submitted its *Initial* and *Second National Communications on Climate Change* in 2004 and 2012 respectively, in which policies and actions in response to climate change were comprehensively elaborated, and the 1994 and 2005 National GHG Inventories were reported.

According to decisions 1/CP.16 adopted at COP 16 in 2010 and 2/CP.17 at COP 17 in 2011, non-Annex I Parties, consistent with their capabilities and the level of support provided for reporting, should submit their first biennial update report by 2014, containing updates of national greenhouse gas inventories, mitigation actions, needs and support received, and the *Biennial Update Report* should be subject to international consultations and analyses. Upon receiving the grants from the Global Environment Facility (GEF) in 2015, the Chinese government launched the preparation of its first Biennial Update Report by organizing the departments and research institutions concerned and by following the guidelines for the preparation of biennial update reports from non-Annex I Parties, which was adopted by COP 17. After over one year of efforts, the *First Biennial Update Report on Climate Change of the People's Republic of China* was completed. This report was approved for submission by the State Council after multiple and repeated revisions based on broad comments.

The First Biennial Update Report on Climate Change of the People's Republic of China, approved by the Chinese government, is divided into eight Parts: National Circumstances and Institutional Arrangements for Addressing Climate Change, National Greenhouse Gas Inventory, Mitigation Actions and Their Effects, Finance, Technology and Capacity-Building Needs and Support Received, Information on Domestic Measurement, Reporting and Verification (MRV), Other Information, Basic Information of the Hong Kong SAR on Climate Change, and Basic Information of the Macao SAR on Climate Change, presenting a full picture of China's national efforts on climate change. The National GHG Inventory as presented herein is of 2012, while the relevant data and information in other Parts are generally updated to 2014 or 2015. The national data and information in Parts I to VI do not include those of the Hong Kong SAR, the Macao SAR or Taiwan Province, with only exceptions of the administrative delineations, total national territory, and otherwise specified. In accordance with the relevant principles set down in the Basic Law of the Hong Kong SAR of the People's Republic of China and the Basic Law of the Macao SAR of the People's Republic of China, the basic information of these two SARs on addressing climate change in this report is provided by the Environmental Protection Department of the Hong Kong SAR Government, and by the Meteorological and Geophysical Bureau of the Macao SAR Government respectively.

Addressing climate change is a shared mission of mankind. Considering its basic national circumstances and the characteristics of its development stage, China is vigorously promoting eco-civilization, and green, circular and low-carbon development by integrating climate change into its medium- and long-term national economic and social development planning and by attaching equal importance to mitigation and adaption, and try to make progress on all fronts by resorting to legal and administrative means, technologies and market forces. The Chinese government will continue, as always, to fulfill its own obligations under UNFCCC, to follow the principles of equity, common but differentiated responsibilities and respective capabilities, to actively fulfill the international commitments consistent with China's basic national context, current development stage and actual capabilities, and to implement its Nationally Appropriate Mitigation Actions (NAMAs) and Nationally Determined Contributions (NDC) for the enhancement sake, to actively participate in negotiations on global climate change for a fair and just, cooperative and mutual beneficial global climate governance, to deepen bilateral dialogues and pragmatic cooperation on climate change, to fully play the role of the Fund for South-South Cooperation on Climate Change in support of other developing countries to enhance their capacity building in response to climate change.

CONTENTS

Part I National Circumstances and Institutional Arrangements for Addressing Climate Change

China is a country with a huge population, complex climate and vulnerable eco-environment, and one of the most vulnerable countries to the adverse impacts of climate change. As the largest developing country in the world, China attaches great importance to the issue of global climate change by integrating its consideration into the national economic and social development planning, and by taking low-carbon development as a basic path for eco-civilization. It has set up leading groups on climate change and inter-departmental coordination agencies in central and local governments to robustly address climate change.

Chapter 1 Natural Conditions and Resources

1.1 Natural Conditions

1.1.1 Climate Profile

China's climate is characterized with its complexity and diversity in category and significant temporal and spatial changes in precipitation. The country is classified into three climatic zones based on its natural geographic and climatic characteristics: the eastern China is a monsoon region, featuring four distinct seasons and vulnerable to monsoon, where any misbehaving monsoon leads to widespread droughts or floods; the northwestern region is of a typical continental arid climate, cold in winter and hot in summer; the Qinghai-Tibetan Plateau falls into a plateau climate category, the annual mean temperature of which is below 0°C in most of the region. Generally speaking, the temperature in China is of significant seasonal variations which are mostly more intense than in other parts of the world in the same latitudes. Due to the huge temperature difference from region to region, the country is divided from south to north into six belts by temperature indicators, i.e. equatorial, tropical, subtropical, warm temperate, temperate and cold temperate. From the perspective of temporal distribution, precipitation mostly concentrates in summertime, the seasonally uneven distribution of which often leads to floods or droughts. From the perspective of spatial distribution, the annual precipitation varies largely from region to region, gradually declining from over 1,500 mm in southeastern coastal regions, to less than 50 mm in extremely dry regions in the Northwest.

1.1.2 Climatic Disasters

China is subject to impacts of severe climatic disasters, which, featuring high frequency, intensity and wide exposure, cause huge direct losses. In 2014, climatic disasters hit 24.89 million hectares of crops, of which 3.09 million hectares of crops were demolished. At the same time, China reported RMB 103 billion yuan in direct economic losses caused by floods and geological disasters, 83.6 billion yuan by droughts, 12.9 billion yuan by low temperature, cold damage and snow disasters, and 13.6 billion yuan by ocean disasters.[1]

1.2 Natural Resources

1.2.1 Land Resources

China's land resources have the following three typical features in terms of composition and distribution: (1) the land types are complex and diverse. Arable lands, forests, grasslands, deserts and beach lands are distributed extensively across China, but the arable lands only account for 17.34% of the total land area; (2) the per capita cropland is low. In 2014, cropland in China was 135 million hectares, or 0.099 hectare per capita, almost the same as the 2010 level; and (3) land resources are unevenly distributed. The Northeast China Plain, North China Plain, Middle- and Lower-reach Yangtze Plain, Pearl River Delta and Sichuan Basin are the areas where croplands mostly concentrate, while grasslands are mainly distributed in the northern and western China, and forests mainly concentrate in the Northeast, Southwest and South China.[2]

1.2.2 Water Resources

Water resources are scarce and unevenly distributed in China in either temporal or spatial sense. In 2014, its annual average precipitation was 622.3 mm and total stock of water resources was 2.73 trillion m^3, 1.6% below normal. The water supply across the country totaled 609.5 billion m^3, accounting for 22.4% of the total stock of water resources of the year, 492.1 billion m^3 of which came from surface water source, accounting for 80.8%, 111.7 billion m^3 from groundwater, accounting for 18.3%, and 5.7 billion m^3 from other water sources, accounting for 0.9%. The theoretical potential of

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1 Source: 2014 *Statistical communique on National Economic and Social Development*

2 Source: *China Statistical Yearbook*-2015

annual hydropower resources in China is 6082.9 TWh, while the technically exploitable installed capacity is 660.42 GW, suggesting an annual hydropower generation of 2988.2 TWh. In 2014, China's hydropower installed capacity was 304.86 GW, 1.4 times higher than that in 2010, sharing 22.2% of the total installed power generation capacity nationwide[1].

1.2.3 Forest Resources

China's forest resources are relatively insufficient in total amount, low in quality and uneven in regional distribution. According to the eighth national forest resources inventory (2009-2013), its forest cover stood at 208 million hectares, its forest coverage at 21.63%, its total standing stock volume at 16.433 billion m^3 and its plantation, which still ranks first in the world, at 69 million hectares[2].

1.2.4 Grassland Resources

China is a big country of grassland, covered by nearly 400 million hectares of natural grassland of various types. In 2014, its grassland produced a total of 1.02 billion ton fresh grass, higher than the average of the recent decade by 4.04%. The national average vegetation coverage of grassland stood at 53.6% in 2014, higher than that in 2011 by 2.6 percentage points. By the end of 2014, the total artificial grassland amounted to 22.007 million hectares, an increase by 5.5% over the previous year.

[1] Source: *China Statistical Yearbook-2015*
[2] Source: *China Statistical Yearbook-2015*

Chapter 2 Social and Economic Development

2.1 Social Development

2.1.1 Population

China is the most populous country in the world. By the end of 2014, its total population increased by 26.91 million relative to 2010, numbering to 1.368 billion including 749 million urban and 619 million rural inhabitants, accounting for 54.8% and 45.2% of the total respectively. The birth rate in 2014 was 12.37‰, mortality rate was 7.16‰ and natural growth rate was 5.21‰ (Table 1-1).

Table 1-1 Population number and composition by the end of 2014[1]

Indicator	Year-end number (million)	Percentage (%)
Total National Population	1367.82	100.0
Of which, Urban	749.16	54.8
Rural	618.66	45.2
Of which, Male	700.79	51.2
Female	667.03	48.8
Of which, age 0-14	225.58	16.5
age 15-64	1004.69	73.4
age 65 and over	137.55	10.1

2.1.2 Employment

China's newly employed population has been increasing. By the end of 2014, the total employed population was 772.53 million. Broken down by the three industries (primary, secondary and tertiary), the employees were 227.9 million, 230.99 million and 313.64 million, accounting for 29.5%, 29.9% and 40.6% of the total employed population respectively. By jurisdiction, the urban and rural employed populations reached 393.1 million and 379.43 million respectively, being in the ratio of 50.9:49.1. Compared with 2010, the urban and rural employed populations in 2014 increased by 11.48 million, the former outnumbering the latter (45.6:54.4 in 2010)[2].

2.1.3 Education and Medical Care

The gaps still exist in basic public services in China, particularly on education and health

[1] Source: *China Statistical Yearbook-2016*
[2] Source: *China Statistical Yearbook-2015*

care. In 2014, there were 94.511 million primary school students, 43.846 million junior secondary school students and 24.005 million senior secondary school students as well as 25.477 million university students receiving regular education in China. On average, the numbers of students in higher learning institutions, senior secondary, junior secondary and primary schools per 100,000 people were 2488, 3065, 3222 and 6946 respectively. In 2014, there were 982,000 health care facilities, 7.59 million medical workers and 6.6 million hospital beds, and there were 21.2 doctors and 48.3 hospital beds per 10,000 people in China. The medical infrastructure capacity has increased continuously[1].

2.1.4 Population in Poverty

The number of rural poor population in China has decreased year by year. According to the rural poverty line of annual per capita income of RMB 2300 yuan (at 2010 constant price), there were 70.17 million rural poor people in 2014, a significant decrease compared with 166 million in 2010[2]. Currently, the poor people are mainly living in resource-scarce areas subject to poor natural conditions, posing a grave challenge to poverty eradication.

2.1.5 Environmental Protection

The deterioration of China's ecosystems and environment has not yet been thoroughly reversed. In 2014, the COD and ammonia nitrogen emissions in wastewater were 22.946 Mt and 2.385 Mt respectively, and SO_2 and NOx emissions in waste gas were 19.744 Mt and 20.78 Mt respectively. Compared with 2010, COD and ammonia nitrogen increased by 85.3% and 98.3% respectively, SO_2 and NOx[3] decreased by 9.6% and 13.6%[4] respectively. Among 161 cities applying updated air quality monitoring standards, 16 have and 145 have not met the annual air quality standard. In China, there are 470 cities conducting precipitation monitoring, 29.8% of which are found to be of acid rain. Within the whole scope of sea waters of China in the seasons of spring, summer and autumn, those inferior to the Sea Water Quality Standard Category IV mainly concentrate in Liaodong Bay, Bohai Bay, Laizhou Bay, Yangtze River Estuary, Hangzhou Bay, Zhejiang

[1] Source: *China Statistical Yearbook-2015*
[2] Source: *China Statistical Yearbook-2015*
[3] NOx is a result from comparison between 2014 and 2011, due to lack of 2010 emission statistics.
[4] Source: *China Statistical Yearbooks-2015*, *-2011*, and *-2012*.

coast and Pearl River Estuary[1].

2.2 Economic Development

2.2.1 Economic Development Level

China is a developing country with medium economic development level. In 2014, China's GNI was RMB 64.47911 trillion yuan, GDP was RMB 64.3974 trillion yuan, and per capita GDP was RMB 47,203 yuan[2], or about US$ 7,684 at the 2014 exchange rate. Its economic development level represents an upper-middle income country according to the World Bank standard. In 2011-2014, China witnessed its annual GDP growth rate at 8.1%. At present, China has entered into a new normal in economic development, under which the growth rate is changing from high to medium-high speed, and the development pattern is being transformed from scale- and speed-based to quality- and efficiency-based one, and the economic structure is being adjusted from incremental capacity expansion to restocking and optimal incrementation in parallel, and the development driving force is turning from such elements as resource and low cost labor dependent to innovation-driven. China is experiencing a remarkable evolution to a stage at which the economy becomes more advanced in pattern, more optimized in work division and more reasonable in structure.

2.2.2 Economic Structure and Industrial Development

China's economic structure is still experiencing a transition. In 2014, the proportions of the three industries in China's GDP were 9.1:43.1:47.8. Compared with 2010, the shares of the primary and secondary industries declined by 0.4 and 3.3 percentage points respectively, and that of the tertiary industry increased by 3.7 percentage points. Thanks to its rapid development, the tertiary industry including modern service sector has taken up a larger share than the secondary industry. The situation that the secondary industry stands first in GDP proportion is changing. In 2014, China's gross output of agriculture, forestry, livestock and fishery was RMB 10.22261 trillion yuan, and the total crop planting acreage was 165.446 million hectares, and the grain output was 607.03 Mt, an increase by 60.55 Mt relative to 2010.[3]

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[1] Source: *2014 Report on the State of the Environment in China*
[2] Source: *China Statistical Yearbook-2016*
[3] Source: *China Statistical Yearbook-2016*

2.2.3 Income and Consumption Levels

The income growth of urban and rural residents mostly keeps step with the economic growth in China. In 2014, the per capita disposable income of residents was RMB 20,167.1 yuan, while that of urban residents was RMB 28,843.9 yuan, and that of rural residents was RMB 10,488.9 yuan. The per capita consumption expenditure of residents nationwide was RMB 14,491.4 yuan, and that of urban and rural residents were RMB 19,968.1 yuan and 8,382.6 yuan respectively. The income and consumption levels were significantly increased relative to 2010 (Table 1-2).

Table 1-2 Changes in income and consumption of Chinese residents (RMB **yuan)**[1]

Indicator	2010	2014
Per capita disposable income of urban residents	19,109	28,843.9
Per capita net income of rural residents	5,919	10,488.9
Per capita consumption expenditure of urban residents	13,472	19,968.1
Per capita consumption expenditure of rural residents	4,382	8,382.6

2.2.4 Foreign Trade and Economic Cooperation

China is an import and export trade power. In 2014, China's total import and export value, actually used foreign investment, contracted value and fulfilled value of contracted projects were US$ 4,301.5 billion, 119.7 billion, 191.8 billion and 142.4 billion, an increase by 44.6%, 10.0%, 42.7% and 54.4% respectively relative to 2010, leading to expanding foreign trade and economic cooperation[2].

[1] Source: *China Statistical Yearbook-2016*
[2] Source: *China Statistical Yearbook-2015*

Chapter 3 National Development Strategies and Targets

To realize the dream of great renewal of the Chinese nation, China has put forward “Two Centenary” Goals: to complete the emergence of a moderately prosperous society in all respects by 2020, and to make China a modern socialist country by 2050. To achieve the above goals, the CPC Central Committee and the State Council have released several important documents such as the *Comments on Accelerating Eco-Civilization* and the *Integrated Reform Plan for Promoting Eco-Civilization*, clearly identifying the acceleration of eco-civilization as an important initiative to actively address climate change and maintain global ecological security, and taking green, circular and low-carbon development as a basic path for eco-civilization, so as to put in place systematic and complete systems for improving the ecosystem more quickly and make the reform for promoting eco-civilization more systemic, more holistic and better coordinated. *The Outline of the 13th Five-Year Plan for National Economic and Social Development of the People’s Republic of China* set “innovation, coordination, green, openness and sharing” as a core concept of China’s development, hence a higher position of green development in the national development strategy.

In terms of economic and social development, the main targets by 2020 proposed by the Chinese government are to:

— further improve the quality of economic development. Based on improved balance, inclusiveness and sustainability of economic development, China will double its GDP and per capita income of urban and rural residents by 2020 relative to 2010. On annual average, GDP will increase by 6.5%, and per capita disposable income of residents by over 6.5% during the 13th Five-Year Plan (FYP) period, while the key economic indicators will be balanced and coordinated, and the development quality and efficiency will be significantly increased, and the value added from service sector will share 56% of GDP.

— further promote coordinated development. China will continue to improve the contribution of consumption to the economic growth for the sake of a significant increase in investment and business efficiencies. The urbanization quality will be improved, while the urbanization rate of registered population will be increased, and that of permanent residents will reach 60%. A new regional coordinated development pattern will be in place to optimize the spatial distribution of development. The opening-up will be increased in both depth and breadth, the capacity will be strengthened in global allocation of resources, import and export structure will be optimized, and international payments will be basically balanced.

— generally improve people's well-being. China will improve public service systems, such as employment, education, culture and sports, social security, health care and housing, steadily promote equal access to basic public services, increase the education attainment years of working-age population and the employment, narrow the income gap, raise the percentage of population with medium income, and conduct targeted poverty alleviation for addressing the regional overall poverty by 2020.

— improve eco-environmental quality. China will improve green and low-carbon production mode and lifestyle, significantly increase the efficiency of energy resource exploitation and utilization, effectively control the consumption of energy and water resources, land for construction and total carbon emissions, dramatically reduce the total emissions of main pollutants. A layout of major functioning zones and ecological security shelters will be basically take shape.

For addressing climate change, the Chinese government has proposed the main objectives and tasks by 2020:

Mitigation. Relative to 2015, carbon dioxide (CO_2) emissions per unit of GDP will be reduced by 18% through promoting low carbon development in key sectors including industry, energy, building and transport, and effectively controlling the emissions from power generation, steel, building materials and chemical industry among other key sectors. The energy production and consumption revolution will be promoted, with non-fossil fuel accounting for 15% of the total primary energy consumption and the total energy consumption being limited within 5 billion tce. Support will be given to the development-optimized regions and low-carbon pilot cities for them to take the lead in peaking their carbon emissions, laying a solid foundation to achieve the peaking of CO_2 emissions around 2030 and make best efforts to peak early. Low-carbon pilots will be deepened, and demonstration projects for near-zero carbon emission areas will be conducted. Non-CO_2 GHG emissions will be controlled. Efforts will be made to develop a unified national carbon emission trading scheme, and to implement the carbon emission reporting, measuring, verification and allowance systems for key emitters. The statistical accounting, performance assessment and accountability practices and carbon emission standard system will be improved. Stronger efforts will be made to promote and utilize low-carbon technologies and products.

Adaptation. The capacity of key sectors and ecologically vulnerable areas will be strengthened for climate change adaptation. A technical standard system for agricultural adaptation will be preliminarily set up, and efficient utilization coefficient of agricultural irrigation water will be raised to over 0.55. The desertification being combated will account for over 50% of that which is controllable. The stability of forest ecosystem will be enhanced and hazard rate of forest pests will be controlled below 4‰. The urban resilience to the changing climate will be enhanced to better ensure the urban and rural water supply. The adaptation capacity of vulnerable coastal and low-lying areas will be improved, while key urban districts and other key areas will be strengthened in flood and waterlogging control and drought relief; science-based measures will be taken to prevent and cope with extreme weather events and climate disasters, and efforts will be made to improve prediction and warning and disaster prevention and mitigation systems.

Prior to the 2015 Paris Climate Change Conference, the Chinese government further set forth its goals to address climate change beyond 2020 through the NDC: China will peak CO_2 emissions by around 2030 and strive to peak it earlier, and by 2030 CO_2 emissions per unit of GDP will be reduced by 60-65% relative to 2005, non-fossil fuels will account for about 20% of the total primary energy consumption, and the forest stock volume will be increased by 4.5 billion m^3 relative to 2005.

Chapter 4 National Institutional Arrangements for Addressing Climate Change

To practically strengthen the leadership for addressing climate change and energy-conservation and emission reduction, in June 2007, the Chinese government decided to set up the National Leading Group on Climate Change, Energy Conservation and Emissions Reduction (hereinafter referred to as the Leading Group), also known as, when necessary, National Leading Group on Climate Change or the State Council Leading Group on Energy Conservation and Emission Reduction (i.e. one organization with two titles), as a national deliberation and coordination body in this connection. In 2013, according to the State Council's organizational adjustment, personnel changes and work needs, the Leading Group was chaired by Premier Li Keqiang, with member ministries/departments being increased from the initial 20 to 26 including 7 new ones: Ministry of Education (MOE), Ministry of Civil Affairs (MCA), State-owned Assets Supervision and Administration Commission of the State Council (SASAC), State Administration of Taxation (SAT), General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ), National Government Offices Administration (NGOA) and Legislative Affairs Office of the State Council (LAO), except for Civil Aviation Administration of China (CAAC) which was merged into the Ministry of Transport (MOT). The Leading Group Office, which is based at the National Development and Reform Commission (NDRC), is responsible for the Group's specific work. In 2015, the Leading Group reviewed and submitted China's NDC. To enhance climate change related strategic research and international cooperation, in 2012, the National Center for Climate Change Strategy and International Cooperation (NCSC) was established under NDRC, with its main responsibilities being the organization of research projects on policies, regulations and planning for China to address climate change.

As requested by the Central Government of China, the provincial (autonomous region and municipal) governments have not only established their respective Leading Groups on Climate Change, which are chaired by their top leaders and participated in by relevant departments and are to lead and coordinate the efforts to address climate change, but also set up working bodies at their development and reform departments in this regard (Figure 1-1).

According to the ministerial responsibility assigned by the Chinese government on climate change issue, the NDRC is responsible for organizing the preparation of *the Third*

National Communication on Climate Change of the People's Republic of China and *the First Biennial Update Report on Climate Change of the People's Republic of China*, including the national GHG inventories for 2010 and 2012 (see Part II).

National Leading Group on Climate Change, Energy Conservation and Emissions Reduction

Ministerial Members:
Ministry of Foreign Affairs
National Development and Reform Commission
Ministry of Education
Ministry of Science and Technology
Ministry of Industry and Information Technology
Ministry of Civil Affairs
Ministry of Finance
Ministry of Land and Resources
Ministry of Environmental Protection
Ministry of Housing and Urban-Rural Development
Ministry of Transport
Ministry of Water Resources
Ministry of Agriculture
Ministry of Commerce
National Health and Family Planning Commission
State-owned Assets Supervision and Administration Commission
State Administration of Taxation
General Administration of Quality Supervision, Inspection and Quarantine
National Bureau of Statistics
State Forestry Administration
National Government Offices Administration
Legislative Affairs Office of the State Council
Chinese Academy of Sciences
China Meteorological Administration
National Energy Administration
State Oceanic Administration

The Leading Group Office is located at NDRC

Provincial Leading Group on Climate Change

Departmental members:
Provincial Development and Reform Commission
Provincial Bureau of Finance and others

Leading Group Office is located at Provincial Development and Reform Commission

Figure 1-1 Coordination Agencies on Climate Change Issues in China

Part II National Greenhouse Gas Inventory

According to relevant decisions of UNFCCC, and considering China's circumstances, the National Greenhouse Gas Inventory of 2012 covers six gases including carbon dioxide (CO_2), methane (CH_4), Nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6) from energy, industrial processes, agriculture, land-use change and forestry and waste. The Inventory mainly follows the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the *Revised 1996 IPCC Guidelines*) and the *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the *IPCC Good Practice Guidance*). Activity data are mainly from official statistics, while emission factors are mainly from the 2012 China's country-specific parameters. Compared with 2005 Inventory reported in the *Second National Communication*, the 2012 Inventory is more complete and comparable.

Chapter 1 Institutional Arrangements for the Preparation of the Inventory

In order to better prepare the National Greenhouse Gas Inventory, China has initially established a national system for greenhouse gas inventory development. NDRC is responsible for the preparation of the Inventory, including selecting domestic professional research institutions and universities as members of the inventory team, working with the National Bureau of Statistics (NBS) to provide basic statistical data for the Inventory, coordinating of industrial associations and typical businesses to provide related data, and establishing of the National Greenhouse Gas Inventory Database to support the preparation and data management of the inventory.

On the basis of the preparation of the *Initial* and *Second National Communications*, NDRC has chosen the following institutes (Table 2-1) through a bidding and tendering process for preparing the 2012 greenhouse gas inventories in China for energy, industrial processes, agriculture, land-use change and forestry, and waste: NCSC, Tsinghua University, Institute of Environment and Sustainable Development in Agriculture of the Chinese Academy of Agricultural Sciences (CAAS), Institute of Atmospheric Physics of the Chinese Academy of Sciences (CAS), Institute of Forest Ecology, Environment and Protection of the Chinese Academy of Forestry (CAF), and Chinese Research Academy of Environmental Sciences (CRAES). The following agencies are involved in the preparation of the inventories: Energy Research Institute of NDRC, Fudan University, China Special Equipment Inspection and Research Institute, Foreign Economic Cooperation Office of the Ministry of Environmental Protection (MEP), State Forestry Administration (SFA) Survey Scheme Designing Institute, Research Institute of Forestry New Technology of the Chinese Academy of Forestry and others. On the basis of inventories prepared for the above-mentioned sectors, NDRC organized the members of the Leading Group and relevant experts for discussions, based on which the national greenhouse gas inventory of 2012 was finalized.

Table 2-1 Organizations Involved in Preparation of National Greenhouse Gas Inventory of 2012

Organization	**Role**
NDRC	overall coordination
NCSC	greenhouse gas inventory for energy national greenhouse gas inventory database
Tsinghua University	greenhouse gas inventory for industrial processes
Institute of Environment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Sciences	greenhouse gas inventory for agriculture (livestock)
Institute of Atmospheric Physics, Chinese Academy of Sciences	greenhouse gas inventory for agriculture (croplands)
Institute of Forest Ecology, Environment and Pr otection, Chinese Academy of Forestry	greenhouse gas inventory for land-use change and forestry
Chinese Research Academy of Environmental Sciences	greenhouse gas inventory for waste

Chapter 2 Scope and Methodologies

2.1 Key Category Analysis

A key category refers to source or sink that has significant influence on the accuracy of a country's total GHG inventory due to its higher absolute emissions or uncertainty. In order to improve the quality of inventory, higher-tier (Tier 2 and 3) methods are suggested for key categories. According to the *IPCC Good Practice Guidance* and the *IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry*, key category analysis was done quantitatively and qualitatively for the 2005 National Greenhouse Gas Inventory. The results showed that the 2005 inventory had 51 key categories, including CO_2 emissions from public electricity and heat production, CO_2 emissions from road transport, N_2O emissions from adipic acid production, HFC-23 emissions from HCFC-22 production, CH_4 emissions from rice cultivation; annual amount of carbon uptake by forests, and CH_4 emissions from solid waste disposal. Emissions from these key categories were calculated with higher-tier methods and country-specific emission factors in the 2012 National Greenhouse Gas Inventory as many as possible. The methodologies applied for China's 2012 inventory are shown in Table 2-2.

2.2 Energy

The 2012 National Greenhouse Gas Inventory for energy contains fuel combustion and fugitive emissions. Fuel combustion emissions cover CO_2, CH_4 and N_2O emissions from energy industries, manufacturing industries and construction, transport, other sectors and other categories. Fugitive emissions cover CH_4 emissions from solid fuels, and oil and natural gas systems. Compared with *China's National Greenhouse Gas Inventory* of 2005, the following items were newly added: CH_4 emissions from energy industries, and CH_4 and N_2O emissions from manufacturing industries and construction, and other sectors.

CO_2 emissions from fuel combustion were calculated using sectoral approach and were verified with the reference approach. CH_4 and N_2O emissions from road transport were calculated using the Tier 3 method, i.e. COPERT model. The newly reported CH_4 emissions from the energy industries, the CH_4 and N_2O emissions from manufacturing industries and construction, and other sectors were calculated using the Tier 1 method. The fugitive CH_4 emissions from the coal mining and post-mining activities was calculated using the Tier 1 and Tier 2 methods combined, while the fugitive CH_4 emissions from the oil and gas systems was calculated using the Tier 1 and Tier 3 combined (Table 2-2).

Table 2-2 Methodologies used for the National Greenhouse Gas Inventory of 2012

Source/Sink Categories	**CO_2**		**CH_4**		**N_2O**	
	method	**emission factor**	**method**	**emission factor**	**method**	**emission factor**
Energy industries (1A1)	T2	CS	T1	D	T1	D
Manufacturing industries and construction (1A2)	T2	CS	T1	D	T1	D
Transport (1A3)	T2	CS	T1, T3	D, CS	T1, T3	D, CS
Other sectors (1A4)	T2	CS	T1	D	T1	D
Other (1A5)	T2	CS	T1, T2	D, CS	T1	D
Fugitive emissions from solid fuel (1B1)			T1, T2	D, CS		
Fugitive emissions from oil and natural gas (1B2)			T1, T3	D, CS		
Mineral products (2A)	T1, T2	D, CS				
Chemical industry (2B)	T1, T2	D, CS			T3	CS
Metal production (2C)	T1, T2	D, CS	T1	D		
Enteric fermentation (4A)			T1, T2	D, CS		
Manure management (4B)			T1, T2	D, CS	T1, T2	D, CS
Rice cultivation (4C)			T3	CS		
Agricultural soils (4D)					T1, T2	D, CS
Field burning of agricultural residues (4F)			T1	D	T1	D
Changes in forest and other woody biomass stocks (5A)	T2	CS				
Forest and grassland conversion (5B)	T2	CS	T1	D	T1	D
Solid waste disposal on land (6A)			T1, T2	D, CS	T1	D
Waste-water handling (6B)			T1, T2	D, CS	T1, T2	D, CS
Waste incineration (6C)	T2	CS	T1	D	T1	D

Note: The methodological codes T1, T2 and T3 represent Tier 1, Tier 2 and Tier 3 methods respectively; the emission factor code CS represents the country-specific emission factor in China, D represents the defaulted IPCC emission factor. Their parallel appearance shows that the sub-items use different Tier methods or emission factor data sources. Other (1A5) includes CH_4 and N_2O emissions from biomass, CO_2 emissions from non-energy use, and others.

2.3 Industrial Processes

The 2012 inventory for Industrial Processes include the emissions from mineral products, chemical industry, metal production, and production and consumption of halocarbons and SF_6. Compared with the 2005 inventory, the 2012 inventory expands to cover CO_2 emissions from glass production in mineral products and that from soda production in chemical industry, CO_2 and CH_4 emissions from ferroalloy production, and CO_2 emissions from magnesium, lead and zinc production. Tier 2 method was used for soda production, and Tier 1 method was used for other newly added sources. The calculation methods for original sources are the same as those in the National Greenhouse Gas Inventory of 2005, as shown in Table 2-2.

2.4 Agriculture

The 2012 inventory for agriculture includes CH_4 emissions from livestock enteric fermentation, CH_4 and N_2O emissions from manure management, CH_4 emissions from rice cultivation, N_2O emissions from agricultural soils and CH_4 and N_2O emissions from field burning of agricultural residues. Compared with the 2005 inventory, the 2012 inventory made a few changes: non-dairy cattle was classified into beef cattle, yaks and other cattle in enteric fermentation and manure management, and N_2O emissions from field burning of agricultural residues in agricultural fields were newly added. CH_4 emissions from beef cattle enteric fermentation and manure management are calculated by Tier 2 method, emissions from yaks and other cattle by Tier 1 method, N_2O emissions from field burning of agricultural residues by Tier 1 method, other sources are calculated by the same methods used in the 2005 inventory, as shown in Table 2-2.

2.5 Land-Use Change and Forestry

Land-use change and forestry (LUCF) covers changes in forest and other woody biomass stocks and the emissions from forest conversion. CO_2 emission sources and sinks are calculated by Tier 2 method, and CH_4 and N_2O emissions by Tier 1 method in this sector in line with the National Greenhouse Gas Inventory of 2005, as shown in Table 2-2.

2.6 Waste

The 2012 inventory for waste covers GHG emissions from urban solid waste disposal, wastewater handling and waste incineration. Compared with the 2005 inventory, CH_4 and N_2O emissions from biological treatment of urban domestic waste and from waste incineration are newly included. The newly included emission sources are calculated by Tier 1 method, and other sources are calculated by the same methods as in the National Greenhouse Gas Inventory of 2005, as shown in Table 2-2.

Chapter 3 Data Sources

3.1 Energy

The data on the 2012 Chinese fossil fuel combustion are mainly from energy statistics and other relevant statistics provided by NBS. Considering that in 2015 NBS revised the energy statistics of China since 2000, the inventory of GHG from fossil fuel used the latest revised statistics. In 2012, China consumed 2.75 billion, 0.68 billion and 0.19 billion tce of coal, oil and natural gas respectively.

The data sources of biomass combustion for energy purpose include the *China Agriculture Yearbook* 2013. The activity data of fugitive emissions from coal mining and post-mining activities are mainly from the *China Energy Statistical Yearbook* 2014 and the *China Coal Industry Yearbook* 2013. The activity data of fugitive emissions from oil & gas system are mainly provided by enterprises. The emission factors of CO_2 from solid fuel combustion and those of CH_4 and N_2O from road transport are updated based on the 2012 data, while emission factors from other emission sources are the same with those in the National GHG Inventory of 2005.

3.2 Industrial Processes

The production data of cement clinker, crude steel and primary aluminum in 2012 are from the statistics of NBS; the production of ammonia is mainly from *China Chemical Industry Statistical Yearbook* 2013; that of lime is from the estimates by China Lime Association; that of nitric acid is from the survey by China Technological Cooperation Network on Chemical, Nitric Acid and Nitrate; those of adipic acid, ferrosilicon alloy and HCFC-22 are from the survey of enterprises; the major activity data on the industrial processes are shown in Table 2-3. The emission factors of production of cement clinker, ammonia, adipic acid and HCFC-22 are calculated by country-specific data in 2012 obtained through typical enterprise survey. The emission factors of other sources are adopted from the National Greenhouse Gas Inventory of 2005.

Table 2-3 Major activity data on industrial processes in 2012 (Mt)

Item	Production	Item	Production
Cement clinker	1303.92	ferrosilicon	5.83
Crude steel	731.04	electrolytic aluminum	20.25
Ammonia	55.28	HCFC-22	0.578

3.3 Agriculture

Activity data of agriculture in 2012 are mainly from *China Agriculture Yearbook 2013*, *China Statistical Yearbook 2013* and *China Animal Industry Yearbook 2013*. The main activity data are shown in Table 2-4. Factors of N_2O direct emission from agricultural soils are observational data. Country-specific CH_4 emission factors in 2012 were used for enteric fermentation by dairy cattle, beef cattle, buffalo, sheep and goats, for manure management of swine, beef cattle, dairy cattle and other main animals and of rice cultivation. Emission factors of other sources are adopted from the *National Greenhouse Gas Inventory* of 2005.

Table 2-4 Major activity data on agricultural activities in 2012

	Activity Data		Activity Data
Dairy herd stock (million)	14.94	Pig stock (million)	475.92
Beef cattle stock (million)	63.39	Total sown area of crops (million hectares)	163.42
Buffalo stock (million)	10.57	Sown area of grain crops (million hectares)	111.20
Goat stock (million)	141.36	Nitrogen fertilizer consumed (million tons)	24.00
Sheep stock (million)	143.68	Compound fertilizer net consumed (million tons)	19.90

3.4 Land-Use Change and Forestry

In the preparation of the LUCF inventory of 2012, the data from the sixth to ninth continuous forest resources inventories were used. According to the actual inventories of provinces (autonomous regions and municipalities), interpolation or extrapolation methods were used to obtain activity data of provinces (autonomous regions and municipalities) in 2012. National data are calculated by aggregating data of provinces. Parameters such as biomass expansion factor and biomass carbon content are adopted from the National Greenhouse Gas Inventory of 2005.

3.5 Waste

The activity data of waste are from the *China Urban Construction Statistical Yearbook* 2012 and the *China Environment Statistical Yearbook* 2012. Activity-related data of waste sector are shown in Table 2-5. Emission factors of solid waste disposal are country-specific data in 2012. Other emission factors are adopted from the National Greenhouse Gas Inventory of 2005.

Table 2-5 Activity-related data of waste sector in 2012 (Mt)

	Activity-related Data
Landfill of municipal solid waste (MSW)	105.12
Waste incineration	41.76
Biological treatment of MSW	3.93
COD discharged from wastewater	24.24

Chapter 4 National Greenhouse Gas Inventory of 2012

4.1 Overview

China's total greenhouse gas emissions in 2012 (excluding LUCF) amounted to 11896 Mt CO_2 eq (Table 2-6), wherein the CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6 accounted for 83.2%, 9.9%, 5.4%, 1.3%, 0.1% and 0.2% respectively; GHG sink by LUCF amounted to 576 Mt CO_2 eq. The greenhouse gas emissions (including LUCF) amounted to 11320 Mt CO_2 eq. The GHG Inventory by gas is given in Tables 2-6 and 2-7.

Table 2-6 GHG inventory of China in 2012（100 Mt CO_2 eq）

	CO_2	CH_4	N_2O	HFCs	PFC	SF_6	Total
Energy	86.88	5.79	0.69				93.37
Industrial processes	11.93	0.00	0.79	1.54	0.12	0.24	14.63
Agriculture		4.81	4.57				9.38
Waste	0.12	1.14	0.33				1.58
Land-use change and forestry	-5.76	0.00	0.00				-5.76
Total (excluding LUCF)	98.93	11.74	6.38	1.54	0.12	0.24	118.96
Total (including LUCF)	93.17	11.74	6.38	1.54	0.12	0.24	113.20

Note: 1. Shaded cells do not require entries; 0.00 indicates that the value is less than 0.005; due to rounding, the aggregation of various items may have a slight difference with the total.
2. Global GWP values (Table 2-8) are from IPCC AR II in the 100-year time scale.

Table 2-7 China's GHG emissions by gas in 2012

GHGs	Excluding LUCF		Including LUCF	
	CO_2 eq (100 Mt)	Share (%)	CO_2 eq (100 Mt)	Share (%)
CO_2	98.93	83.2	93.17	82.3
CH_4	11.74	9.9	11.74	10.4
N_2O	6.38	5.4	6.38	5.6
Fluorinated gas	1.91	1.6	1.91	1.7
Total	118.96		113.20	

Note: due to rounding, the aggregation of various items may be slightly higher or lower 100%.

Table 2-8 GWP of GHGs used in the inventory

GHGs	GWP	GHGs	GWP
CO_2	1	HFC-152a	140
CH_4	21	HFC-227ea	2900
N_2O	310	HFC-236fa	6300
HFC-23(CHF_3)	11700	HFC-245fa	1030
HFC-32	650	PFC-14(CF_4)	6500
HFC-125	2800	PFC-116(C_2F_6)	9200
HFC-134a	1300	SF_6	23900
HFC-143a	3800		

Note: GWP of HFC-245fa is from the IPCC AR4 in 100-year time scale.

Energy sector is the main source of GHG emissions in China. In 2012, energy activity emissions accounted for 78.5% of the national total emissions (excluding LUCF). GHG emissions of industrial processes, agriculture and waste accounted for 12.3%, 7.9% and 1.3% respectively, as shown in Figure 2-1.

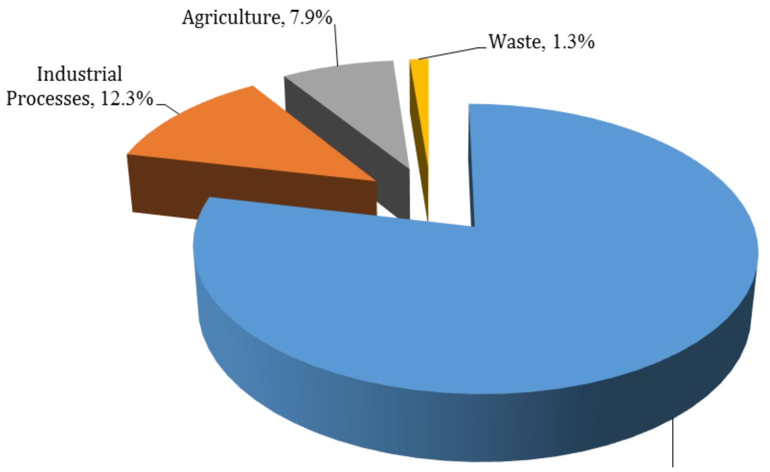

Figure 2-1 GHG Emissions by sector in China in 2012

(A) Carbon dioxide

In 2012, China's CO_2 emissions (excluding LUCF) were 9893 Mt, of which 8688 Mt were from energy, accounting for 87.8%; 1193 Mt were from industrial processes, accounting for 12.1%; 12 Mt were from waste, accounting for 0.1%, see Table 2-6 for details. Land-use change and forestry are sinks, which removed 576 Mt CO_2. Other than that, in 2012 international aviation emitted 17 Mt CO_2, international marine emitted 27 Mt CO_2, biomass combustion emitted 813 Mt CO_2, which were all reported as memo items, not included in the national total, as shown in Table 2-9.

(B) Methane

In 2012, China's CH_4 emissions were 55915 kt, of which 27586 kt were from energy, accounting for 49.3%; 6 kt were from industrial processes; 22886 kt were from agriculture, accounting for 40.9%; 14 kt were from LUCF; and 5423 kt were from waste, accounting for 9.7%.

(C) Nitrous oxide

N_2O emissions in China in 2012 were 2059 kt, of which 224 kt were from energy, accounting for 10.9%; were from industrial process 255 kt, accounting for 12.4%; 1475 kt were from agriculture, accounting for 71.6%; 0.1 kt were from LUCF emissions; 105 kt were from waste , accounting for 5.1%.

(D) Fluorinated Gas

Fluorinated gas emissions of China in 2012 were 191 Mt CO_2 eq, all of which were from industrial processes. Among them, emissions from metal production were 11 Mt CO_2 eq, accounting for 5.7%; the emissions from the production of halocarbons and SF_6 were 118 Mt CO_2 eq, accounting for 61.8%; the emissions from the consumption of halocarbons and SF_6 were 62 Mt CO_2 eq, accounting for 32.5% as shown in Table 2-10.

4.2 Energy

In 2012, China's total GHG emissions from energy were 9337 Mt CO_2 eq. Among them, the emissions from fuel combustion were 8813 Mt CO_2 eq, accounting for 94.4%; fugitive emissions were 524 Mt CO_2 eq, accounting for 5.6%.

In the total, the CO_2 emissions were 8688 Mt, all of which were from fuel combustion. CH_4 emissions were 27586 kt, of which fuel combustion accounted for 9.5%, fugitive emissions accounted for 90.5%. N_2O emissions were 224 kt, all of which were from fuel combustion.

Table 2-9 National GHG inventory of anthropogenic emissions by sources and removals by sinks of GHG not controlled by the Montreal Protocol (Gg)

Source/Sink categories	CO_2	CH_4	N_2O
Total (including LUCF)	9317408	55915	2059
1. Energy	8688288	27586	224
Fuel combustion	8688288	2620	224
Energy industries	4078222	48	89
Manufacturing industries and construction	3205343	204	52
Transport	788625	78	22
Other sectors	542600	758	7
Others	73498	1531	55
Fugitive emissions from fuel		24966	
Solid fuels		23847	
Oil and gas		1119	
2. Industrial processes	1193164	6	255
Mineral products	834034		
Chemical industry	131076	NE	255
Metal production	228055	6	NE
Production of halocarbons and SF_6			
Consumption of halocarbons and SF_6			
3. Agriculture		22886	1475
Enteric fermentation		10743	
Manure management		3331	249
Rice cultivation		8458	
Agricultural soils		NE	1218
Field burning of agricultural residues		354	8
4. Land-use change and forestry	-575848	14	0
Changes in forest and other woody biomass stocks	-597529		
Forest conversion	21681	14	0
5. Waste	11804	5423	105
Solid waste disposal on land		2531	1
Wastewater handling		2892	97
Waste incineration	11804	0	7
Memo items			
International aviation	16796	0	0
International marine	27094	3	1
CO_2 emissions from biomass	813325		

Note: Shaded cells do not require entries. 0 indicates that the value is less than 0.5. NE (Not Estimated) stands for existing emissions and removals which have not been estimated. Due to rounding, the aggregation of various items may have slight difference with the total. Memo items are not counted in the total emissions.

Table 2-10 National GHG inventory of anthropogenic emissions of HFCs, PFCs and SF_6 (Gg)

Source/Sink Categories	HFC-23	HFC-32	HFC-125	HFC-134a	HFC-143a	HFC-152a	HFC-227ea	HFC-236fa	HFC-245fa	CF_4	C_2F_6	SF_6
Total	9.9	0.2	0.3	28.8	0.1	0.2	0.0	0.0	0.1	1.6	0.2	1.0
1. Energy												
2. Industrial processes	9.9	0.2	0.3	28.8	0.1	0.2	0.0	0.0	0.1	1.6	0.2	1.0
Mineral products												
Chemical industry												
Metal production	NE	NE	NE	NE	NE	NE	NE	NE	NE	1.4	0.2	NE
Production of halocarbons and SF_6	9.9	0.2	0.3	0.7	0.1	0.2	0.0	0.0	0.0	0.0	0.0	NE
Consumption of halocarbons and SF_6	NE	NE	NE	28.0	NE	NE	NE	NE	0.1	0.1	0.0	1.0
3. Agriculture												
4. Land-use change and forestry												
5. Waste												

Note: Shaded cells do not require entries. 0.0 indicates that the value is less than 0.05. NE (Not Estimated) stands for existing emissions and removals which have not been estimated.

4.3 Industrial Processes

In 2012, China's total GHG emissions from the industrial processes were 1463 Mt CO_2 eq. Among them, emissions from mineral products were 834 Mt, accounting for 57.0%; emissions from chemical industry were 210 Mt or 14.4%; emissions from metal production were 239 Mt or 16.3%; emissions from the production of halocarbons and SF_6 were 118 Mt or 8.1%; emissions from consumption of halocarbons and SF_6 were 62 Mt or 4.2%.

From the perspective of the composition of gases, the CO_2 emissions were 1193 Mt, of which 69.9% were from mineral products, 11.0% from chemical industry and 19.1% from metal production. CH_4 emissions were 6 kt, all of which were from metal production. N_2O emissions were 255 kt, all of which were from chemical industry. HFCs emissions were 154 Mt CO_2 eq, of which 76.3% were from the production of halocarbons and SF_6, 23.7% were from the consumption of halocarbons and SF_6. PFCs emissions were 12 Mt CO_2 eq, of which 91.1% was from metal production, 0.3% and 8.6% were respectively from the production and consumption of halocarbons and SF_6. SF_6 emissions were 24 Mt CO_2 eq, all of which were from the consumption of halocarbons and SF_6.

4.4 Agriculture

In 2012, China's total greenhouse gas emissions from agriculture were 938 Mt CO_2 eq. Among them, the emissions from enteric fermentation were 226 Mt, accounting for 24.1%; the emissions from manure management were 147 Mt, accounting for 15.7%; the emissions from rice cultivation were 178 Mt, accounting for 18.9%; the emissions from agricultural soils were 378 Mt, accounting for 40.3%; the emissions from field burning of agricultural residues were 10 Mt, accounting for 1.1%.

Regarding the composition of gases, CH_4 emissions were 22886 kt, of which enteric 46.9% were from fermentation emissions, 14.6% were from manure management, 37.0% were from rice cultivation, 1.5% were from field burning of agricultural residues. N_2O emissions were 1475 kt, of which manure management emissions accounted for 16.9%, agricultural soils emissions for 82.6%, field burning of agricultural residues for 0.6%.

4.5 Land-Use Change and Forestry

In 2012, China's LUCF removed 576 Mt CO_2 eq. Among them, changes in forests and other woody biomass stocks removed 598 Mt CO_2 eq, forest conversion emitted 22 Mt CO_2 eq.

Regarding the composition of gases, the CO_2 removals were 576 Mt, of which the removals by changes in forests and other woody biomass stocks were 598 Mt and the emissions from forest conversion were 22 Mt. CH_4 emissions were 14 kt, all of which were from the forest conversion. N_2O emissions were 0.12 kt, all of which were from the forest conversion.

4.6 Waste

In 2012 the total greenhouse gas emissions from waste were 158 Mt CO_2 eq, of which 54 Mt were from solid waste disposal, accounting for 33.8%; 91 Mt were from wastewater handling, accounting for 57.3%; 14 Mt were from waste incineration (non-energy use), accounting for 8.9%.

Regarding the composition of gases, CO_2 emissions were 12 Mt, all of which were from waste incineration. CH_4 emissions were 5423 kt, of which 46.7% were from solid waste disposal, 53.3% were from wastewater handling. N_2O emissions were 105 kt, of which 1.1% were from solid waste disposal, 91.8% were from wastewater handling, 7.0% were from waste incineration.

Chapter 5 Quality Assurance and Quality Control

5.1 Quality Assurance and Quality Control

In preparing the National Greenhouse Gas Inventory of 2012, to reduce uncertainty and improve the quality of inventory, the inventory team paid much attention to quality assurance and quality control.

In terms of methods, the team carried out key category analysis, the results of which were used to choose approach. Emissions from key categories were estimated using as many higher-tier methods and country-specific emission factors as possible in 2012 inventory, thus improving the accuracy of the inventory.

Regarding the activity data, NBS established a sector statistical reporting system for addressing climate change, which increased the types of energy statistics in a detailed way to gradually incorporate the activity data required by the preparation of GHG Inventory into the government statistical system. In terms of the estimation of CO_2 emissions from coal combustion, further investigation was made on the NCV of coals consumed in key sectors by type and purpose. In addition, the inventory team used the latest revised national statistical data in order to ensure the estimation results in the inventory accurately reflect China's actual emissions.

In terms of emission factors, NBS initially established a relevant parameter statistical survey system. The inventory team and other relevant departments conducted researches on the rate of carbon storage in the coal chemical industry, and on-site measurement of nitrogen excretion by main livestock and poultry as well as direct emission factors of N_2O from agricultural soils, to obtain country-specific emission factors and related parameters. In preparing the Inventory of 2012, the inventory team gave first priority to country-specific emission factors of 2012, and second priority to country-specific emission factors of 2005. The default values of relevant IPCC guidelines were used when national data were not available.

Regarding inventory management, the inventory team emphasized the management of data file. The materials supporting the preparation were archived in a timely manner. The inventory team carried out exchanges with Canada, the United States, the Netherlands, Japan, Korea and others and international organizations such as FAO on data management and quality control. Meanwhile, to ensure high-quality electronic management of inventory-related data, China has established a database system for the national and sector greenhouse gas inventories.

In addition, the inventory team organized a number of technical workshops for academic exchanges and discussions with other domestic research institutions and experts to fully learn from their research results. Meanwhile, the team also invited experts who were not involved in the preparation of the inventory to carry out independent analyses and assessments of the inventory's methodologies and results as a support to the quality assurance of the inventory.

5.2 Uncertainty Analysis

According to error propagation approach in the *IPCC Good Practice Guidance*, the overall uncertainty of the National Greenhouse Gas Inventory of 2012 was estimated at 5.4%, with the uncertainty of energy, industrial processes, agriculture, LUCF and waste at 5.5%, 4.4%, 21.3%, 43.2% and 24.0% respectively as shown in Table 2-11.

Table 2-11 Results of Uncertainty Analysis of National Greenhouse Gas Inventory of 2012

	Emission/Sink (100 Mt CO_2 eq)	**Uncertainty (%)**
Energy	93.37	5.5
Industrial processes	14.63	4.4
Agriculture	9.38	21.3
Land-use change and forestry	-5.76	43.2
Waste	1.58	24.0
Total		***5.4***

Chapter 6 Information on Inventories in Previous Submissions

In the *Initial* and *Second National Communications*, China submitted its National GHG Inventories 1994 and 2005. The following is the summary of the information on the two Inventories. It should be noted that the scope of the two Inventories were different from that of the 2012 Inventory, and the 2005 activity data on energy consumption were also revised by NBS. To ensure a better consistency in the scope and the data sources， the *Third National Communication*, which is currently in preparation, will recalculate and update the data given in the National Greenhouse Gas Inventory of 2005.

6.1 National Greenhouse Gas Inventory of 1994

In 1994, China's total greenhouse gas emissions (excluding LUCF) were 4057 Mt CO_2 eq (Table 2-12), of which CO_2, CH_4 and N_2O accounted for 75.8%, 17.7% and 6.5% respectively (Table 2-13); LUCF removed 407 Mt CO_2 eq. Total net GHG emissions (including LUCF) in China in 1994 were 3650 Mt CO_2 eq, of which the shares of CO_2, CH_4 and N_2O were 73.1%, 19.7% and 7.2% respectively.

Table 2-12 GHG Inventory of China in 1994 (100 Mt of CO_2 eq)

	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Total
Energy	27.95	1.97	0.15				30.08
Industrial processes	2.78	NE	0.05	NE	NE	NE	2.83
Agriculture		3.61	2.44				6.05
Waste	NE	1.62	NE				1.62
Land-use change and forestry	-4.07	NE	NE				-4.07
Total (excluding LUCF)	30.73	7.20	2.64	NE	NE	NE	40.57
Total (including LUCF)	26.66	7.20	2.64	NE	NE	NE	36.50

Note: Shaded cells do not require entries. NE (Not Estimated) stands for existing emissions and removals which have not been estimated. Due to rounding, the aggregation of various items may have a slight difference with the total.

Table 2-13 China's GHG emissions by gas in 1994

GHGs	Excluding LUCF		Including LUCF	
	CO_2 eq (100 Mt)	**Share (%)**	**CO_2 eq (100 Mt)**	**Share (%)**
CO_2	30.73	75. 8	26.66	73.1
CH_4	7.20	17. 7	7.20	19.7
N_2O	2.64	6.5	2.64	7.2
Total	40.57		36.50	

6.2 National Greenhouse Gas Inventory of 2005

In 2005, China's total GHG emissions (excluding LUCF) were approximately 7.467 Gt CO_2 eq (Table 2-14), of which CO_2, CH_4, N_2O and fluorinated gases accounted for 80.0%, 12.5%, 5.3% and 2.2% respectively (Table 2-15). The total GHG removals in LUCF sector were about 421 Mt CO_2 eq. China's total GHG emissions (including LUCF) in 2005 were around 7.046 Gt CO_2 eq, of which CO_2, CH_4, N_2O and fluorinated gases accounted for 78.8%, 13.3%, 5.6% and 2.3% respectively.

Table 2-14 China's Greenhouse Gas Inventory of 2005 (100 Mt CO_2 eq)

	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Total
Energy	54.04	3.24	0.40				57.69
Industrial processes	5.69	NE	0.34	1.49	0.06	0.10	7.68
Agriculture		5.29	2.91				8.20
Waste	0.03	0.80	0.28				1.11
Land-use change and forestry	-4.22	0.01	0.00				-4.21
Total (excluding LUCF)	59.76	9.33	3.94	1.49	0.06	0.10	74.67
Total (including LUCF)	55.54	9.33	3.94	1.49	0.06	0.10	70.46

Note: Shaded cells do not require entries. 0.00 indicates that the value is less than 0.005. NE (Not Estimated) stands for existing emissions and removals which have not been estimated. Due to rounding, the aggregation of various items may have a slight difference with the total.

Table 2-15 China's GHG emissions by gas in 2005

GHGs	Excluding LUCF		Including LUCF	
	CO_2 eq (100 Mt)	Share (%)	CO_2 eq (100 Mt)	Share (%)
CO_2	59.76	80.0	55.54	78.8
CH_4	9.33	12.5	9.33	13.3
N_2O	3.94	5.3	3.94	5.6
Fluorinated gases	1.65	2.2	1.65	2.3
Total	74.67		70.46	

Part III Mitigation Actions and Their Effects

In 2010, the Chinese Government submitted its NAMAs to the Secretariat of the *Convention*. Since the 12th Five-Year-Plan (FYP) Period (2011-2015), China has attached great importance to climate change, making climate change actions as a major strategy in the national economic and social development, GHG emission control as a strategic task in climate change actions, and green low-carbon development as an important approach to China's eco-civilization process. With a series of climate actions taken, China has contributed significantly to combating global climate change.

Chapter 1 Targets and Actions for GHG Emission Control

In the 12th FYP Period, the Chinese government put into force the *National Climate Change Programme*, the *Working Program for Controlling Greenhouse Gas Emissions in the 12th FYP Period*, the *Comprehensive Working Program of Energy Conservation and Emission Reductions in the 12th FYP Period*, the *Plan for Energy Conservation and Emission Reductions in the 12th FYP Period*, the *2014-2015 Action Plan for Energy Conservation, Emission Reduction and Low-Carbon Development*, and the *National Plan on Climate Change 2014-2020*. Their implementation was intended to cap total energy consumption, to accelerate industrial and energy restructuring, to promote energy conservation, carbon reduction and ecosystem enhancement, to control GHG emissions from non-energy activities, to forge ahead with low-carbon and carbon emission trading pilots, to advance international cooperation, and to explore into low-carbon development patterns better suited to the national conditions.

1.1 Targets and Tasks for GHG Emission Control in the 12th FYP Period

It is stated in China's NAMAs that "China will endeavor to lower its carbon dioxide emissions per unit of GDP by 40-45% by 2020 compared to the 2005 level, increase the share of non-fossil fuels in primary energy consumption to around 15% by 2020 and increase forest coverage by 40 million hectares and forest stock volume by 1.3 billion cubic meters by 2020 from the 2005 levels". Accordingly, the *12th Five-Year Plan for National Economic and Social Development* of *P. R. China* issued in 2011 set the reduction of CO_2 emission per unit of GDP for the first time as a binding target. In the same year, the State Council promulgated the *Working Program for Controlling Greenhouse Gas*

Emissions in the 12th FYP Period in which it was made clear that a significant drop of 17% in the CO_2 emission per unit of GDP against the 2010 figure was to be achieved by 2015, with marked progress in controlling CO_2 emission from non-energy activities and other GHG emissions such as CH_4, N_2O, HFCs, PFCs and SF_6.

For the above targets to be met, the *Working Program* pronouncedly called for the application of diverse control measures, which mainly include: vigorous enhancement of the service sector and strategic emerging industries to bring their GDP contributions up to about 47% and 8% respectively by 2015; vigorous promotion of circular economy, energy conservation capacity building and implementation of key energy-conservation projects to generate an energy conservation capacity of 300 Mtce and to reduce energy consumption per unit of GDP by 16% from the 2010 level; vigorous development of renewable energy to raise the share of non-fossil fuels in primary energy consumption to 11.4% by 2015; and vigorous afforestation initiatives to increase forest area by 12.5 million hectares, forest coverage to 21.66% and forest stock volume by 600 million m^3 in the 12th FYP Period.

1.2 GHG Emission Control Actions and their Effects in the 12th FYP Period

In the 12th FYP Period, China resorted to legal, administrative, technical and market means to experiment on and explore into low-carbon new development patterns better suited to the national conditions. By 2015, China has made positive progress in its NAMAs. In particular, the CO_2 emissions per unit of GDP dropped by 38.6% as against 2005 and by 21.7% as against 2010 (Figure 3-1); the non-fossil fuels accounted for 12% of the total energy consumption; the installed hydro, on-grid wind, photovoltaic (PV) and nuclear power capacities reached 319.5, 130.7, 42.2 and 27.2 GW, or 2.7, 123, 603 and 3.9 times of those in 2005, respectively; forest area and stock volume increased respectively by 32.78 million hectares and about 2.68 billion m^3 relative to 2005.

In the 12th FYP Period, GHG emission control was taken as the priority at the provincial level, with specific tasks and measures carefully tailored to local carbon intensity reduction targets, fundamental capacity building efforts made in a down-to-earth manner, and active explorations and innovations made as to the local low-carbon development institutions and mechanisms. Most provinces have outperformed the carbon intensity reduction targets set in the *Working Program for Controlling Greenhouse Gas Emissions in the 12th FYP Period*.

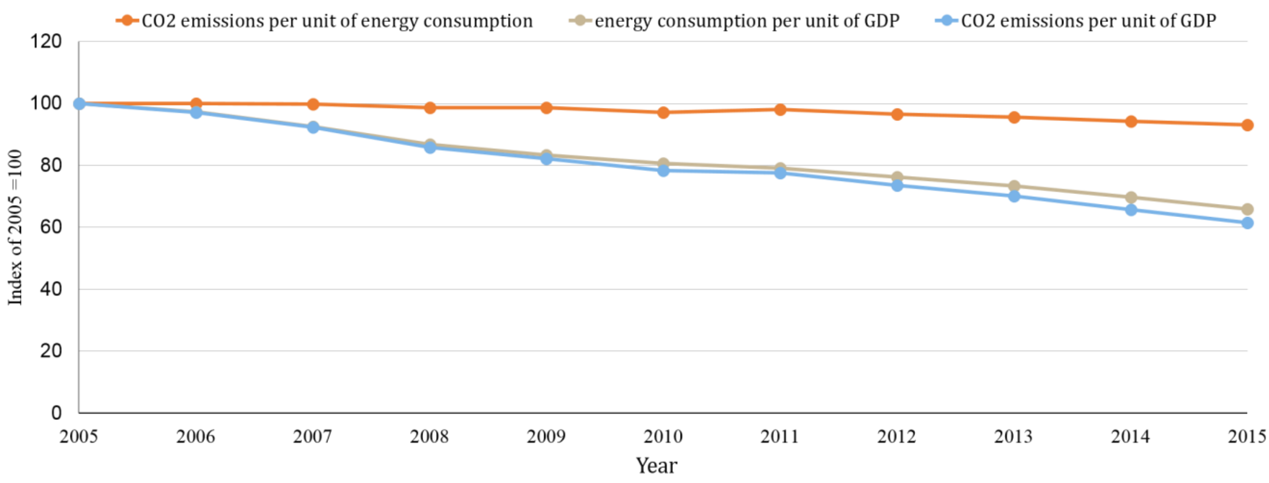

Figure 3-1 Changes in Major Indicators for Low-Carbon Energy and Economic Transition

1.3 Targets and Tasks for GHG Emission Control in the 13th FYP Period

In accordance with its *Outline of the 13th Five-Year Plan for National Economic and Social Development*, China will take active actions to control its carbon emissions, to seek to put in place a system of "double-control" (meaning control over both carbon emission intensity and total absolute emissions), to lower the CO_2 emission per unit of GDP by 18% against the 2015 level by 2020, and to support optimization development zones and low-carbon pilot cities become the pioneers in achieving carbon emission peaking. China will effectively control the carbon emissions from power, iron and steel, building materials and chemical industries while pushing forward the low-carbon development in key sectors including industry, energy, building and transportation so that the CO_2 emission per unit of industrial added value will drop 22% by 2020, with carbon emissions peaking in some industrial fields. China will expedite the formation of a clean, low-carbon, secure and efficient modern energy system, reduce the energy consumption per unit of GDP by 15%, increase the share of non-fossil fuels in total energy consumption to 15%. China will strive to increase the forestry carbon sink and reduce the forestry emissions so that by 2020 the forest area will increase by 40 million hectares from the 2005 level, forest coverage to 23% or above, and stock volume to 16.5 billion m^3. China will carry out low-carbon pilots of various types in depth and implement demonstration projects for near-zero carbon emission zones. China will spread the use of low-carbon technologies and products, update the carbon emission standard system and push for the establishment of a unified national carbon emission trading market.

Non-CO_2 GHG emissions will be effectively controlled, with a number of non-CO_2 emission control technologies developed, a number of key projects accomplished with sound emission control effects and a number of replicable pilot demonstration projects deployed. Efforts will be made to ensure that by 2020, the CH_4 emissions from energy activities and N_2O emissions from industrial processes and croplands will reach their peaks, chlorodifluoromethane (HCFC-22) production will be 35% lower than the 2010 figure, and trifluoromethane (HFC-23) emissions will be kept below the emission standard. And the accumulated reduction of GHG emissions arising therefrom will stand at more than 1.1 Gt CO_2 eq in the 13th FYP Period.

Chapter 2 Energy Conservation and Efficiency Improvement

The *12th Five-Year Plan for National Economic and Social Development of P. R. China* issued in March 2011 set it as a binding target to reduce energy consumption per unit of GDP by 16% in 2015 relative to 2010. In August 2011, the State Council issued the *Comprehensive Working Program of Energy Conservation and Emission Reductions in the 12th FYP Period*, which made clear requirements on strict observance of the energy conservation and emission control targets and responsibilities, to further put in place a government-steering market-driven energy conservation and emission control paradigm of full public participation and with enterprise as a principal actor. In August 2012, the State Council issued the *Plan for Energy Conservation and Emission Reductions in the 12th FYP Period* where further targets were set for the 12th FYP Period: saving 670 Mtce of energy, reducing energy consumption per unit of industrial added value (above designated size) by about 21% from the 2010 level, effectively curbing energy consumption growth in the key fields of building and transportation and public institutions, significantly increasing the percentage of major products (workloads) whose per unit energy consumption indicators meet advanced energy-saving standards. These policy measures effectively enabled China to make marked progress in energy conservation and energy efficiency improvement in the 12th FYP Period (Table 3-1), with a drop of 18.4% as against 2010 in energy consumption per unit of GDP in 2015 and accumulated energy saved of 870 Mtce over the five years.

Table 3-1 Changes in Energy Consumption per Unit of GDP and Total Energy Saved 2011-2015

Year	Total Energy Consumption (Mtce)	Energy Consumption per Unit of GDP (tce/RMB 10 thousand yuan)	Energy Consumption Per Unit of GDP Reduction Rate (%)	Annual Amount of Energy Saved (Mtce)
2010	3606.48	0.87	--	--
2011	3870.43	0.86	-2.03	80.08
2012	4021.38	0.82	-3.67	153.14
2013	4169.13	0.79	-3.79	164.25
2014	4258.06	0.75	-4.81	215. 20
2015	4300.00	0.71	-5.55	252.53

Note: Annual Amount of Energy Saved = (Energy Consumption per Unit of GDP for Previous Year- Energy Consumption per Unit of GDP for Current Year) × GDP of Current Year.

Total Energy Consumption and Energy Consumption per Unit of GDP figures are quoted from the *China Statistical Yearbook 2016*; all others are obtained from calculation.

GDP at 2010 Constant Prices.

2.1 Strengthening Performance Assessment of Energy Conservation Targets

The Chinese Government established and kept working on an energy-saving target accountability system and an energy conservation assessment system with Chinese characteristics. The 2011 *Comprehensive Working Program of Energy Conservation and Emission Reductions in the 12th FYP Period* disaggregated the national energy consumption per unit of GDP reduction targets to the provinces, autonomous regions and municipalities with an explicit requirement for further breakdowns to be duly made, for related statistical, monitoring and assessment system to be enhanced, and for energy-saving target accountability assessments to be reinforced. At the onset of the 11th FYP Period, the State Council started its assessment on the provincial governments with regard to their performance of the energy-saving targets and energy conservation measures, the result of which was made public.

To give impetus to energy conservation and management enhancements by key energy-consuming entities, the NDRC issued the *Notice on Implementation Program for 10,000-Enterprise Energy Conservation and Low Carbon Development Initiative (Top 10,000 Initiative)* in 2011, requiring local administrations to come up with their list of enterprises (entities) to be involved in the initiative according to the threshold requirements set forth in the *Program*, and to make a breakdown of their shares of the overall initiative target of 250 Mtce to fix the individual energy-saving targets for each participating enterprise in the 12th FYP Period. Starting from 2012, NDRC, together with the Ministry of Industry and Information Technology (MIIT) and other government agencies, organized targeted supervision and assessment on more than 16000 entities, including enterprises whose individual annual integrated energy consumptions were above 10,000 tons and selected major energy consumers whose individual annual integrated energy consumptions were above 5,000 tons. The results were disclosed to the public. By 2014, the initiative's target had been outperformed in advance, with 309 Mtce of energy saved in accumulative total (Table 3-2).

Table 3-2 Accountability Assessment Results and Total Energy-Saving Statistics of Top 10,000 Initiative 2012-2014[1]

Year	Number of Enterprises Assessed	Percentage of Outperformed Targets (%)	Percentage of Duly Fulfilled Targets (%)	Percentage of Almost Fulfilled Targets (%)	Percentage of Unfulfilled Targets (%)	Total Energy Saved (Mtce)
2012	14,542	25.90	50.40	14.30	9.50	170
2013	14,119	28.15	50.41	13.00	8.44	249
2014	13,328	30.96	51.13	10.80	7.11	309

Note: Total Energy Saved = Sum of Annual Amount of Energy Saved.

2.2 Adjusting and Optimizing the Industrial Structure

The Chinese government actively encourages the development of the strategic emerging industries and service industry in a bid to keep lowering the proportion of energy intensive industries in the national economy. In July 2012, the State Council issued the *12th FYP-Period National Strategic Emerging Industry Development Plan* which set forth the key directions and major tasks for the development of the seven emerging strategic industries, namely, energy conservation and environment protection, new-generation information technology, biotech, high-end equipment manufacturing, new energy, new materials, and new-energy vehicles. In December 2012, the State Council issued the *12th FYP-Period Service Industry Development Plan* which proposed to speed up the development of the producer services (i.e. financial, transport, logistic and hi-tech services) and the customer services (i.e. commercial and trading, cultural, tourism and health services). In 2012, the tertiary industry for the first time leveled off with the secondary industry in terms of added value contributing to GDP, reaching 50.5% in 2015 or 6.3 percentage points higher than that of 2010.

[1] Data Source: Assessment results disclosed by the NDRC for the 2012, 2013 and 2014 10000-Enterprise Energy Conservation Initiatives.

Meanwhile, the Chinese government implemented the plan to phase out backward production capacity with a sound exit mechanism put in place to keep optimizing the internal structure of the secondary industry. In 2011, MIIT issued the *12th FYP-Period Targets for Phasing out Backward Production Capacity in Industrial Fields*, with specific targets and tasks for 19 key fields, together with the *Implementation Program for Assessment on Work Related to the Phasing-out of Backward Production Capacity* as the supporting document. In 2013, the State Council released the *Guiding Opinion on Addressing Enormous Excess Production Capacity* which made the captioned work an explicit priority in industrial restructuring to be put in place to "digest, transfer, integrate and phase out" the excess capacity by giving full play to the market mechanism and by improving supporting policies. By the end of 2014, all the 19 fields involved outperformed their targets, one year before the 2015 deadline (See Table 3-3).

Table 3-3 Fulfillment of the 2011-2014 Targets for Phasing Out Backward Production Capacity

Sectors (Unit)	2011-15 Targets	2011 Fulfillment	2012 Fulfillment	2013 Fulfillment	2014 Fulfillment	2011-2014 Fulfillment
Iron Production (Mt)	48	31.92	10.78	6.18	28.23	77.11
Steel Production(Mt)	48	28.46	9.37	8.84	31.13	77.8
Coke (Mt)	42	20.06	24.93	24	18.53	87.52
Carbide (Mt)	3.8	1.52	1.32	1.18	1.94	5.96
Ferroalloy (Mt)	7.4	2.13	3.26	2.1	2.62	10.11
Electrolytic Aluminum (Mt)	0.9	0.64	0.27	0.27	0.51	1.69
Copper Production (Mt)	0.8	0.42	0.76	0.86	0.76	2.8
Lead Production (Mt)	1.3	0.66	1.34	0.96	0.36	3.32
Zinc Production (Mt)	0.65	0.34	0.33	0.19	/	0.86
Cement (Mt)	370	154.97	258.29	105.78	87.73	606.77
Flat Glass (million weight)	90	30.41	58.56	28	37.6	154.57
Paper Production (Mt)	15	8.31	10.57	8.31	5.47	32.66
Alcohol (Mt)	1	0.49	0.73	0.34	/	1.56
Monosodium Glutamate	0.18	0.08	0.14	0.29	/	0.51
Citrus Acid (Mt)	0.05	0.04	0.07	0.07	/	0.18
Leather Production (million standard pieces)	11.00	4.88	11.85	9.16	6.22	32.11
Dyeing (billion meters)	5.58	1.9	3.3	3.2	2.1	10.5
Chemical Fiber (Mt)	0.59	0.37	0.26	0.55	0.11	1.29
Lead Rechargeable Battery (GVA)	7.46	/	29.71	28.4	30.2	88.31
Power Generation (GW)	/	7.84	5.51	5.44	4.86	23.65
Coal (Mt)	/	48.7	43.55	145.78	235.28	473. 31

Data Source: MIIT *Notice Regarding Targets for Phasing Out Backward Production Capacity of Key Industrial Sectors in the 12th FYP Period*; MIIT information bulletin on the fulfillment of the backward production capacity out-phasing targets for 2011, 2012, 2013 and 2014.

2.3 Implementing Key Energy-Conservation Projects

The *Comprehensive Working Programe of Energy Conservation and Emission Reduction in the 12th FYP Period* explicitly required to implement key energy-conservation projects, focusing on energy-saving retrofits, energy-saving technology industrialization demonstration, energy-saving products for public benefit, Energy Management Contracting dissemination and energy-saving capacity building. These projects strived to achieve by 2015 a respective increase in the average operational efficiency of the coal-fired industrial boilers and kilns by 5 and 2percentage points , 2-3 percentage points of motor systems relative to the 2010 levels, an increased residual heat and pressure power generation capacity of 20 GW, a large increase in the market share of energy-efficient products, and a total energy-saving capacity of 300 Mtce to be generated in the 12th FYP Period. Since 2010, key energy conservation projects have been effectively implemented. See Table 3-4 for progress with the "energy-saving products for public benefit project" and Figure 3-2 for progress in the energy conservation service industries and Energy Management Contracting.

Table 3-4 Promotion of the Energy-Saving Products for Public Benefit Project in 2011-2013

Year	Efficient Electric Motors （MW）	Energy-Efficient Home Appliances (million)	Efficient Light Bulb (million)	Energy Efficient Cars (million)	Annual Energy Saving Capacity (Mtce)
2011	>2000	>18.26 (air conditioners only)	150	>4	/
2012	>14000	>90	160	>3.5	>12
2013	25000	130	/	2.65	20

Data Source: *China's Policies and Actions on Climate Change 2012, 2013* and *2014*.

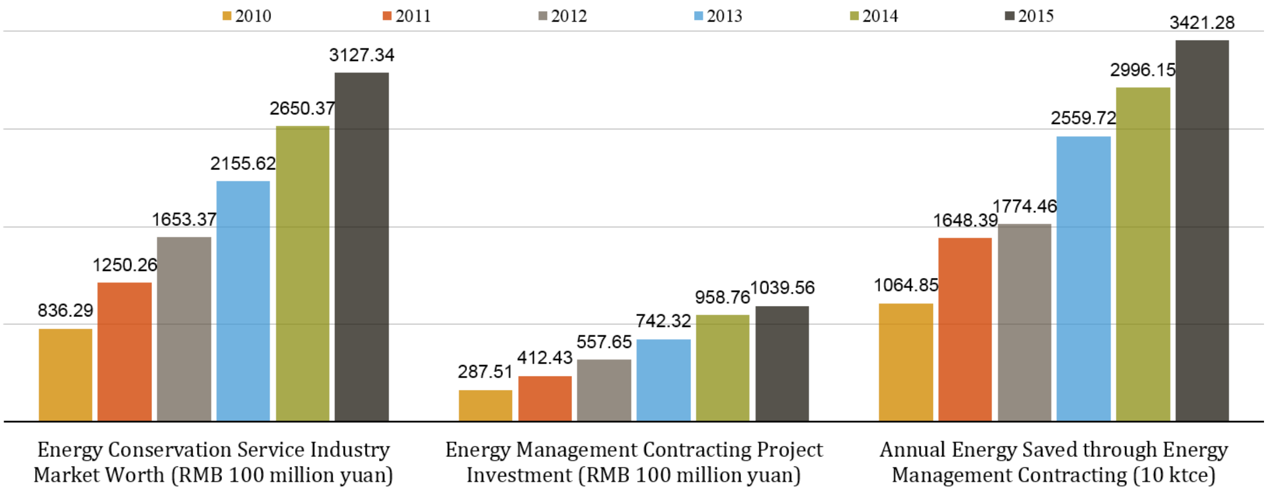

Figure 3-2 Development of Energy Conservation Service Industry and Energy Management Contracting in China 2010-2015[1]

Development of Clean and Efficient Coal-Fired Power Generation. In 2012, NDRC, the National Energy Administration (NEA) and the Ministry of Finance (MOF) promulgated the *Notice Regarding Comprehensive Upgrading and Reconstruction of Coal-Fired Power Plants* in a bid to promote reconstructions under the same caption. In 2014, NDRC, NEA and MEP issued the *2014-2020 Action Plan of Upgrading and Reconstructing Coal-Fired Power Generation Plants for Energy Conservation and Emission Reduction*, which comprehensively accelerate the pace of energy conservation and super low emission reconstructions for coal-fired power industry. During 2011-2015, an accumulated total of 400GW coal-fired power had been reconstructed and over 28 GW outdated coal-fired power generator sets had been phased out. In 2015, the average gross coal consumption for 6000kW and above coal-fired generator sets was 315 gce/kWh, with a five-year reduction of 18 gce/kWh[2] in total and an annual saving above 70 Mtce.

1 Data Source: ESCO Committee of China Energy Conservation Association (EMAC)

2 Data Source: *2016 National electricity Demand and Supply Situation Analysis and Prediction Report* issued by China Electricity Council.

Box 3-1 Key Energy-Conservation Projects in the 12th FYP Period

01 **Energy-Saving Retrofit Project**

Coal-fired industrial boiler (kiln) retrofit, electric motor energy efficiency, energy system optimization, waste heat and pressure utilization, fossil fuel conservation and alternatives, green lighting and other energy conservation transformation projects were implemented and expected to generate a respective energy-saving capacity of 75 Mtce, 80 TWh, 46 Mtce, 57 Mtce, 11.2 Mtce, and 21 Mtce.[1]

02 **Energy-Saving Technology Industrialization Demonstration Project**

A number of major or key energy-saving technologies including the utilization of lower-grade residual energy, rare earth permanent magnet motor, PV power system, zero emission and industrial links were promoted. Key products and core parts with good energy-saving effects and promising markets were put under scaled production for industrialized application. According to the planning target, over 30 key energy-saving technologies had been deployed in the 12th FYP Period, with an energy saving capacity of 15 Mtce generated.

03 **Energy-Saving Products for Public Benefit Project**

Major products promoted for household use include efficient lighting products, energy-efficient home appliances, energy-saving and new-energy vehicles; for commercial use, unitary air conditioner sets; for industrial use, efficient electric motor. China has put in place an energy-efficient product promotion system covering several hundred thousand types of products for the benefit of the general public.

04 **Energy Management Contracting (EMC) Extension Project**

The Opinions on Accelerating the Implementation of Energy Management Contracting and Promoting the Development of Energy Conservation Service Industry promulgated by the General Office of the State Council aimed to direct energy conservation service companies towards stronger technological R&D, service innovation, talent cultivation and brand building efforts for enhanced fund-raising capacity and unceasing pursuit of sound business modes. Over the last five years, the energy conservation service industry had grown from RMB 83.53 billion yuan in 2010 to RMB 312.73 billion yuan in 2015 in terms of market value; the EMC investment capital, from RMB 28.75 to 103.96 billion yuan, marked with a corresponding rise in the project energy-saving capacity from 10.65 Mtce to 34.21 Mtce.[2]

1 Data Source: *Plan for Energy Conservation and Emission Reductions in the 12th FYP Period*.

2 Data Source: ESCO Committee of China Energy Conservation Association (EMAC)

05 **Energy-Saving Capacity Building Project**

Efforts were made to advance the establishment of the energy conservation monitoring platform, the energy consumption database and data exchange system, and to reinforce data collection, sorting and pooling, forecast and early warning, and information exchange capacities. Pilots were executed to build up facilities for monitoring energy consumption of major energy consumers online, and demonstration projects, for urban energy metering. Efforts were also made to drive standard-setting and law enforcement capacity building by the energy conservation regulatory agencies that currently have an on-post staffing of about 16,000 and a 3-tiered (provincial-municipal-county) organizational structure roughly in place[1].

2.4 Improving Economic Incentive Policies for Energy Conservation

Pricing Policies. To curb blind expansion of energy-intensive industries and to advance industrial restructuring and technological upgrading, NDRC and MIIT jointly issued the *Notice Concerning the Application of Differentiated Electricity Tariff for Electrolytic Aluminum Enterprises* in December 2013, which pointed out that for each ton of electrolytic aluminum produced there would be no surcharge over the baseline tariff for each kWh AC power consumed below the benchmark of 13700 kWh, a surcharge of RMB 0.02 yuan for each kWh consumed within the range of 13700-13800 kWh, and a surcharge of RMB 0.08 yuan for each kWh consumed above the benchmark 13800 kWh. To build public awareness for thrifty and rational power use, NDRC issued the *Notice on Issuing the Guiding Opinions on the Pilot Implementation of Tiered Pricing for Household Electricity Consumption* in 2011, which divided the monthly household electricity consumptions into three tiers: basic, decent and high, with the first to be fixed according to the average monthly consumption of 80% households in the area, and the second and third having a respective minimum surcharge of RMB 0.05 and 0.3 yuan per KWh over the first-tier tariff. In March 2014, NDRC issued the *Guiding Opinions on the Establishment and Enhancement of Tiered Pricing for Household Natural Gas Consumption* which required all cities covered by pipeline gases to set up the tiered pricing system which again divide the consumptions into three tiers, with the first to be fixed according to the average monthly amount of gas consumed by 80% households in the area and the second and third having a rate 1.2 and 1.5 times that of the first respectively. In May 2014, NDRC, MIIT and AQSIQ jointly issued the *Notice Regarding Matters Relevant to the*

[1] Data Source: *China's Policies and Actions on Climate Change 2014.*

Promotion of Cement Industry Restructuring via Pricing Means to exert a RMB 0.4 yuan per KW price hike over cement enterprises to be phased out.

Tax and Credit Policies. In October 2011, MOF and SAT revised and adopted the *Detailed Rules for the Implementation of the Interim Resource Tax Regulation of P. R. China*. In October 2014, MOF and SAT issued the *Notice on Adjusting Crude Oil and Natural Gas Resource Tax Related Policies* and the *Notice Regarding the Implementation of Coal Resource Tax Reform*. Accordingly, starting from 1 December, 2014, mineral resource compensation fees for natural gas would be reduced to zero, and resource taxes for crude oil and natural gas would be increased from 5% to 6%; the price-based coal resource tax reform would be launched nationwide, with the coal resource tax rate range nailed down to 2-10% and all related charging fees checked up. The Chinese government encouraged financial institutions of various types to render greater credit support to energy conservation and consumption reduction projects by innovating credit management patterns. China Banking Regulatory Commission promulgated the *Notice on Issuing the Green Credit Guidelines* in February 2012 and formulated the *Green Credit Statistical System* in 2013, which specified the green credit statistical category covering 12 types of energy conservation and environment protection project and service. By the end of 2015, banking and financial institutions had a total green credit balance of RMB 8.08 trillion yuan (7.01 trillion from 21 major institutions), accounting for 9.68% of the total loan balance and able to generate an energy saving capacity of 221 Mtce with the projects they support[1].

2.5 Improving Energy Efficiency Standards and Labeling

In June 2012, NDRC and the Standardization Administration (SAC) jointly launched the Project on Promoting a Hundred Energy Efficiency Standards to further raise the energy efficiency market access thresholds for energy end-use products and the energy consumption market access thresholds for energy-intensive industries, the impact of which was felt as a weathercock. In 2015, the General Office of the State Council issued the *Opinions on Reinforcing the Energy Saving Standardization* which required intensified efforts in revising the energy saving standards for key sectors, strict enforcement of the mandatory energy saving standards, and promotion of recommended energy saving standards. In the 12th FYP Period, a total of 221 national energy efficiency

[1] Data Source: *China Banking Sector CSR Report 2015.*

standards were approved and issued as a framework covering important sectors such as manufacturing industry, energy, building, transport and public institutions. NDRC, AQSIQ and the Certification and Accreditation Administration (CNCA) jointly established and enforced China's energy efficiency labeling system. Up to 2015, this system covered 12 lots (33 categories in total) of energy end-use products, with over 10,000 enterprises and 930,000 product models on record. Investigations and studies show that 98.1% urban consumers are aware of the energy efficiency labeling and that the energy efficiency labeling system has saved over 441.9 TWh of electricity over the last 10 years since its inception.[1]

2.6 Promoting Energy Conservation Technologies and Products

To accelerate advancement and promotion of the energy-saving technologies, and to direct energy users towards the adoption of advanced and applicable new technologies, new facilities and new techniques for energy conservation, NDRC started from 2008 to release the *Catalogue for the Promotion of National Key Energy-Saving Technologies* on yearly basis. To coordinate the effective promotion of energy-saving and low-carbon technologies, NDRC issued in January 2014 the *Notice on Interim Measures for Promotion of Energy-Saving and Low-Carbon Technologies* and released the 2014 and 2015 Editions of the *Catalogue for the Promotion of National Key Energy-Saving Low-Carbon Technologies* (*Section for Energy Saving*) with the latter covering 266 key energy-saving technologies in 13 industries including coal, power generation, iron and steel, nonferrous metal, petroleum and petrochemical, chemical industry, building materials, machinery, light industries, textile, building, transport and telecommunication. Since 2009, MIIT has generated and released six editions of *Catalogue of Recommanded Energy-Saving Mechanical and Electrical Equipment (Products)*, four editions of *Catalogue of "Energy-Efficiency Star" Products*, and one *Catalogue of Recommanded Energy-Saving Technologies for Telecommunication*. To boost energy-efficient product consumption, promotion campaign were intensified in the 12th FYP Period by fiscally subsidizing efficient lighting, energy-saving home appliances, energy-saving and new-energy vehicles for household use, and the like; self-contained air conditioner sets for business use; and efficient electrical motors for industrial use etc, and by releasing six editions of *Catalogue for the Promotion of Efficient Electrical Motors* and eight editions of *Catalogue*

[1] Data Source: NDRC Bulletin *"Symposium in Celebration of the 10th Anniversary of the Implementation of the Energy Efficiency Labeling System successfully convened in Beijing".*

for the Promotion of Energy-Efficient Vehicles.

2.7 Enhancing Energy Efficiency of Buildings

According to the *Plan for Energy Conservation and Emission Reductions in the 12th FYP Period*, 400 million m^2 existing residential buildings in heating areas in North China were to be metered for heating and be retrofitted in energy conservation, 50 million m^2 existing residential buildings in areas of hot summer and cold winter and 60 million m^2 public buildings were to be retrofitted in energy conservation by 2015. And the *12th FYP-Period Building Industry Energy Conservation Plan* issued in 2012 by the Ministry of Housing and Urban-Rural Development (MoHURD) proposed to use a combination of measures including policies and laws, institutional arrangements and mechanisms, planning and design, standard and codes, technological deployment, building and operation, and industrial support. To the same end, MoHURD together with the MOF issued the *Opinions on the Implementation of the Energy Conservation Renovations on Existing Residential Buildings in Areas with Hot Summers and Cold Winters* in April 2012; the NGOA and the AQSIQ issued the *Notice on Strengthening Matters Related to Public Institution Energy and Resource Metering* in 2014.

Intensified supervision and management efforts have resulted in a growing proportion of new buildings conforming to the mandatory energy-saving standards to the present level of approximately 100%. By 2015, the area of energy-saving buildings nationwide amounted to over 12 billion m^2, accounting for over 40% of total urban residential construction area and representing an annual energy conservation capacity of over 100 Mtce. A total of 1.18 billion m^2 existing residential buildings in heating areas in North China were metered for heating and retrofitted in energy conservation in accumulation, outperforming the targets set by the State Council; and 70.90 million m^2 existing residential buildings in areas with hot summers and cold winters accomplished energy conservation reconstruction in the 12th FYP Period. By the end of 2015, 3979 building projects nationwide were granted the Green Building Labels (GBL), with a total floor area of more than 450 million m^2. Constant progress has been made in the advancement of the mandatory green building standards: compliance with the standards has been made a must in such localities as Beijing, Tianjin, Shanghai, Chongqing, Jiangsu, Zhejiang, Shandong and Shenzhen, with more than one billion m^2 conforming to the green building standards. Piloting and demonstration of super low energy-consuming building projects grew in number and size: by the end of 2015, over 60 pilot passive super low energy-consuming green building projects were initiated in 12 provinces located in the 4 climate zones, namely, severe cold, cold, hot summer and cold winter, and hot summer warm winter zones; up to 2015 altogether 97 cities, 198 counties, 6 districts and 16 townships have been proclaimed as demonstration sites for renewable energy application in building; solar light and heat, utilized in about 3-billion-m^2 urban buildings; and superficial geothermal energy, utilized in about 500-million-m^2 urban buildings nationwide.

In 2011, the NGOA issued the *Public Institution Energy Conservation Plan for the 12th FYP Period*, which set the specific quantitative targets of a respective 15% and 12% reduction for energy consumption per capita and per unit of construction area together with the administrative targets of putting in place well-fledged systems of organization and management, policies and regulations, monitoring and appraisal, technical support, publicity and training, and market-oriented services. In the 12th FYP Period, the NGOA, together with the NDRC, the MOF and other departments, issued the *Opinions on the Implementation of the Public Institution Energy and Resource Conservation Projects in Advancement of the Eco-Civilization* and the *Interim Regulations on Public Institution Energy Audit.* Under its initiation, 2050 national energy-saving public demonstration agencies were established. Plan targets were successfully fulfilled: energy consumption per capita and per unit of construction area by public agencies dropped by 17.1% and 13.9% respectively (See Figure 3-3).

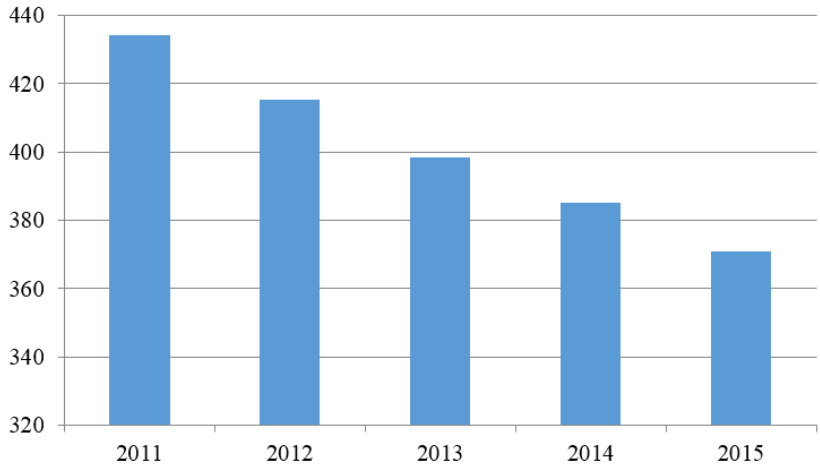

Figure 3-3 Changes of Overall Energy Consumption Per Capita in National Public Institution 2011-2015 (kg tce per capita)

2.8 Promoting Transport Energy Conservation

In 2011, the MOT issued the *12th FYP-Period Transportation Development Plan* which set forth the targets of reducing the 2015 energy consumption per unit of transport turnover for commercial vehicles and ships by 10% and 15% respectively relative to the 2005 level and lowering the energy consumption of the civil aviation per ton kilometer by more than 3% in the 12th FYP Period. Starting from 2011 it had successively issued the *Work Plan for Controlling Transport Greenhouse Gas Emissions in the 12th FYP Period* and the *Transport Climate Change Action Plan 2012-2020*, and promulgated the *Guidelines on the Development of Green Circular Low-Carbon Transportation*, the *Guidelines on Building a Low-Carbon Transport System*, the *Opinions on the Implementation of the 2014-2015 Action Plan for Energy Conservation, Emission Reduction and Low-Carbon Development in the Transport Industry* and other policy documents to set forth such measures as enhancing green infrastructure, promoting the application of green transport equipment, accelerating the formation of a green transportation organizational structure, improving IT application and smart transportation, and expanding in depth the pilot and demonstration projects as well as targeted actions. The energy consumption intensity reduction targets set in the *12th FYP-Period Plan* have been successfully fulfilled: Compared with 2005, commercial vehicles and ships registered a respective drop of 15.9% and 20% in the energy consumption per unit of transport turnover in 2015. For changes in the railway transportation energy consumption, see Figure 3-4.

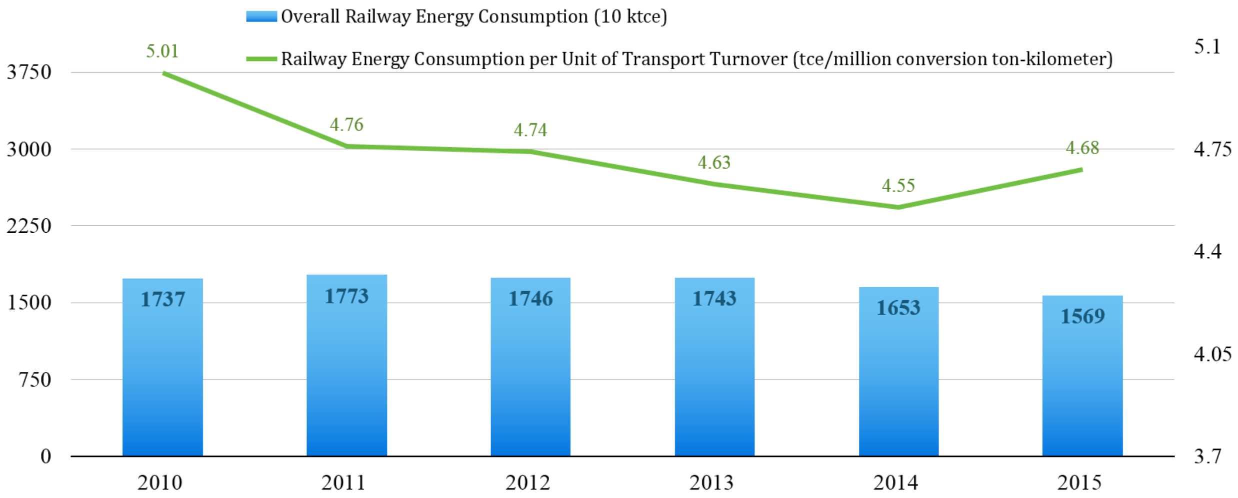

Figure 3-4 Changes in Railway Transportation Energy Consumption 2010-2015[1]

[1] Data Source: *Railway Statistical Bulletins 2010, 2011, 2012, 2013, 2014, 2015*

Chapter 3 Optimizing Energy Mix

Through strict cap control of coal consumption, sped-up development of clean energy including natural gas, and promotion of non-fossil fuels development, China has achieved an 8.4 percentage points decrease in coal's share in the total energy consumption from 72.4% in 2005 to 64% in 2015, a 3.5 percentage points increase in natural gas' share in the total energy consumption from 2.4% in 2005 to 5.9% in 2015, and an increase of 4.6 percentage points in non-fossil fuels' share in the total energy consumption from 7.4% in 2005 to 12.0% in 2015 (see Figure3-5), bringing the share of low-carbon energy including non-fossil energy and natural gas in total energy consumption up to 17.9%.

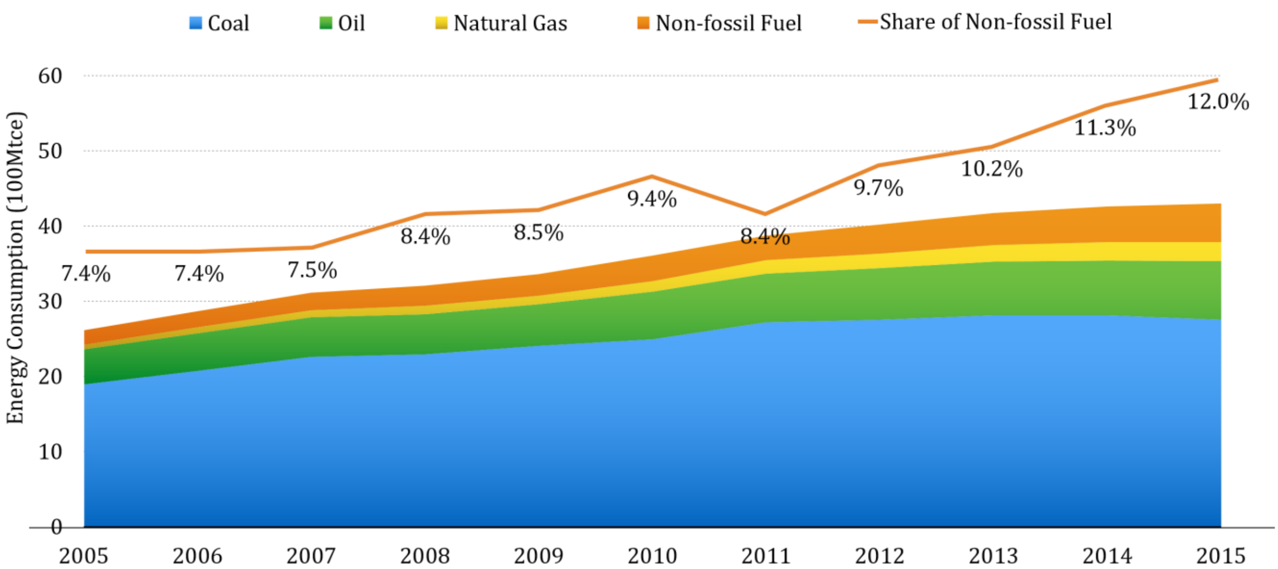

Figure 3-5 China's Energy Consumption Mix

3.1 Strict Control of Total Coal Consumption

The *Energy Development Strategic Action Plan 2014-2020* issued by the State Council in 2014 highlighted the energy development targets and actions for 2020, including reduction and replacement of coal consumption, minimization of coal share in total energy consumption, and reduction of coal consumption in the Beijing-Tianjin-Hebei-Shandong, Yangtze River Delta and Pearl River Delta regions. To follow up on the *Air Pollution Prevention and Control Action Plan*, MEP, NDRC and other relevant government departments jointly issued in 2013 the *Detailed Rules for the Implementation of Air Pollution Prevention and Control Action Plan in Beijing-Tianjin-Hebei Cluster and Surrounding Areas* which set forth the target of reducing coal consumption by 13, 10, 40 and 20 million tons respectively (83 million tons in total) in Beijing, Tianjin, Hebei and Shandong by the end of 2017. In December 2014 the NDRC together with the MIIT, MOF, MEP, NBS, and NEA issued the *Interim Measures for Managing Coal Consumption Reduction and Replacement in Key Areas,* putting forward specific targets and plans for coal consumption reduction and replacement in Beijing, Tianjin, Hebei, Shandong, Shanghai, Jiangsu, Zhejiang and Pearl River Delta of Guangdong. The NDRC, NEP and NEA jointly issued in 2015 the *Working Program for Strengthening Coal Consumption Control of Key Air Pollution Control Cities*, which set the target of achieving negative increase as against the previous year in the coal consumption of the Top 10 cities of poor air quality. In 2014, the NDRC, NEA and MEP jointly issued the *Working Program of the Energy Industry for Strengthening Air Pollution Prevention and Control* which required coal share in energy consumption to be gradually reduced and developed medium- and long-term control targets for the total national coal consumption.

In 2015, the coal consumption in China was 2.75 billion tce, showing a slow-down or slightly declining trend, the share of coal in the total energy consumption dropped by 5.2 percentage points relative to the 2010 level, the total output of coal-fired power generation exhibited consecutive negative growth in 2014 and 2015. Up to now, more than 20 provinces (autonomous regions, municipalities) and 30 cities have set coal consumption control targets of various types.

3.2 Sped-up Development of Clean Energy including Natural Gas

The *12th FYP-Period Natural Gas Development Plan* released by the NDRC in 2012 set the targets of a domestic natural gas supply capacity of 176 billion m^3 and import volume of about 93.5 billion m^3, along with development targets for conventional natural gas, synthetic natural gas, coal bed methane, shale gas, natural gas penetration rate and infrastructure etc. In 2014 the NDRC, NEA and MEP jointly issued the *Working Program for Air Pollution Prevention and Control in the Energy Industry* requiring the share of natural gas (not including synthetic natural gas) in energy consumption to reach 7% and 9% respectively by 2015 and 2017. In the same year, the NDRC issued the *Opinions on Establishing a Long-Term Mechanism for Secure and Stable Natural Gas Supply* to set forth the task and measures to guarantee long-term stable natural gas supply. Together with relevant departments, NDRC issued the *Guiding Opinions on Developing Distributed*

Natural Gas and the *Rules for Implementation of the Distributed Natural Gas Demonstration Projects*, to further advance the development of distributed natural gas with policies regarding financial subsidies, grid integration of the electricity generated, subsidized feed-in tariffs, etc. In 2014, NEA issued the *Notice on Regulating the CTL and CTG Industries for Scientific and Orderly Development* where access parameters were proposed regarding energy conversion efficiency, energy consumption, water consumption, CO_2 emission, pollutant discharge to regulate the operation of coal-to-liquids (CTL) and coal-to-gas (CTG) projects. In 2012, the MOF and NEA jointly issued the *Notice on Promulgating Policies for Subsidizing the Development and Utilization of Shale Gas* to make arrangements for special budgetary fund support to shale gas development. In 2012, the NDRC, together with MOF and others, had the *Shale Gas Development Plan 2011-2015* developed. In 2011, NDRC and NEA had the *Exploitation and Utilization Plan for Coal Bed Methane in the 12th FYP Period* developed, which contained an overall programme for coal bed methane control and utilization to offer guidance and impetus to the use of coal bed methane and the development of surface coal bed methane.

In 2015, China produced 134.6 billion m^3, imported 63.9 billion m^3 and consumed 193.1 billion m^3 of natural gas. The share of natural gas in the total energy consumption grew to 5.9% in 2015 from 4.0% in 2010, maintaining a momentum of steady increase. By 2015, a total of 64,000 km of natural gas pipelines have been built to bring into shape a national gas transmission pipeline network.

3.3 Promoting Non-Fossil Fuels Development

NDRC, NEA, MoHURD and MOF issued dozens of policy documents, including the *Plan of Renewable Energy Development in the 12th FYP Period, the Plan of Solar Power Development in the 12th FYP Period*, the *Plan of Biomass Development in the 12th FYP Period*, the *Interim Measures for Special Funds for Renewable Energy Development*, the *Interim Measures for Subsidy Funds from Renewable Energy Tariff Surcharges*, and the *Notice on Further Promoting the Utilization of Renewable Energy in Building*. These documents were intended to clarify on relevant development targets, planning layouts, and priority areas; to set down or update preferential grid integration, purchase, pricing and burden-sharing policies for renewable energy; and to set aside special renewable energy development fund in support of resource assessment and investigation, technology R&D,

pilot and demonstration projects, and rural renewable energy development and utilization. In 2015, NDRC issued the *Notice on Lowering the Coal-Fired Power Grid Tariff and the General Industrial and Commercial Power Consumption Prices,* which decided that the renewable energy surcharge on electricity consumptions for demand other than household and agricultural production needs were raised by RMB 0.004 yuan per kWh to 0.019 yuan per kWh.

As indicated in Table 3-5, compared to 2010, 2015 saw an increase of 265.39 GW or 7.3 percentage points (in terms of contribution to the national total) in installed capacity and 725.5 TWh or 7.4 percentage points (in terms of contribution to the national total) in power generation by non-fossil fuels. China is the largest user of new and renewable energy in the world, accounting for 25% and 42% respectively of the total and newly installed renewable energy capacity. In 2014, China registered a final balance of RMB 49.14 billion yuan in renewable energy tariff surcharge-based revenue, of which 5.2, 27.5 and 7.4 billion were used respectively to subsidize PV, wind and biomass power generation.

For a snapshot of the mitigation actions and effects, see Table 3-6 at the end of this Part.

Table 3-5 Non-Fossil Fuels Installed Capacity and Power Generation[1]

	Unit	2005	2010	2014	2015
1. Installed Capacity (IC)					
Hydropower (incl. Pumped Storage)	GW	117.39	216.06	304.86	319.54
Wind Power (on-grid)	GW	1.27	31.31	96.57	130.75
Solar Power (on-grid)	MW	70	860	24860	42180
Biomass Power (on-grid)	GW	2	5.5	9.81	10.3
Geothermal & Ocean Current Power	MW	25	28	30	30
Renewable Energy TOTAL	GW	120.76	253.76	436.13	502.80
Nuclear Power	GW	6.85	10.82	20.08	27.17
Non-Fossil Fuels TOTAL	GW	127.61	264.58	456.21	529.97
2. Power Generation (PG)					
Hydropower (incl. Pumped Storage)	TWh	396.4	686.7	1060.1	1112.7
Wind Power (on-grid)	TWh	1.6	49	159.8	185.6
Solar Power (on-grid)	GWh	0	500	23500	39500
Biomass Power (on-grid)	TWh	5.2	24.8	46.1	52. 0
Geothermal & Ocean Current Power	GWh	100	150	150	150
Renewable Energy TOTAL	TWh	403.3	761.15	1289.65	1389.95
Nuclear Power	TWh	53.1	74.7	133.2	171.4
Non-Fossil Fuels TOTAL	TWh	456.4	835.85	1422.85	1561.35
3. Share of Non-Fossil Fuels					
National Total Installed Capacity	GW	517.18	966.41	1370.18	1525.27
National Total Power Generation	TWh	2497.5	4227.8	5680.1	5739.9
Non-Fossil Fuel Contribution/IC	%	24.7	27.4	33.2	34.7
Non-Fossil Fuel Contribution/PG	%	18.3	19.8	25.0	27.2

[1] Data Source: *China Statistical Yearbook 2016* and the NEA.

Chapter 4 Control of GHG Emissions from Non-Energy Activities

In the 12th FYP Period, China intensified its control of GHG emissions from the sectors of industrial processes, agriculture, and waste, conducted vigorous researches on non-CO_2 GHG emissions, and further combated and controlled climate change and air pollution in a synergetic manner.

4.1 Control of GHG Emissions from Industrial Processes

In 2015, NDRC in collaboration with the Ministry of Foreign Affairs (MFA), MOF, and MEP, took active focused action on HFCs control: issued the *Notice on Organizing and Carrying out Work Related to the Disposal of Hydrofluorocarbons*, allocated the key HFCs reduction demonstration project funds in two batches according to the budgetary investment plan of the central government, and arranged for HCFC-22 production facilities already in operation but not yet supported as CDM projects to remove and destroy HFC-23. In 2015, MEP promulgated the *Supplementary Notice on Strictly Controlling the Construction, Reconstruction and Expansion Projects of Hydrofluorocarbon-Containing Production*, requiring all newly built HCFC-22 production facilities to operate immediately upon installation of the HFC-23 treatment facilities so that this by-product was discharged not directly into the atmosphere but after being treated pollution-free. MIIT involved relevant professional associations and enterprises in the application of alternative technologies to replace limestone with carbide slag in cement clinker production, enhanced production processes using blast furnace slag and fly ash as mixed additives to cement production, secondary and tertiary treatment methods to process N_2O emissions from nitric acid production processes, and catalytic and thermal-oxidative decomposition to handle N_2O emissions from the adipic acid production processes, etc.

4.2 Control of GHG Emissions from Agriculture

In 2012, the Ministry of Agriculture (MOA) started and pushed through a soil test based fertilization campaign with central budgetary support to deploy pilots on the basis of farmer-enterprise partnership in "100 counties, 1000 townships and 10000 villages". It also received central budgetary support in the form of earmarked fund and project fund for its initiative to spread the use of residue coverage, non-tillage and other protective farming technologies, to increase the organic carbon content in soil by feeding livestock with crop residue and returning the manure to fields. In the 12th FYP Period, MOA and

MOF continued the subsidization project for higher soil organic matter content to extend technical measures such as crop residue return to fields, manure-fertilized farming, and intensive application of organic fertilizers. The central government made budgetary investments into selected intensive swine and milk cow farms (husbandry area), especially for their standardization of the livestock and poultry pens and installation with auxiliary facilities for manure slurry treatment such as manure lagoons, fecal sewage reticulation, etc.

4.3 Control of GHG Emissions from Waste Sector

The Chinese government attaches great importance to the development of circular economy, actively pushing for reducing, reusing and recycling of the resources to curb GHG emissions from the source and production process. To significantly enhance the municipal waste treatment capacities and to reduce, recycle and detoxify municipal wastes as far as possible for better urban human settlement, the State Council approved and forwarded in 2011 the *Notice* of *the Ministry of Housing and Urban-Rural Development Regarding Opinions on Further Enhancing Municipal Waste Treatment*. In 2012, the General Office of the State Council issued the *Plan for Building Waste Water Treatment and Recycling Facilities in All Cities and Townships in the 12th FYP Period* and the *Plan for Building Municipal Waste Detoxification Treatment Facilities in All Cities and Townships in the 12th FYP Period* in a bid to actively control CH_4 emission from municipal waste water and solid waste treatment processes. MoHURD, in collaboration with relevant departments, improved the existing municipal waste standards, implemented the system of charged municipal waste treatment services, promoted the use of advanced waste incineration technologies, formulated incentive policies to advance the recycling and reuse of the landfill gases. By the end of 2015, China's municipal waste water treatment capacity, volume and rate reached 140 million m^3/day, 42.9 billion m^3/year, and 91.9% respectively. With 890 facilities for environment-friendly municipal waste treatment, including 640 sanitary landfills and 220 waste incineration stations, China has managed to register a rate of 94.1% in this connection.

Chapter 5 Increasing Carbon Sinks

In the 12th FYP Period, under the guidance of the targets and tasks fixed in the *Working Program for Controlling Greenhouse Gas Emissions in the 12th FYP Period*, the *Plan of Forestry Development in the 12th FYP Period*, and the *Key Points of Forestry Action Plan on Climate Change in the 12th FYP Period*, the forestry administration forge ahead with the climate actions, with significant progress achieved. Vigorous afforestation, scientific management, and strict control efforts in the last five years have resulted in a steady growth of the natural resources and of the sink increase and emission reduction capacities.

5.1 Acceleration of Afforestation and Greening

Efforts have been made to fully implement the *Outline of the National Afforestation and Greening Plan 2011-2020*, to carry forward the nationwide voluntary tree-planting initiative; to advance afforestation and greening in dry areas, Beijing-Tianjin-Hebei region and other key areas, and to speed up major forestry programmes, including the Conversion of Slope Farmlands into Forests, Integrated Stony Desertification Control, Desertification Control for Areas in the Vicinity of Beijing and Tianjin, Northwest-North-Northeast China (Sanbei) and Yangtze River Shelterbelt Development, and Natural Forest Resources Conservation. With 460 million mu (307 thousand km^2) or 28% more land afforested in the 12th as against the 11th FYP Period, 2015 forest coverage and stock volume increased to 21.6% and 15.14 billion m^3 respectively, the tasks planned for the 12th FYP Period have been fully accomplished.

Natural Forest Resources Conservation Programme. In February 2011, SFA, together with relevant departments, jointly issued the *Notice on Continuing to Implement the Programme of Natural Forest Resources Conservation in Key State-Owned Forest Plantations in the Lower Reaches of Yangtze River, the Upper and Middle Reaches of Yellow River, Northeast China and Inner Mongolia*, to formally launch the Natural Forest Resource Conservation Programme Phase II with an estimated investment of RMB 244.02 billion yuan to meet the target of increasing forest area by 5.2 million hectares in 2020. Over the last five years, afforestation of 2.5 million hectares has been completed under this programme.[1]

[1] Data Source: *China Forestry Development Bulletin 2011, 2012, 2013, 2014, 2015*

Northwest-North-Northeast China (Sanbei) Shelterbelt Development Programme. In August 2012, SFA issued the *Plan of Northwest-North-Northeast China Shelterbelt Development Programme Phase V 2011-2020* which aimed to complete afforestation of 16.47 million hectares, increase forest area by 9.884 million hectares and forest coverage rate by 2.27 percentage points by 2020. In 2015, a total area of 745.5 thousand hectares were afforested under this programme[1].

Programmes of Shelterbelt Development along the Yangtze River, in the Pearl River Basin, along the Coastal Line, in the Taihang Mountains and in Plain Areas. In July 2013, SFA formally launched the *Programme of Shelterbelt Development along the Yangtze River, in the Pearl River Basin, in the Taihang Mountains and in Plain Areas Phase III 2011-2020* and in 2015 started drafting the *Plan for the Third Phase (2016-2025) of the Programme of Shelterbelt Development along the Coastal Line*. Over the last five years, afforestation of 838 thousand hectares, 253 thousand hectares, 732 thousand hectares and 209,000 hectares have been completed under the Yangtze River Upper and Middle Reaches, Pearl River Basin, Coastal Line Shelterbelt Development Programmes and Taihang Mountains Greening Programme respectively[2].

Programme for Conversion of Slope Farmlands into Forests. In August 2014, NDRC and SFA, together with relevant departments, jointly issued the *Notice on Releasing the General Plan for a New Round of Conversions of Farmlands to Forests and Grasslands*[3]. In 2015, China converted 533 thousand hectares of slope farmlands back into forests and afforested 55 thousand hectares of barren hills and sandy wastelands[4].

Programme on Desertification Control for Areas in the Vicinity of Beijing and Tianjin. In May 2015, SFA together with relevant departments jointly issued the *Plan for the Second Phase of the Programme on Desertification Control for Areas in the Vicinity of Beijing and Tianjin (2013-2022)* to intensify efforts to advance desertification control in Beijing and Tianjin. Over the last five years, an accumulated of 2.19 million hectares of land has been afforested under this programme[5].

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1 Data Source: *China Forestry Development Bulletin 2015*

2 Data Source: SFA Bulletin entitled "Precise Greening to Build Up the Ecological Shelterbelt in Key Areas—A Summary of the Programmes of Shelterbelt Development along the Yangtze River, in the Pearl River Basin, along the Coastal Line, in the Taihang Mountains and in Plain Area".

3 Data Source: SFA Bulletin entitled "Another Round of Farmland-to-Forest Conversion Programme Launched to Mark another major breakthrough in comprehensive and deepened reform"

4 Data Source: *China Forestry Development Bulletin 2015*

5 Data Source: *China Forestry Development Bulletin 2011, 2012, 2013, 2014, 2015*.

5.2 Implementation of Forest Tending and Management

In 2011, SFA and its provincial (autonomous region, municipality) branches set up the Forest Tending and Management Leading Groups to strengthen target management and performance assessment and to create a synergy in strengthening forest management. In 2012, SFA revised and issued the *Requirements on Forest Tending Operation Design* and the *Methods of Inspection and Assessment on Forest Tending*, finished drafting the *Regulations on Forest Tending*, as a further step towards sound standard and institutional building. In 2013, the Chinese government formally ratified 15 National Forest Management Model Bases. SFA released the *Guidelines on Preparing Close-to-Nature Forest Management Programmes for State-Owned Forest Plantations in North China* and the *Guidelines on the Cultivation and Utilization of Industrial Forests for State-Owned Forest Plantations in South China* in 2014 and the *National Forest Managers Training Plan 2015-2020* in 2015, to provide guidance to forest manager trainings at the national, provincial and county levels. In 2015, SFA completed the preparation of the *National Forest Management Plan (2016-2050)*. Over the last five years, the total area of forests tended in China reached 40.86 million hectares, which helped to optimize the forest structure, increase the forest resources, and give impetus to initiatives of better job opportunities and income increase for forest plantation workers and forest farmers.

5.3 Enhancement of Forest Disaster Control

Efforts have been made to implement forest land protection and utilization plans, to check upon cases of illegal forest land occupation and land reclamations in key state-owned forest plantations, to crack down upon illegal forest land occupation and to stop forest land from diminishing. Efforts have also been made to strengthen natural forest resource protection, enhance protective policies, expand the protection scope of the natural forest resources, and to stop commercial lumbering of natural forests. By the end of 2015, natural forest put under the management and protection of the *Programme of Natural Forest Resources Conservation* reached 1.732 billion mu (1,155 thousand km^2), with starkly enhanced carbon sink and other biological functions. Forest disaster prevention and control have been strengthened. With regard to enhanced forest fire prevention, in the 12th FYP Period the national forest fire area rate was kept firmly below 1‰ and there had been a continued decreasing momentum for annual forest fire incidences, affected areas and number of casualties with a respective drop of 58%, 85%

and 43%. With regard to better integrated forest vermin control, the national vermin hazard rate was kept under 4.5‰ in 2015, with serious hazards from pine wood nematode, American white moth and other major vermin effectively held in check.

5.4 Development of Marine Blue Carbon Sinks

In the 12th FYP Period, China conducted theoretical and technological researches into the shellfish and seaweed cultivation for carbon sequestration technologies and carbon sequestration potential appraisals, which led to the preliminary establishment of the shellfish and seaweed carbon sequestration potential evaluation technologies, and conducted integration and demonstration of shellfish and seaweed carbon sequestration technologies. Outbreaks have been made with regard to the application of satellite remote sensing technologies in monitoring marine carbon flux and ecosystems such as seaside wetlands, seaweed beds and coral reefs to form well-fledged regional carbon sink monitoring technologies and capacities. In the 13th FYP Period, the Chinese government will rehabilitate coastal belt ecosystems, improve water quality environment and develop marine carbon sink with the implementation of key projects including the “South Mangrove and North Willow”, “Blue Gulf” and the “Eco-Island and Reef”.

Chapter 6 Piloting and Demonstration of Low-Carbon Development

Since 2010, China has successively initiated low-carbon province/city and carbon emission trading pilots, and forged ahead with pilots in building low-carbon industrial parks, low-carbon communities, low-carbon towns, and green transportation to explore into various paths and patterns to achieve low-carbon development at various levels and in various fields.

6.1 Launching Pilots of Low-Carbon Provinces and Cities

In 2010, NDRC issued the *Notice on Carrying out Pilots of Low-Carbon Provinces and Cities*, pursuant to which pilots have been initiated in two batches in 42 places: Guangdong, Liaoning, Hubei, Shaanxi, Yunnan, Hainan, Tianjin, Chongqing, Shenzhen, Xiamen, Hangzhou, Nanchang, Guiyang, Baoding, Beijing, Shanghai, Shijiazhuang, Qinhuangdao, Jincheng, Hulunbuir, Jilin, Daxing'anling, Suzhou, Huai'an, Zhenjiang, Ningbo, Wenzhou, Chizhou, Nanping, Jindezhen, Ganzhou, Qingdao, Jiyuan, Wuhan, Guangzhou, Guilin, Guangyuan, Zunyi, Kunming, Yan'an, Jinchang and Urumqi. These pilots were required to draw out clear objectives, principles and requirements for low-carbon development, to prepare their low-carbon development plans, to formulate supportive policies for low-carbon and green development, to seek low-carbon and green development modes suited to local conditions, to establish an industrial system featuring low carbon, green development, environmental protection and resource recycling, to establish the GHG emission statistical and management system, to enforce accountability for GHG Emission control targets, to actively promote a low-carbon green life and consumption style, and to reinforce the total GHG emission control mechanism and the peak target forcing mechanism.

In the 12th FYP Period, the pilot provinces and cities worked conscientiously to meet the *Notice's* requirements by putting in place a Leading Group and by exploring into ways for institutional innovations in the field of carbon emission accounting and management platform building, impact assessment of carbon emissions, carbon emission trading, carbon emission accounting and reporting of enterprises, low-carbon product certification in the context of the *Low-Carbon Pilot Project Implementation Scheme* approved by NDRC. Significant improvements have been made in these pilots. Of all the pilots, 39 laid down special plans on low-carbon development, 13 set up special funds of low-carbon development, 34 prepared local one- or multi-year GHG inventory, 36 established carbon intensity target disaggregation and assessment mechanisms, 14 had in place low-carbon product certification systems, 5 experimented on the carbon assessment mechanism for new fixed asset investment projects, 34 drew timelines for carbon emission peaking of which 12 made 2020 the peaking target including Beijing, Shanghai, Guangzhou, Hangzhou, Qingdao, Jilin, Suzhou, Zhenjiang, Ningbo, Wenzhou, Nanping and Jiyuan. Progress in low-carbon development was remarkable for the pilots: in terms of carbon emissions per ten thousand yuan GDP, the 42 pilots had an average accumulated decrease of 19.4% from the 2010 level in 2014, faster than that of the national average and of their counterparts.

6.2 Advancing Local Caron Emission Trading Pilots

In 2011, NDRC issued the *Notice on Carrying out Carbon Emission Trading Pilots*, in which Beijing, Tianjin, Shanghai, Chongqing, Hubei, Guangdong and Shenzhen were approved as the pilots for carbon emission trading. The pilots were required to fully acknowledge the importance of related work, to strengthen project management and leadership, to set up full-time dedicated team, to allocate special project fund, to lay down implementation schemes clarifying on guiding principles, targets, tasks, measures and timetable as well as governance regulations with explicitly stated game rules, to calculate and fix local GHG emission caps, to develop local GHG emissions quotas allocation schemes, to put in place supervision systems and registries of local carbon emission trading, and to develop trading platforms as a robust enabler to support the piloting process.

Carbon emission trading pilots were launched successively from June 2013 to June 2014. All pilots promulgated regulations on local carbon trading in consideration of local conditions in relation to their carbon intensity targets, economic growth trends, enterprise- and industry-specific emission levels, etc., set the access thresholds for carbon trading, with which altogether over 1,900 enterprises and entities under emission control were made eligible, and identified through research the GHG types and industries to be involved as well as allocation schemes of quotas totaling 1.2 Gt. The pilots studied and set forth their carbon emission accounting methods and standards in light of the industries involved, verified historical carbon emission data of enterprises, established MRV systems, allocated emission quotas, established trading system and trading rules, developed registration systems, set up dedicated governing bodies, activated market monitoring and supervision systems, developed training and capacity building programmes, to initiate a fully-fledged carbon trading pilot system framework. With the inception of the pilots, the carbon markets have been operating smoothly and growing gradually in trading size. All pilots put carbon trading under centralized management, established carbon emission trading institutions which were then designated as the sole carbon trading venue within their respective areas. By the end of 2015, the secondary markets of seven pilots in China had an accumulated quotas transaction of 50.32 million tons worth RMB 1.41 billion yuan at an average trading price of RMB 28 yuan per ton, while CCER transaction of 35.6 million tons worth RMB 300 million yuan at an average trading price of RMB 8 yuan per ton. Among them, Hubei, Guangdong, Shenzhen and Beijing were by far the largest contributor in terms of trading size and market vitality. It is worth noting that Guangdong and others have introduced auction into their quotas allocation mechanisms in an attempt to test the interactive pricing between the primary and secondary markets, which would certainly offer valuable experience for future attempts to establish a more rational carbon pricing system. Besides, the establishment and operation of the pilot carbon trading markets gave rise to carbon related financial services, which not only added to the fund-raising channels for enterprise energy conservation and emission reduction initiatives but also further satisfied the increasingly diversified demands of the carbon market players. All pilots intensified compliance supervision and enforcement during the entire piloting process, resulting in a compliance rate exceeding 96% and 98% respectively in 2014 and 2015. Active explorations made by the pilot provinces and cities brought into shape the current somewhat binding trading and policy system oriented towards the absolute total emission control target rather than the intensity target with a number of economic sectors encompassed.

6.3 Launching Low-Carbon Industrial Parks and Community Pilots

NDRC has organized researches on assessment indicator systems and supporting policies for low-carbon industrial parks, communities, towns and cities in a bid to find a development pattern and policies mechanisms best-suited to the Chinese conditions.

Low-Carbon Industrial Parks. In 2013, MIIT, together with NDRC, issued the *Notice on Carrying out National Pilots of Low-Carbon Industrial Parks* and jointly initiated pilots, based on which corresponding assessment indicator system and supporting policies were researched into and formulated. A number of industrial parks with sound conditions, distinct features, representativeness and legitimate background were chosen as pilot sites and a number of low-carbon management modes suited to the Chinese conditions were promoted through the pilots to provide guidance and impetus to low-carbon industrial development. In 2014, the first list of National Pilot Low-Carbon Industrial Parks totaling 55 were approved and released; and in 2015, the implementation plans of 39 pilot low-carbon industrial parks were approved. By promoting renewable energy, accelerating the transformation of conventional industries into low-carbon industries and the development of innovated low-carbon industries, the pilot parks greatly reduced their carbon emissions per unit of industrial added value.

Low-Carbon Communities. In 2014, NDRC issued the *Notice on Carrying out Pilot Low-Carbon Communities* which heralded nationwide low-carbon community pilot initiatives and set forth new concepts, new practices and new patterns for low-carbon development from the perspectives of community planning, building and facility construction, operation and management, environment cultivation, cultural activities, etc. To provide further guidance over and impetus to low-carbon pilot communities development, NDRC issued the *Notice of NDRC General Office on Promulgating* the *Guidelines on Developing Pilot Low-Carbon Communities* to provide differentiated guidance over new urban communities as well as existing urban and rural communities regarding the siting requirements, targets, composition and defining criteria for the pilots. At the same time, low-carbon community carbon emission accounting methodologies were developed through researches and the *Low-Carbon Community Assessment Indicator System* activated to render technical support to low-carbon pilot communities. As was envisioned in the centralized national deployment, work plan compilation, pilot community selection, and supportive policy formulation were soon in full swing at various localities to generate positive results: these pilots helped to incorporate the low-carbon development awareness into district planning, building and management as well as residents' everyday life. They were positive explorations into effective control of the carbon emissions from the urban and rural communities to facilitate low-carbon urban and rural community development.

Low-Carbon Towns. In 2011, MOF, MoHURD and NDRC launched the Green and Low-Carbon Development Pilot and Demonstration Project for Selected Towns. Seven towns including Gubeikou of Miyun in Beijing, Daqiuzhuang of Jinghai in Tianjin, Haiyu of Changshu in Jiangsu, Sanhe of Feixi in Hefei, Guankou of Xiamen in Fujian, Xiqiao of Foshan in Guangzhou, Mudong of Ba'nan in Chongqing, were chosen as the first group of pilots. They explored into different low-carbon development modes, according to each local economic and social development levels, location privilege, as well as resource and environment conditions. In 2011, under MoHURD initiation, low-carbon eco-city technologies were researched into and promoted, and projects started on pilot and demonstration basis. In 2012, along with MOF, MoHURD granted central budgetary support of RMB 50 million yuan to each of the eight green eco-cities including the Tianjin Sino-Singapore Eco-City. By the end of 2015, MoHURD ratified 28 low-carbon or green eco-city pilots and 25 low-carbon eco-city international cooperation pilots. In 2015, NDRC issued the *Notice on Accelerating Work Related to the Advancement of the National Low-Carbon Town Pilots* which set forth the three-year target of building up a number of national low-carbon demo towns integrating industrial and urban development, with sound spatial structure, intensive and comprehensive resource utilization, low-carbon and environmentally friendly infrastructure, low-carbon and efficient production style, and low-carbon and comfortable life style. The document also identified Shenzhen International Low Carbon City of Guandong, Zhuhai Hengqin New District of Guangdong, Qingdao Sino-German Eco-Park of Shandong, Zhenjiang Guantan Low-Carbon New Town of Jiangsu, Sino-Sweden Low-Carbon Eco-City in Wuxi of Jiangsu, Kunming Chenggong Low-Carbon New District, Wuhan Huashan New Eco-Town of Hubei, Sanming New Eco-City of Fujian as the first group of pilots for national low-carbon town pilots.

6.4 Advancing Other Low-Carbon Piloting and Demonstration Projects

Low-Carbon Transportation Pilots. In 2011, MOT launched the Low-Carbon Transportation Pilot Project, with an emphasis on road and waterborne transportation as well as urban passenger transportation. Ten cities, including Tianjin, Chongqing, Shenzhen, Xiamen, Hangzhou, Nanchang, Guiyang, Baoding, Wuxi and Wuhan, were chosen as the first group of pilots. Sixteen cities, including Beijing, Kunming, Xi'an, Ningbo, Guangzhou, Shenyang, Harbin, Huai'an, Yantai, Haikou, Chengdu, Qingdao, Zhuzhou, Bengbu, Shiyan and Jiyuan, were identified in 2012 as the second group of pilots for low-carbon transportation development. It also organized researches on the system of assessment indicators for low-carbon transportation cities, low-carbon ports, low-carbon navigation route development and low-carbon road construction. The pilots strived to build and upgrade transportation carbon emission management system and to accelerate the development of a transportation system featuring low-carbon emission by building low-carbon transportation infrastructure, promoting the application of low-carbon transport equipment, optimizing transportation organizational modes and operations, developing smart transportation facilities, and improving public information services of transportation.

Low-Carbon Product Certification. NDRC and CNCA jointly established the low-carbon product certification system in 2013, issued the *Regulations on Managing Energy-Saving and Low-Carbon Product Certification*, launched low-carbon product certification pilots and had product carbon emission accounting methods researched into in 2015. CNCA has then publicized the criteria for approving low-carbon product certification agencies. The first certification catalogue included four product types, namely, common Portland cement, plate glass, aluminum alloy profiles, and small- and medium-sized three-phase asynchronous motors, while the second catalogue covered three product types, namely, building ceramic tiles (planks), tires and textile fabrics. Guangdong Province and Chongqing Municipality were identified as the pilot sites for low-carbon product certification. Explorations were made into enabling institutional environment for enterprises to produce and the public to consume low-carbon products. By the end of 2015, a total of 981 low-carbon products from 14 provinces (autonomous regions, municipalities) have been granted the certificate.

Carbon Capture, Utilization and Storage (CCUS). In April 2013, NDRC issued the *Notice on Promoting the Test and Demonstration of Carbon Capture, Utilization and Storage*, making it clear that CCUS test and demonstration projects would be advanced soon to actively promote the engineering application of CCUS and launching SINOPEC's whole-process CCUS of smoke and gas from the coal-fired power plants (the first of its type in China). The Ministry of Land and Resources completed initial assessment of CO_2 geological storage potential and applicability of 417 basins and successfully implemented China's first CO_2 geological storage demonstration project in Ejin Horo Banner, Erdos, Inner Mongolia in partnership with the China Shenhua Group. In 2013, the Ministry of Science and Technology (MOST) released the *Special Plan for the Development of CCUS Technologies in the 12th FYP Period*; initiated a number of projects under the CCUS National Science and Technology Pillar Program, including the CO_2

chemical engineering and utilization key technology R&D and demonstration project, the CO_2 mineralization application technology R&D and demonstration project, and the demonstration project of the research and test on coal-fired power plant CO_2 capture and recovered coal bed methane utilization and storage technologies, and established the China Strategic Alliance on CCUS Technological Innovation consisting of more than 40 members including enterprises, universities and research institutes.

Chapter 7 International Market Mechanism (CDM)

To further advance Clean Development Mechanism (CDM) programs in China in an orderly manner and to facilitate the healthy development of the CDM market, NDRC, along with MOST, MFA and MOF, revised the *Measures for Operation and Management of Clean Development Mechanism Projects* in August 2011. Statistics from the CDM Database of Clean Development Mechanism in China (cdm.ccchina.gov.cn) indicate that NDRC approved a total of 2,226 CDM projects in the 12th FYP Period, of which 2,115 were successfully registered with the Executive Board of the United Nations Clean Development Mechanism and 3,468 issuances of projects (including projects prior to 12th FYP) were given with certified emission reductions (CERs) totaling 695 Mt CO_2eq, among which 1,135 projects were issued for the first time with CERs totaling 107 Mt CO_2eq.

Table 3-6 Mitigation Actions and Effects

No.	Action Name	Targets or Major Components	Sectors/ GHGs Covered	Time Frame	Nature of action [a]	Supervision Departments	Status [b]	Progress	Methodologies[1] and Assumptions	Estimated Emission Reduction[2]	Support Received
1	Nationwide Mitigation Action	Reducing CO_2 emissions per unit of GDP by 40%-45% against the 2005 level by 2020	Energy Activities in All Sectors/ CO_2	2006-2020	Mandatory/Government	NDRC	In Progress	CO_2 emissions per unit of GDP dropped by 38.6% against the 2005 level in 2015	Carbon emission intensity reduction rate= (1-carbon intensity of the target year/base year carbon intensity) × 100%.	/	
Energy Conservation and Improvement of Energy Efficiency											
2	Nationwide Energy Conservation Action	Reducing the 2015 energy consumption per unit of GDP by 16% against the 2010 level	All Sectors /CO_2 etc.	2011-2015	Mandatory/ Government	NDRC and Other Relevant Departments	Completed	Energy consumption per unit of GDP dropped by 18.4% against the 2010 level in 2015; an accumulative total energy conservation of about 870 Mtce over the five years	Carbon emission = energy saved × implied emission factor of total energy consumption	An accumulative total of about 1.90 Gt in CO_2 emissions reduction over the five years	
3	10000 Enterprise Energy Conservation and Low Carbon Development Initiative	Saving an accumulative total of 250 Mtce energy over 2011-2015	Industry etc./ CO_2 etc.	2011-2015	Mandatory/ Government	NDRC, MIIT, etc.	Completed	An accumulative total of about 309 Mtce energy saved over 2011-2014	Carbon emission = energy saved×implied emission factor of total energy consumption	An accumulative total of about 680 Mt in CO_2 emissions reduction	
4	Boiler/Kiln Retrofit Programme	Raising the 2015 average industrial boiler /kiln efficiency by 5 and 2 percentage points against 2010 respectively	Industry/ CO_2 etc.	2005-2015	Government	NDRC and Other Relevant Departments	Completed	An estimated energy conservation of 75 Mtce or so over 2011-2015	Carbon emission = energy saved× implied emission factor of total energy consumption	An estimated CO_2 emissions reduction of 160 Mt over 2011-2015	
5	Energy-Efficient Electric Motor System Project	Raising the 2015 average motor operation efficiency by 2 to 3 percentage points against 2010 respectively	Industry /CO_2 etc.	2005-2015	Government	NDRC and Other Relevant Departments	Completed	An estimated power conservation of about 80 TWh over 2011-2015	Carbon emission =electricity saved× electricity emission factor	An estimated CO_2 emissions reduction of 50 Mt over 2011-2015	
6	Energy System Optimization Project	Enhancing the tiered energy consumption price for enterprises in power, iron and steel production, metallurgy, ammonia, refinery, ethylene industries and energy system package optimization and renovation	Industry /CO_2 etc.	2005-2015	Government	NDRC and Other Relevant Departments	In Progress	An estimated energy conservation of about 46 Mtce over 2011-2015	Carbon emission = energy saved× implied emission factor of total energy consumption	An estimated CO_2 emissions reduction of 100 Mt over 2011-2015	
7	Waste Heat and Pressure Utilization Project	Increasing waste heat and pressure power generation capacity by 20 GW by 2015	Industry /CO_2 etc.	2005-2015	Government	NDRC and Other Relevant Departments	Completed	An estimated energy conservation of about 57Mtce over 2011-2015	Carbon emission = energy saved× implied emission factor of total energy consumption	An estimated CO_2 emissions reduction of 130 Mt. over 2011-2015	

1 The implied emission factors of solid fuels, liquid fuels, gaseous fuel and total energy consumption are calculated using data from the GHG Inventory in the *People's Republic of China Second National Communication on Climate Change* whereas the grid average emission factor was adopted as the electricity emission factor.

2 "Emission reduction results" are superimposing and not to be accumulated.

No.	Action Name	Targets or Major Components	Sectors/ GHGs Covered	Time Frame	Nature of action [a]	Supervision Departments	Status [b]	Progress	Methodologies[1] and Assumptions	Estimated Emission Reduction[2]	Support Received
8	Fossil Fuel Conservation and Replacement Project	Saving or replacing 8 Mt petroleum over 2011-2015	Industry, Transport, etc./ CO_2 etc.	2005-2015	Government	NDRC and Other Relevant Departments	Completed	An estimated energy conservation of about 11.2 Mtce over 2011-2015	Carbon emission = energy saved× petroleum consumption emission factor	An estimated CO_2 emissions reduction of 20 Mt over 2011-2015	
9	Green Lighting Project	Gradually phasing out low-efficient incandescent lamps and promoting energy-saving lamps	Service etc./ CO_2 etc.	Since 1990s	Government	NDRC and Other Relevant Departments	In Progress	An estimated energy conservation of about 21 Mtce over 2011-2015	Carbon emission = energy saved× implied emission factor of total energy consumption	An estimated CO_2 emissions reduction of 50 Mt over 2011-2015	
10	Demonstration Project of the Industrialization of Energy- Saving Technologies	Promoting industrialization of over 30 key energy conservation technologies	Industry, Transport, etc./ CO_2 etc.	Since 2011	Government	NDRC and Other Relevant Departments	In Progress	An estimated energy conservation of about 15 Mtce over 2011-2015	Carbon emission = energy saved ×implied emission factor of total energy consumption	An estimated CO_2 emissions reduction of 30 Mt over 2011-2015	
11	Energy-Saving Products for Public Benefit Project	Giving subsidies for promotion of energy-efficient light fixtures, air conditioners, flat panel TVs, computers as well as electric motors, wind turbine, pumps and automobiles	Industry, Transport, etc./ CO_2 etc.	Since 2007	Government	NDRC and Other Relevant Departments	In Progress	By 2013 the Project of Energy-Saving Products for Public Benefit had come into being, covering 15 product types of several hundred thousand models under 3 categories: home appliance, automobile, and industrial products. Annual energy conservation of about 20 Mtce was achieved in 2013.	Carbon emission = energy saved× implied emission factor of total energy consumption	A yearly CO_2 emission reduction of 40 Mt in 2013	
12	Energy Management Contracting Promotion Project	promoting energy management contracting and developing energy conservation service industry	Energy Conservation Service/ CO_2 etc.	Since 2010	Government	NDRC and Other Relevant Departments	In Progress	EMC project investment of RMB 103.96 billion generating an energy conservation capacity of 34.21 Mtce in 2015	Carbon emission = energy saved× implied emission factor of total energy consumption	A yearly CO_2 emission reduction of 70 Mt in 2015	
13	Energy Efficiency Labelling	Applying energy efficiency labelling on energy end-user products, production enterprises and testing companies.	All Sectors/ CO_2 etc.	Since 2005	Government	NDRC and Other Relevant Departments	In Progress	An accumulated energy conservation of 441.9 TWh over 2005-2015	Carbon emission = electricity saved × electricity emission factor	An accumulated CO_2 emissions reduction of 290 Mt over 2011-2015	
14	Energy Conservation in Industry Sector	Reducing 2015 energy consumption per unit of industrial added value (above designated size) by 21% against 2010	Industry/ CO_2 etc.	2011-2015	Government	NDRC, MIIT and Other Relevant Departments	Completed	2014 energy consumption per unit of industrial added value (above designated size) dropped by 21% against 2010; an accumulated energy conservation of about 580 Mtce over 2011-2014	Carbon emission = energy saved× implied emission factor of total energy consumption	An accumulated CO_2 emissions reduction of 1270 Mt over 2011-2014	
15	Energy Conservation in Building Sector	Generating an energy conservation capacity of 116 Mtce In the building industry over 2011-2015	Building Energy Consumption/CO_2 etc.	2011-2015	Government	NDRC, MoHURD and Other Relevant Departments	Completed	An estimated energy conservation of about 116 Mtce over 2011-2015	Carbon emission = energy saved ×implied emission factor of total energy consumption	An estimated CO_2 emissions reduction of 250 Mt over 2011-2015	

No.	Action Name	Targets or Major Components	Sectors/ GHGs Covered	Time Frame	Nature of action [a]	Supervision Departments	Status [b]	Progress	Methodologies[1] and Assumptions	Estimated Emission Reduction[2]	Support Received
Energy Mix Optimization											
16	Developing Non-Fossil Fuels	Raising the share of non-fossil fuels in total energy consumption to 15% by 2020 and 20% by 2030	Energy/ CO_2 etc.	2005-2030	Mandatory/ Government	NEA, NDRC and other Departments	In Progress	The share of non-fossil fuels in total energy consumption was 12% in 2015, up 4.6 percentage points against 2005 level.	Emission reduction=∑ (current-year non-fossil fuel consumption -current-year energy consumption× 2005 share of non-fossil energy in total energy consumption)) ×implied emission factor of total energy consumption	An accumulated CO_2 emissions reduction of 1750 Mt over 2006-2015	CNREC established under the support of Sino-Danish Renewable Energy Development Programme (RED)
17	Developing Natural Gas	Raising the share of natural gas in total energy consumption to over 10% by 2020	Energy/ CO_2 etc.	2005-2020	Government	NEA, NDRC and other Departments	In Progress	The share of natural gas in total energy consumption was 5.9% in 2015 up 3.5 percentage points against 2005 level.	Emission reduction=∑ (current-year natural gas consumption - current-year energy consumption× 2005 share of natural gas in total energy consumption)× (implied emission factor of total energy consumption –implied emission factor of natural gas)	An accumulated CO_2 emissions reduction of 520 Mt over 2006-2015	
18	Developing Hydropower	Raising the regular installed hydropower capacity to about 350 GW by 2020	Energy/ CO_2 etc.	2005-2020	Mandatory/ Government	NEA, NDRC and other Departments	In Progress	In 2015 hydropower accounted for 19.4% of total power generated, up 3.5 percentage points as against 2005. The 2015 installed hydropower capacity was 320GW and hydropower generation was 1111 TWh.	Emission reduction=∑ (current-year hydro power generation – current-year total power generation× 2005 share of hydropower) × electricity emission factor	An accumulated CO_2 emissions reduction of 390 Mt over 2006-2015	CNREC established under the RED support
19	Developing Wind Power	Raising the installed wind power capacity to 200 GW and on-grid price of wind power electricity equal to that of coal-fired electricity by 2020	Energy/ CO_2 etc.	2005-2020	Mandatory/ Government	NEA, NDRC and other Departments	In Progress	In 2015 wind power accounted for 3.2% of total power generated, up 3.2 percentage points as against 2005. The 2015 installed on-grid wind power capacity was 130.75 GW and on-grid wind power generation was 185.6 TWh.	Emission reduction=∑ (current-year wind power generation – current-year total power generation× 2005 share of wind power)×electricity emission factor	An accumulated CO_2 emissions reduction of 540 Mt over 2006-2015	CNREC established under the RED support
20	Developing Solar Power	Raising the installed PV power generation capacity to 100 GW and on-grid price for solar power electricity equal to that of coal-fired electricity by 2020	Energy/ CO_2 etc.	2005-2020	Mandatory/ Government	NEA, NDRC and other Departments	In Progress	In 2015 solar power accounted for 0.7% of total power generated, up 0.7 percentage points as against 2005. The installed on-grid solar power capacity was 42.18 GW and on-grid solar power generation was 39.5 TWh in 2015.	Emission reduction=∑(current-year solar power generation – current-year total power generation× 2005 share of solar power)×electricity emission factor	An accumulated CO_2 emissions reduction of 60 Mt over 2006-2015	CNREC established under the RED support

Note: a) Mandatory/Voluntary/Governmental/Market; b) Under Planning/In Progress/Completed

Part IV Finance, Technology and Capacity-Building Needs and Support Received

Finance, technology and capacity building mark an essential part in addressing climate change. The developed countries fulfilling their obligations by providing finance, technology and capacity building supports to the developing countries is an important assurance for the latter to effectively address climate change. At a point of in-depth industrialization and urbanization, China is faced with the challenges of economic development, poverty elimination, livelihood enhancement, environmental protection and climate change responses simultaneously. It requires not only assiduous efforts on the domestic side but also support from the Annex-I Parties in terms of finance, technology and capacity building in line with the obligations under the Convention to help raise China's climate change coping capacity so that it can meet all its GHG emission control targets and achieve goals contained in its NDC.

Chapter 1 Finance Needed and Support Received for Addressing Climate Change

1.1 Domestic Financial Input

It was made clear in the *Working Program for Controlling Greenhouse Gas Emissions in the 12th FYP Period* that arrangements would be made to earmark fund from the budget for energy conservation and emission control projects and renewable energy development projects in support of climate change related programs to ensure that financial needs were met. China CDM (Clean Development Mechanism) Fund would be fully mobilized to diversify investment and fund-raising channels by actively directing private and foreign capital towards key projects related to the R&D of low-carbon technologies, the development of low-carbon industries and the control of GHG emission. Credit structure would be adjusted and optimized to render sound financial support and related services to GHG emission controls and low-carbon industry promotion. Utilized concessional loan arrangements with international financial organizations and foreign governments would be tilted for greater support to GHG emission control projects.

In the 12th FYP Period, China vigorously carried forward the low-carbon green development strategies and implemented climate change mitigation and adaptation actions, with huge financial inputs. Over the 2010-2014 period, a total of RMB 821.07 billion yuan was taken from the state budgetary fund in support of actions related to climate change mitigation and adaptation, including energy conservation, renewable energy development, energy management, eco-system protection, natural forest conservation, conversion of slope cropland into forests, sand-storm and desertification control, and conversion of croplands into grasslands initiatives[1]. From 2011 to 2014, RMB 20 billion yuan was arranged by the SASAC from the state capital operation budget to support energy conservation and emission control initiatives of various enterprises; the RMB 200 billion yuan was invested by central-government owned enterprises in energy conservation, emission control and carbon reduction, resulting in the accumulated energy saved by about 146 Mtce, or 350 million tons in CO_2 emissions reduction[2]. Financial supports were provided for the central and local governments to conduct climate change policy research, capacity building and public awareness building programs through the CDM Fund. In the 12th FYP Period, the CDM Fund provided a total of RMB 1.1 billion yuan in grants supporting 505 projects, and arranged RMB 13.04 billion yuan in compensated loan arrangement leveraging RMB 64.04 billion yuan in private loan use for 210 entrusted loan projects. In 2015, MOF for the first time incorporated climate change management in the “government income and expense items”, for fund to be arranged for climate change related programs in annual governmental budgets. To promote energy conservation and to improve energy efficiency, MOF promulgated the *Interim Measures of Fund Management for Energy Conservation and Emission Reduction Subsidies* in the same year. Meanwhile, enterprises were encouraged to play a part so as to give free reign to the market mechanisms. Up to 2014, a total of 190 venture capital funds had been established with the support from the

[1] Data Source: *2011 Finance Yearbook of China*, *2012 Finance Yearbook of China, 2013 Finance Yearbook of China*, *2014 Finance Yearbook of China* and *2015 Finance Yearbook of China*. The *2016 Finance Yearbook of China* has not come out yet.

[2] Data Source: *China's Policies and Actions on Climate Change 2015*.

venture capital plan of the emerging industries, of which 44 were in the energy conservation, environment protection and new energy fields with a total investment of RMB 12.6 billion yuan[1].

1.2 International Financial Support Received

1.2.1 Support from GEF, the Operating Entity of the *Convention*

As a developing country, China conforms to the beneficiary requirement for climate fund support under the *Convention* and is entitled to applying for financial support from the operating entity of the Finance Mechanism under the *Convention*. From the 2010 fiscal year to the 2014 fiscal year of the GEF, China received GEF grant commitments of about USD 149 million in total for 20 national climate change projects (Table 4-1) mainly covering such fields as energy efficiency improvement, low-carbon transportation, energy-efficient buildings, low-carbon city demonstration projects and cropland soil carbon storage.

1.2.2 Support Received from Cooperation with Annex I Parties and International Organizations

China highly values bilateral and multilateral international cooperation in the field of climate change. Over the last few years, China has been committed to friendly cooperation with Annex I Parties of the *Convention* and relevant international organizations in the fields of mitigation and adaptation action and related capacity buildings; and to working together with the international community at both national and local levels to explore into and promote innovations and transitions in global green and low-carbon development, for which it has also received some financial support. Major supports are listed in Table 4-2 below.

[1] Data Source: *China's Policies and Actions on Climate Change 2014*.

Table 4-1 GEF-Supported Climate Change Projects in China in the 2010-2014 Fiscal Years[1] (in 10,000 USD)

No.	GEF Project ID	Project Title	GEF Grant
1	3824	Sino-Singapore Tianjin Eco-City Project (SSTECP)	616
2	4109	China Energy Efficiency Promotion in Industry	400
3	4156	Eco-Transport in City Clusters: Model Development and AMP Pilots	480
4	4188	Technology Needs Assessment on Climate Change	500
5	4488	Green Energy Schemes for Low-Carbon City in Shanghai, China	435
6	4493	China Renewable Energy Scaling-Up Program (CRESP) Phase II	2728
7	4500	GEF Large-City Congestion and Carbon Reduction Project	1818
8	4621	Hebei Energy Efficiency Improvement and Emission Reduction Project	364
9	4866	Promoting Energy Efficiency in Industrial Heat Systems and High Energy-Consuming (HEC) Equipment	538
10	4869	Urban-Scale Building Energy Efficiency and Renewable Energy	1200
11	4882	Enabling China to Prepare Its Third National Communication (3NC) and Biennial Update Report to the UNFCCC	728
12	4947	Developing Market-Based Energy Efficiency Program in China	1780
13	5121	Energy Conservation, Greenhouse Gas Mitigation and Soil Carbon Sequestration in Staple Crop Production	510
14	5360	Promoting Energy Efficient Electric Motors in Chinese Industries	350
15	5373	Greening the Logistics Industry in Zhejiang Province	291
16	5411	Jiangxi & Fuzhou Urban Integrated Infrastructure Improvement Project	255
17	5582	Jiangxi & Jinan Sustainable Urban Transport Project	255
18	5627	China Clean Bus Leasing	232
19	5669	Enabling Solid State Lighting Market Transformation and Promotion of Light Emitting Diode Lighting	624
20	5728	Accelerating the Development and Commercialization of Fuel Cell Vehicles in China	823

[1] Data Source: GEF Projects | Global Environment Facility on the Official Website of Global Environment Facility

Table 4-2 Major Supports Received from Bilateral and Multilateral International Cooperation Programmes for Addressing Climate Change

No.	Project Name	Partners	Amount	Timeline
1	Provincial Programmes on Climate Change Mitigation and Adaptation in China	UNDP/ Norway/ EU	4.1 Million USD	2008-2012
2	Sino-Italian Cooperation Program for Environmental Protection	Italy	2.8 Million Euros	2010-2016
3	Applied Research on China National Strategy of Climate Change Adaptation in the 12th FYP Period	Norway	910,000 NOK	2010-2016
4	Sino-Norwegian Biodiversity and Climate Change Project	Norway	19.43 Million NOK	2011-2014
5	Provincial Greenhouse Gas Emissions Inventory Capacity Building and Greenhouse Gas (GHG) Emissions Accounting Methodology For Enterprises of Key Industries	UNDP/ Norway	3 Million USD	2012-2015
6	Establishment of National Registry System for Domestic Emissions Trading Scheme and Voluntary Carbon Emission Reduction (ETS)	UNDP/ Norway	4.06 Million USD	2012-2016
7	Chongqing & Guangdong Low-Carbon Product Certification Project	EU/UNDP	960,000 USD	2013-2014
8	Preparation for Partnership for Market Readiness on Carbon Emission Trading	WB	380,000 USD	2013-2015
9	EU-China Emission Trading Capacity Building Project	EU	5 Million Euros	2014-2017
10	Partnership for Market Readiness on Carbon Emission Trading	WB	8 Million USD	2015-2018
11	Europe-China Eco-Cities Link (EC-LINK) Project	EU	9.36 million Euros	2014-2017
12	Sino-German Public Building Energy Efficiency Project	Germany	3 Million Euros	2011-2015
13	Building Energy Efficiency and Climate Protection: Energy-Consumption Baseline Research for Existing Residential Buildings in North China	Germany	2 Million Euros	2010-2013
14	Key Stakeholder Capacity Building for China's Building Energy Efficiency	Germany	1.95 Million Euros	2013-2016

1.2.3 Support Received for the Preparation of the Biennial Update Report

As a non-Annex I Party to the Convention, China applied to GEF, the operating entity of the Finance Mechanism under the Convention, for financial support to be used in the preparation of the Third National Communication and the First Biennial Update Report. The GEF grant was received in 2015 and the budget for preparation of the Biennial Update Report was 900,000 USD. Upon receiving the GEF grants, the Chinese government made positive arrangements. NDRC established and led a project steering committee, called up relevant agencies and experts to draft the first BUR. Discussions, solicitation of opinions, as well as approval and submission of the first BUR was accomplished in over one year.

1.3 Financial Needs in Future

China still has substantial financial needs to cope with climate change, to fulfill its self-initiated 2030 GHG emission control targets and to implement the 15 key actions set forth in its NDC, which include building low-carbon energy system, building energy-efficient and low-carbon industrial system, controlling emissions from building and transportation sectors, increasing carbon sinks, enhancing overall climate resilience and enhancing support in terms of science and technology. According to NCSC's estimation, there would be an additional investment need of RMB 30 trillion yuan in the next 15 years, or RMB 2 trillion yuan every year on average: 10 trillion for energy conservation and RMB 20 trillion yuan for low-carbon energy development. To fill the gap, it requires not only more investment on the domestic side from the government, enterprises and social groups but also continued involvement in bilateral and multilateral international cooperation, to seek new and additional climate financial supports from developed countries in particular.

Chapter 2 Technology Needs for Addressing Climate Change

2.1 Domestic Policies and Actions

The *Working Program for Controlling Greenhouse Gas Emissions in the 12th FYP Period* issued by the State Council in 2011 pronouncedly proposed to intensify low-carbon technology R&D, extension and application, to implement low-carbon technological innovation and industrialization demonstration projects in key industries and key fields, to highlight the development of affordable and accessible low-carbon technologies, including low-carbon building materials, low-carbon transportation, green lighting, and clean and efficient utilization of coal; to develop key low-carbon technologies including the cost-effective PV cells, building-integrated PV(BIPV), high-power wind power generation facilities, distributed natural gas, geo-thermal power generation, ocean current power generation, smart and green power grid, new-energy automobile, and power storage technologies; and to research on new technologies with independent intellectual property rights such as the carbon capture, utilization and storage technology. The Working Program also proposed to speed up the building of national key laboratories and national engineering research centers of low-carbon technologies, to develop the guiding catalogue of low-carbon technologies, and to implement low-carbon technology industrialization demonstration projects.

In December 2011 NEA issued the *12th FYP-Period National Energy Science and Technology Plan* in which 5 major energy technologies and associated engineering and demonstration programs were designated, including nuclear power generation technology, large-scale wind power generation technology, high-efficiency large-scale PV power generation technology, large-scale multiple energy complementation power generation technology, and high-efficiency biomass utilization technology . In May 2012, MOST, together with MFA and NDRC, released the *12th FYP-Period National Plan for the Development of Special Science and Technology for Addressing Climate Change* which suggested that a number of cross-sector and cross-disciplinary viable and promising mitigation and adaptation technologies be picked out for focused support, concentrated breakthroughs and demonstration, and further proposed the Top 10 key mitigation technologies and Top 10 adaptation technologies as the priority areas. In April 2013, NDRC issued the *Notice on Promoting Carbon Capture, Utilization and Storage Test Demonstration* which proposed to initiate demonstration projects for relevant tests in consideration of the actual status of the carbon capture and storage links, to put demonstration projects and base constructions on top of the agenda, to explore and put in place suitable policies and incentive mechanisms, and to facilitate the formulation of relevant criteria and standards. NDRC released two editions of the *National Guiding Catalogue of Key Energy-Saving Low-Carbon Technologies* respectively in 2014 and 2015, covering altogether 62 low-carbon technologies (Table 4-3). MOST prepared and released the *Guiding List of the Deployment of Energy Conservation and Emission Reduction Technologies and Low-Carbon Technologies*, which covers a total of 19 technologies.

2.2 International Cooperation and Progress

People's Republic of China Second National Communication on Climate Change contains a list of technologies needed for climate change mitigation and adaptation. The mitigation needs concentrates on five sectors which are energy, iron and steel, transportation, building and general technologies, covering specific needs such as IGCC power generation, large-scale offshore wind power generation, hydrogen energy and fuel cell, smart grid and energy storage, carbon capture and storage, and high-efficiency electric vehicles. The adaptation needs concentrates on five sectors which are comprehensive observation, numerical prediction, agriculture, coastal zone protection and ecosystem.

In the 12th FYP Period, China vigorously promoted and participated in international climate technology cooperation. Within the framework of the *Convention*, China took an active part in negotiations and consultations on technological subjects and in the Technology Executive Committee (TEC) and the Climate Technology Center and Network (CTCN) Advisory Board as the representative of developing countries. In the multilateral and regional cooperation dimension, China actively participated in a number of international initiatives, including the Electric Vehicle Initiative (EVI), Carbon Sequestration Leadership Forum (CSLF), International Smart Grid Action Network (ISGAN), and International Partnership for Hydrogen and Fuel Cells in the

Economy (IPHE). In November 2015, twenty countries including China initiated "Mission Innovation" with a commitment to double their clean energy research and development investments over five years. In the bilateral cooperation dimension, China pushed forward the China-US, China-EU, China-UK, China-German and China-Korean cooperation on practical technologies in the climate change-related fields, with gratifying progress achieved in heavy-duty truck and other vehicles emission reduction, electric power system, carbon capture-utilization-storage, building and industrial energy efficiency, forest carbon sink, GHG measurement, industrial boiler energy efficiency and fuel switch, green ports and ships (Table 4-4).

Table 4-3 National Guiding Catalogue of Low-Carbon Technologies

List 1	List 2
Non-Fossil Fuel Related Technologies	
· Microholes array-based flat-plate heat-pipe solar collector technology; · Multiple energy complementation distributed energy source technology; · Solar heat pump distributed centralized heating system technology; · Solar heat utilization and building-integrated PV technology; · High-efficiency PV inverter technology; · Direct-driven permanent magnet wind turbine power generation technology; · Low-speed wind turbine power generation technology; · Biomass molding fuel intensive utilization technology; · High-efficiency biogas combined heat and power (CHP) generation technology; · Intensive crop residue collection equipment and technology; · Biomass pyrolysis charcoal, bio-oil and bio-gas cogeneration technology; · Microgrid operation and integration control key technology.	· Wind farm and PV power plant cluster control technology; · Pumping irrigation technology based on the wind-solar hybrid system of maintenance-free (MF) battery; · Biomass gasification for biogas replacement of kiln fuels technology; · Secondary combustion based high-efficiency biomass gasification technology; · Biogas production technology based on solid-state NaOH normal-temperature aqueous pretreatment; · Biogas production technology based on anaerobic treatment system free of mechanical agitation; · Biomass waste resource recycling technology based on subcritical hydrothermal synthesis; and · Industrial biomass waste resource-recycling (pyrolysis) utilization integration technology.
Fuel and Raw Material Replacement Technologies	
· Municipal waste incineration power generation technology; · Organic waste gas adsorption and recovery technology; · Organic waste anaerobic fermentation for producing vehicle gas technology; · Low-carbon shotcrete technology; · Low cement dosage rock filled concrete (RFC) technology; · Calcium carbide slag cement large-scale application technology; · Engine remanufacturing technology; · CO_2-based fully biodegradable plastics manufacturing technology; · Direct production technology of industrial fibers from recycled PET flakes;	· High-efficiency petrochemical tail gas recovery technology based on double expansion automated cryogenic separation; · High-performance silver catalyst technology applied in ethylene oxidation for production of ethylene oxide; · Controllable grouting technology for materials with time-dependent viscosity; · New drying-in-cement- kiln sludge detoxification and treatment technology; · Fully biodegradable polyhydroxyalkanoates (PHA) manufacturing technology; · Bamboo-plastic composite pressure pipe technology; · Core technology of PSF production from recycled polyester textiles; · Intelligent PH-type expansion evaporator technology;

List 1	List 2
• Bituminous concrete mixing station liquid-to-gas transformation technology; and • Retort calciner insulation transformation technology.	• Environment-friendly PAG water soluble medium quenching technology; • Traction lithium-ion battery power system development technology; • Castor-oil plant whole industry chain high-value utilization technology; and • Biological humic acid (BHA) production technology based on utilization of recycled resource from food waste.
Technologies for Reducing Emissions from Non-CO_2 Sources Including Industrial Processing	
• Low-concentration gas vacuum pressure swing adsorption condensation technology; • Whole -process PFC emission reduction technology in the production of electrolytic aluminum; • Plasma incineration for treatment HFC-23 technology; • HFC-23 high-temperature incineration decomposition (pyrolysis) technology; and • CCl4 (tetrachloromethane) sideline utilization for fluorinated monomer C3H3F3 (trifluoropropene) production technology.	• Coal bed methane (CBM) permeability increase and desorption technology; • SF_6 gas recycling and reutilization technology; • Power switching gear SF_6 replacement technology; • Extruded polystyrene (XPS) production technology using CO_2 instead of HFCs as foam agent; and • Low charge R290 air conditioner compressor technology.
Carbon Capture, Utilization and Storage Technologies	
• CO_2 capture, oil recovery and storage technology; and • CO_2 capture for sodium bicarbonate production technology.	• Low-carbon low-salt rare earth compound separation and purification free of ammonia and nitrogen pollution technology; and • Half-carbon sugar-making technology.
Carbon Sink Technologies	
• Crop residue biochar utilization technology; • Chinese fir plantation managerial technology for carbon sink increase and emission reduction; and • CO_2 emission reduction technology in the process of oil plant utilization as energy and resource.	• Small forest gap thinning and management technology for public welfare forest plantations; and • Crop residue clean pulping and waste sludge fertilizer-producing technology.

Table 4-4 Technology Cooperation under the China-US Climate Change Working Group

Sectors	Technology Cooperation	Progress
Heavy-Duty Trucks & Other Vehicles	• Raising the fuel efficiency standards for heavy-duty trucks; • Enhancing exchanges and cooperation in the fields of clean fuel and motor vehicle emission control technologies; and • Promoting efficient and clean freight.	• "Race to Zero Emission (R2ZE) and official website launched to replicate successful experience in deploying electric and other zero-emission buses; • Programme laid down for cycle tests by China-US Laboratory of Heavy-Duty Truck Engines; • Further cooperation set on track with the implement of the "China Green Freight Initiative (CGFI) for higher freight efficiency.
Electric Power System	• Improving experience sharing in the fields of smart grid and electricity consumption, demand and competition.	• Implementation of the smart grid initiative advanced; • Experiences and best practices in institutional innovation and policy actions shared to give impetus to low-carbon and sustainable development and climate change adaptability of the electric power systems.
Carbon Capture, Utilization and Storage	• Strengthening exchanges and cooperation in the fields of large-scale project demonstration, international standard setting, policy formulation and project management by organizing and hosting workshops, supporting technical expert exchanges.	• Six counterpart CCUS cooperation programmes nailed down to facilitate large-scale CCUS demonstration project development on both sides and to cut down the future technological deployment costs.
Building and Industrial Energy Efficiency	• Strengthening cooperation in Energy Management Contracting (EMC), and in selecting and promoting best practices and most energy-efficient technologies.	• China-US Energy Management Contracting pilots promoted and assessed in line with identical standards for both sides.
Climate Change and Forest	• Reinforcing technical cooperation in forestry MRV; and • Facilitating exchanges and experience-sharing with regard to the synchronization of climate	• Workshops on GHG assessment and reporting in forestry held; • Chinese experts organized on a study tour to US national GHG testing system and technical system in the US land

Sectors	Technology Cooperation	Progress
	change mitigation and adaptation effects on forestry.	territory.
Climate-Smart/Low-Carbon Cities	• Showcasing technologies and services related to climate-smart/ low-carbon city development; and • Facilitating technological exchanges.	• A session of the China-US Climate-Smart / Low-Carbon Cities Summit held in Los Angeles and Beijing respectively.
Industrial Furnace Energy Efficiency and Fuel Switch	• Sharing experiences in furnace system tracking, monitoring and standardization.	• Ningbo and Xi'an chosen as the pilot cities, with collaborative analysis and implementation roadmaps set down for solution to energy and environment challenges posed by industrial furnaces in the two cities; • Funding partners and US technology providers organized on an inspection tour to Ningbo and Xi'an and arranged to meet with local stakeholders who would like to be part of the initiative.
GHG Measurement	• Initiating important win-win metrological science and standards cooperation between China National Institute of Metrology (NIM) and US National Institute of Standards and Technology (NIST) in support of the implementation of the *US-China Joint Announcement on Climate Change* released by Presidents of the two countries on 12 November 2014, and industrial development and environmental protection to raise health and living standards on both sides.	• China and US signed the *Letter of Intent for Cooperation between the China National Institute of Metrology and the US Institute of Standards and Technology on GHG Measurement and Precision Medicine Standards* during President Xi Jinping's state visit to the US in September 2015.

2.3 List of Technologies Needed

Development and transfer of key technologies are crucial to the fulfillment of the targets set forth in China's NDC, including: enhancing R&D and industrialization demonstration of low-carbon technologies related to energy conservation and consumption reduction, renewable energy and advanced nuclear energy, and CCUS, promoting the utilization of CO_2 oil recovery and coal bed methane recovery technologies, researching on extreme weather forecast and early warning technologies; developing biological fixation of nitrogen, green prevention and control of plant diseases and insect pests, and greenhouse agriculture technologies, intensifying R&D of integrated water-saving and sea water desalination technologies, upgrading the science and technology support system for addressing climate change, building effective mechanisms for the integration of governmental, industrial, academic and research stakeholders, and improving the cultivation of climate change professionals.

Based on the technology needs set forth in the second national communication, the NDRC updated technical needed for China's responding to climate change, by leveraging on the World Bank China Climate Technology Needs Assessment Project and in reference to relevant recent strategic and action plans of China on climate change related technologies (Tables 4-5 and 4-6).

Table 4-5 List of Mitigation Technologies Needed by China

Sectors	Technologies
Energy	· Advanced coal gasification technology · Advanced low-rank coal pyrolysis technology · High-efficiency ultra super-critical coal-fired power generation technology · Super-critical CO_2 Brayton cycle power generation technology · Integrated gasification fuel cell combined cycle (IGFC-CC) power generation technology · Magnetohydrodynamic combined cycle (MHD-CC) power generation technology · High-efficiency gas turbine technology
	· Fast reactor and fuel element design and engineerization technology · Super high temperature gas cooled reactor core technology and high-temperature heat technical application technology · Advanced small reactor core technology and engineerization
	· New-generation high-efficiency solar cell industrialization core technology · High-efficiency low-cost crystalline silicon cell industrialization core technology · Thin-film solar cell industrialization core technology · High-parameter solar thermal power generation technology · Distributed solar heat-and-power co-supply system technology · Core technology of solar power for thermochemical production of clean fuels · Intelligent distributed PV and microgrid application technology · High-efficiency low-cost smart PV power plant core technology · Large-scale parabolic trough solar thermal power plant simulation and system integration technology · 50-100MW solar-thermal power plant core technology.
	· 100m and larger scale wind turbine blade design and production technology · Large-power onshore wind turbine set and component design and optimization core technology · Onshore multi-type wind farm operation optimization and maintenance technology · 10MW and larger-scale offshore wind turbine sets and core component design and production core technology · 10MW and larger-scale offshore wind turbine control system and convertor core technology · High-sea wind farm design and construction technology · Largescale offshore wind turbine set basic design and construction technology · Largescale offshore wind power base cluster control technology · Offshore wind farm real-time monitoring and maintenance technology.

Sectors	Technologies
	· Massive hydrogen production technology · Distributed hydrogen production technology · Hydrogen storage and transportation technology · Hydrogen/polymer electrolyte membrane fuel cell (PEMFC) technology · Methanol /polymer electrolyte membrane fuel cell (MFC) technology · Fuel cell distributed power generation technology.
	· Biological aviation fuel production technology · Green bio-refinery technology · Eco energy farm technology · Biomass energy development and utilization exploration technology · Wave energy utilization technology · Tidal current energy utilization technology · Temperature difference/salinity gradient energy development and utilization technology · Hot dry rock (HDR) geothermal resource development and utilization technology · Hot-water geothermal system transformation and production enhancement technology
	· Heat/cold energy storage technology · New compressed-air energy storage technology · Flywheel energy storage technology · High-temperature superconducting (HTS) energy storage technology · High-capacity supercapacitor energy storage technology · Battery energy storage technology · Advanced power transmission equipment technology · DC-grid technology · Electrical vehicle wireless charging technology · New high-capacity high voltage power electronics and system integration · High-efficiency power line carrier communication technology · Renewable energy grid integration and absorption technology · Modern complex power grid security and stability technology

Sectors	Technologies
	· New-generation large-scale low-energy consumption CO_2 capture technology · IGCC-based CO_2 capture technology · Large-capacity oxygen-enriched combustion boiler core technology · CO_2 oil recovery and storage technology · CO_2 CBM recovery and storage technology · CO_2 water recovery and storage technology · CO_2 fixation by mineral conversion and utilization technology · CO_2 mineralization fuel cell technology · CO_2 chemical conversion and utilization technology · CO_2 biological conversion and utilization technology · CO_2 safe and reliable storage, monitoring and transportation technology.
Iron & Steel	· Coking coal preheating technology · New coking technology · Coke oven raw gas waste heat recovery technology · Coking technology replacing coal with waste · Low carbon emission iron-making technology · Energy-saving electric furnace steel-making technology · High-efficiency cast-rolling technology · Low-heat value gas high-efficiency utilization for power generation technology.
Transport	· Advanced heavy-load rail transit equipment · Urban rail transit traction power supply system regenerative braking technology · Rail-vehicle DC inverter air conditioning technology · Fuel stratified injection (FSI) engine technology · Vehicle fuel cleaning and efficiency enhancement technology · Ship propulsion system based on propeller resistance reduction · Digital quayside power supply system · Asphalt pavement cold recycling technology · LED smart lighting technology · Superpower HID Lighting technology · Port optimization technology

Sectors	Technologies
Building	· Building industrialization technology · Prefabricated housing technology · Super energy-saving building technology · High-efficiency heat pump technology · Magnetic-suspension inverted-frequency centrifugal central air conditioning technology · Air conditioning system with independent temperature and moisture controls · Vent heat and refrigeration unit condensation heat recovery technology · Highly fire-proof exterior wall insulation technology · Heat-reflective coated glass technology · Low emissivity (low-E) glass technology · Building sun-shading technology
Building Materials	· Glass furnace flue gas waste heat power generation technology · Computer process control technology · Technology of No. 0 port oxy-fuel combustion-supporting system for float glass furnace · Glass furnace holistic thermal insulation technology · Batch preheating technology using glass furnace flue gas waste heat · Oxy-fuel combustion technology
Chemical Industries	· High CO_2-content natural gas for methanol production technology · Hydraulic turbine energy conservation technology · Compressor Hydro COM stepless capacity regulation system · Open-type heat pump technology · CO_2 emission-free pulverized coal pressure transmission technology · Ion exchange membrane technology
Non-Ferrous Metal	· Oxygen-enriched top-blowing smelting technology · Flash oxygen-enriched bath smelting technology · Flue gas waste heat recovery technology
Agriculture, Forestry and Land Use	· High-efficiency nitrapyrin urea utilization technology for production enhancement and emission reduction · High-yield low-emission rice variety selection and breeding technology · Agro-forest system building technology · Best forest management practice identification technology · Integrated land use management technology

Sectors	Technologies
Waste	· Waste-to-Energy with Gas Turbine (WtE-GT) combined circle power generation technology · Gas-gas heating (GGH) technology · High-efficiency landfill gas collection and utilization technology · Landfill bio-cover emission reduction technology.
Marine	· Wave energy utilization technology · Tidal current energy utilization technology · Ocean thermal and salinity energy utilization technology · Blue carbon sinks investigation and evaluation technology system · Blue carbon sinks stock volume enhancement technology system · CO_2 sea-bed storage technology
General	· High-efficiency industrial boiler (kiln) technology · New-generation energy-saving motor and electric drive system · Sophisticated industrial waste energy recovery and utilization technology · Industrial system optimized energy conservation technology

Table 4-6 List of Adaptation Technologies Needed by China

Sectors	Technologies
Agriculture	· Heat-tolerant rice seeding technology · Blast-resistant rice seeding technology · Bacterial blight-resistant rice seeding technology · Sheath blight-resistant rice seeding technology · Drought-tolerant corn seeding technology · Rust-resistant corn seeding technology · Drought-tolerant wheat seeding technology · Powdery mildew-resistant wheat seeding technology · Fusarium head blight-resistant wheat seeding technology · Insect-resistant cotton seeding technology · Water and fertilizer precision irrigation control technology · Degradable mulching technology · Under-mulch drip irrigation technology · Surface rainwater harvesting technology
Forestry	· Vegetation recovery technology for arid and semi-arid stony hillside difficult plots · Desert vegetation fast recovery technology · Arid area afforestation technology using micro-catchment water harvesting system (MCWHS) · Vegetation recovery technology for hillside fragile eco-regions · Forest fire disaster-causing mechanism and integrated prevention and control technology · Technical measures for logging operations based on the philosophy of forest health · Low-function forest reconstruction measures and countermeasures · Multi-layer forest plantation management technique · Boreal coniferous forest logging management technique · Management technique weighing forest products with forest services
Water Resources	· Solar PV water-lifting irrigation water-saving techniques · Rubber dam water supply technology · Large sprinkler irrigation technology · Drought adaptation technology · Rainwater catchment and utilization technology · Water development and integrated utilization technology for water-poor stratum · Waste water purification technology based on integrated-flow constructed wetland · Reclaimed water recycling and treatment device and technology · Mummified media filter (HF) technology for decentralized treatment of municipal waste water

Sectors	Technologies
	· Low-temperature membrane distillation technology · Membrane separation seawater or brackish water desalination technology · Optimal water resource allocation technology · Inter-basin water transfer technology · Emergency water resource deployment technology · Water ecological environment protection and rehabilitation technology · Risk management-based water resource planning technology
Urban	· Urban waterlogging prevention and control technology based on whole-process regulation of major drainage systems · Long-distance high-head large-capacity water diversion core technology · Waste water source separation based semi-centralized separate supply and discharge treatment technology · Urban energy infrastructure water-gas-heat supply integration technology · Passive super low energy consumption green building construction technology · Rooftop greening technology · Permeable pavement application technology · Large urban underground pipeline network disaster resistance optimization technology · Climate adaptation-based urban infrastructure design and construction standards upgrading and support technology · Urban infrastructure operation risk simulation early warning and integrated disaster prevention restructuring technology · Urban transport infrastructure smart monitoring and maintenance technology · Underground pipeline cavity and defect fast detection, risk evaluation and green rehabilitation technology · Urban climate change adaptation planning system building technology · Urban green space distribution optimization technology · Public transit infrastructure optimal distribution and smart operation technology
Disaster Prevention and Reduction	· Energy supply strategic planning and integrated environment impact model · Regional numerical weather prediction technology · Environment-related numerical weather modeling technology · Automatic weather station (AWS) technology · Radio sounding technology · Lightening detection technology · Weather radar monitoring technology · Meteorological satellite remote sensing technology · High-performance computer technology · Meteorological observation data quality control technology · Meteorological data reanalysis technology · Meteorological satellite data assimilation technology

Sectors	Technologies
	· Global numerical weather prediction technology · Catastrophic weather forecast technology · Global and regional weather system model technology · Climate and climate change integrated impact evaluation technology · Extreme flood and drought hazard early identification and warning technology · Climate change-extreme flood impact model technology · Flood prevention and mitigation adaptation technology · Marine eco-system climate change vulnerability and adaptation technology · Climate change-coastal eco-social development impact evaluation technology · Coastal zone climate change adaptation technology and measures

Chapter 3 Capacity Building Needs for Addressing Climate Change

3.1 Domestic Policies and Actions

The *Working Program for Controlling Greenhouse Gas Emissions in the 12th FYP Period* released in 2011 proposed to improve the policy system and institutional mechanism for addressing climate change and to gradually establish a GHG emission statistical accounting system. In September 2014, the State Council released the *National Plan on Climate Change 2014-2020*, explicitly requiring that important headways be made with regard to capacity building; that climate law system be put in place; that marked progress be made in basic theoretical studies, technology R&D, demonstration and deployment; that regional climate change see obvious improvement in scientific research observation and impact assessment; that climate change-related MRV system be gradually improved; that professional team grow in size; that public awareness of climate change be increased; and that the climate change management and policy systems become sounder.

In the 12th FYP Period, the Chinese government leveraged on domestic resources to intensify efforts in raising its climate change coping capacity, pushing forward law and policy making, enhancing top-level low-carbon development design, improving management system and work mechanism, strengthening low-carbon technology R&D and application, upgrading the statistical accounting system, and increasing fundamental readiness against climate change. In relation to law-making, China moved forward steadily with climate change legislation: NDRC, along with relevant departments, drafted the *Climate Change Law (Draft)* and circulated it among local governments, enterprises and NGOs for feedbacks in 2015; NDRC promulgated the *Interim Measures for Managing Carbon Emissions Trading* in 2014, based on research and verification of which the *Regulations on the Management of Carbon Emissions Trading (Draft for Approval)* was submitted to the Legal Affairs Office of the State Council. In relation to the management system, due to structural setup and personnel changes of the State Council and based on actual needs, the General Office of the State Council made some adjustments to the National Leading Group on Climate Change and further nailed down the management system and operational mechanism for NDRC to take the supervising responsibility and other departments and localities to take shared responsibilities in their respective fields, with the general public actively involved in responding to climate change. In relation to statistical accounting, NDRC, together with NBS, released the *Opinions for Strengthening Climate Change Statistics* in 2013 to further enhance capacity building in the field of climate change statistics.

3.2 International Cooperation and Progress

International cooperation was taken as a priority area in China's efforts to enhance its climate change coping capacity. Under the GHG data management cooperation initiative of the US-China Climate Change Working Group, the two countries conducted a series of cooperation and exchange activities related to enterprise GHG accounting and reporting to increase the transparency of GHG emission data. With the joint support from Norwegian government and the UNDP, China initiated researches on accounting methodologies for enterprises in six key industries and training programs covering all industries, and sent representatives to Sweden to attend the EU Small-Emitter GHG MRV Symposium. Australian government supported relevant organizations in China to conduct researches on GHG accounting methodologies and reporting formats for enterprises of the system engineering of petroleum and petroleum refining, coal production and coking industries. The World Bank and the EU supported a series of researches on and preparatory work for the carbon emission trading market mechanism in China.

3.3 List of Capacity Building Needs

Helping developing countries to raise their climate change coping capacity is one of the major means for developed countries to undertake their historical responsibilities, and is an important part of what enhancing *Convention* implementation. Since the publication of the *Second National Communication*, China has been relying on its limited domestic and international resources to strengthen climate change coping capacity building, and has achieved some positive results regarding GHG inventory preparation, accounting and verification, adaptation to climate change, and local decision-making. In recent years, China successively released a number of plans, including th*e National Strategy for Adaptation to Climate Change*, the *National Plan on Climate Change 2014-2020* and the NDC to make overall arrangements for related work over the next period of time and to set forth requirements for enhancing overall climate change coping capacity. Based on the capacity building needs spread out in the *Second National Communication*, the list of capacity building needs has been updated by NDRC as follows (Table 4-7).

Table 4-7 A List of Capacity Building Needs in China

Sector	Capacity Building Needs
GHG Inventory Preparation	· Furthering international exchanges on the preparation of GHG inventory, covering activity data collection, emission factor monitoring and testing, precise disaggregation of the domestic and international fuel consumption by airlines and by marine navigators, methodologies related to the estimation of emissions from non-fossil fuel sources, etc.; · Sharing experiences in database construction for GHG inventory preparation; · Strengthening exchanges on guidelines for preparing local GHG inventories.
GHG Statistical Accounting System	· Sharing updates on the basic statistical system required in the GHG emission accounting; · Exchanging international experiences related to GHG emission data reporting platform.
Adaptation to Climate Change	· Employing advanced international experience to enhance local capacity for developing local adaptation strategies and plans; · Improving international cooperation in the fields of high-efficiency water irrigation, water resource allocation, and integrated coastal zone management and conservation; · Enhancing climate change adaptation management of the cities; · Enhancing international cooperation on integrated climate change assessment and risk management, climate change monitoring and early-warning system, emergency response mechanism for extreme weather and climate events, and emergency management system building for prevention and control of disasters; · Promoting international exchanges in the fields of blue carbon sinks, marine GHG monitoring system building as well as sea level rise predication, impact investigation, overall evaluation and adaptation technologies.
Local Government Leadership on Climate Change Issues	· Intensifying trainings for decision makers and officials at various levels through international cooperation to raise stakeholder awareness of the great relevance of low-carbon development; · Learning from advanced international experiences to enhance guidance over local carbon emission data collection, processing and decision-making for stronger local low-carbon development planning capacity.
Carbon Emission Trading	· Strengthening cooperation and exchanges with carbon emission rights trading areas to benefit from advanced international experiences in the institutional design dimensions of quota allocation, accounting and verification, trading rules, incentives

Sector	Capacity Building Needs
System	and punishments, monitoring and supervising systems; · Accelerating cultivation of professionals for carbon emission trading through international cooperation; · Exploring into the possibilities of linking the carbon emission trading markets in China and in other countries as well as the cooperation mechanisms for bilateral and multilateral carbon emission trading activities through international exchanges.
Education, Training and Talent Cultivation	· Educating and training government officials, enterprise managers, media professionals about climate change to raise their awareness and handling capacity; · Encouraging scientists and researchers to participate in international research programmes and reinforcing team building among media professionals as well as strategy and policy making experts through international cooperation.

Part V Information on Domestic MRV

Domestic MRV capacity building is crucial to how effectively developing countries can address climate change. As a responsible developing country, China attaches great importance to fundamental capacity building: In November 2009, the State Council Executive Meeting decided to incorporate carbon intensity reduction target into the medium and long-term national economic and social development plan as a binding target, for which national statistical, monitoring and assessment methodologies were to be developed accordingly. In the 12^{th} FYP Period, continued efforts and progress have been made to establish the climate change statistical indicator and basic statistics system, the GHG emission accounting and reporting system, and the CO_2 emission control target performance evaluation and accounting system.

Chapter 1 Overview

It was pointed out in texts covering Needs for Finance, Technologies and Capacity Building in the *Second National Communication* that establishment and improvement of China's statistical and accounting systems for GHG emissions can improve authoritativeness and transparency of its national GHG inventory, and improve the standardization and normalization of national GHG inventory preparation. In this regard, the *12^{th} Five-Year Plan for National Economic and Social Development of P. R. China* explicitly required that statistical and accounting systems for GHG emissions be established and improved to strengthen climate change statistics-related work.

The Chinese government and relevant departments promulgated a series of policy documents (Table 5-1) to enhance institutional arrangements and improve corresponding operational mechanisms. In November 2011, the State Council issued the *Working Program for Controlling Greenhouse Gas Emissions in the 12^{th} FYP Period*. It requires to set up GHG emission-related basic statistics and accounting systems at the national, local and enterprise levels. It also requires to strengthen evaluation of the provincial (autonomous region, municipality) fulfillment of the CO_2 emission intensity reduction targets of the 12^{th} FYP Period. In May 2013, approved by the State Council, NDRC along with NBS formulated the *Opinions on Strengthening Climate Change Statistics*. It clearly required various provinces and departments to fully acknowledge the importance of climate change statistics, strengthen management and leadership, improve institutional arrangements, scale up financial resources and reinforce capacity building. In November 2013, NBS together with NDRC issued the *Notice on Launching Climate Change Statistical Operations* and formulated the *Regulations on Statistical and Reporting Operations of Departments Involved in Addressing Climate Change (Trial)*. In January 2014, NBS issued the *Notice on Work Scheme for Statistical Operations Related to Addressing Climate Change* and developed the *Climate Change Statistical Data Sheet for Integrated Government Statistics System*. In 2014, NDRC issued successively the *Notice on the Preparation of GHG Emission Reports of Key Enterprises (public entities)*, the *Measures of Accountability Assessment with Regard to Fulfillment of* CO_2 *Emissions per Unit of GDP Control Targets*, etc. SFA prepared and implemented the *Overall Plan for the Establishment of National Forestry Carbon Sink Measurement and Monitoring System* and other technological codes of practice.

Under the joint efforts of related departments, significant progress has been made in the 12th FYP Period in the systems design, institutional arrangements and operational mechanisms for basic statistical, accounting and reporting, evaluation and assessment for addressing climate change and controlling GHG emissions (Table 5-2). The establishment of the three systems has laid a solid foundation for the establishment of a fair and just international MRV system and for opening up new stages for China's response to climate change.

Table 5-1 List of China's Climate Change-Related MRV Policy Documents

Issued in	Issued by	Document Name
Mar. 2011	General Office of NDRC	*Notice on Releasing the Guidelines for Preparation of Provincial GHG Inventory (Trial)*
Jun. 2012	NDRC	*Interim Measures for Managing Voluntary GHG Emission Reduction Trading*
May 2013	NDRC; NBS	*Opinions on Strengthening Climate Change Statistics*
Oct. 2013	General Office of NDRC	*Notice on Issuing GHG Emission Accounting Methods and Reporting Guidelines for Enterprises of the First Ten Industries Involved (Trial)*
Nov. 2013	NBS; NDRC	*Notice on Launching Climate Change Statistical Operations*
Jan. 2014	NBS	*Work Scheme for Statistical Operations Related to Addressing Climate Change*
Jan. 2014	NDRC	*Notice on the Preparation of GHG Emission Reports of Key Enterprises (Institutions)*
Aug. 2014	NDRC	*Measures of Accountability Assessment with Regard to Fulfillment of the CO_2 Emission per Unit of GDP Control Targets*
Dec. 2014	General Office of NDRC	*Notice on Issuing GHG Emission Accounting Methods and Reporting Guidelines for Enterprises of the Second Four Industries Involved (Trial)*
Jan. 2015	General Office of NDRC	*Notice on Launching Provincial GHG Inventory Preparation for the Next Stage*
Jul. 2015	General Office of NDRC	*Notice on Issuing GHG Emission Accounting Methods and Reporting Guidelines for Enterprises of the Third Ten Industries Involved (Trial)*

Table 5-2 A Snapshot of China's Climate Change-Related MRV System

	National	Local	Enterprise
Basic Statistics	GHG emission statistical system and sector-specific parameter survey system	GHG emission basic statistical system	Energy consumption and GHG emission accounting system
	Climate change statistical indicator system and sectoral statistical reporting system	Climate change statistical indicator system and statistical reporting system	GHG emission monitoring plan
	Working mechanism such as establishing the leading group on climate change statistics	Working mechanism with regard to job specification, accountability , etc.	
Reporting and Verification	Preparation and reporting of the GHG inventories on regular basis; and CO_2 emission accounting on yearly basis.	Preparation and reporting of the GHG inventories on regular basis	GHG emission reporting on yearly basis for key enterprises
	Data management system for GHG Inventories	Guidelines on the preparation of the GHG Inventories	Guidelines on GHG emission accounting and reporting for key enterprises
	Direct reporting platform for key enterprises	On-line reporting system for key enterprises	
Assessment and Verification	Assessment on fulfillment of the yearly and overall carbon intensity reduction targets	Provincial GHG Inventory Data Quality Assessment and Review system	GHG emission verification for key enterprises; verification on and certification of voluntary GHG emission reductions
	Measures of accountability assessment with regard to the fulfillment of the CO_2 emission per unit of GDP reduction targets	The measure of accountability assessment with regard to the prefectural governments' fulfillment of the carbon intensity reduction targets	
	Indicator system for the accountability assessment with regard to the fulfillment of the CO_2 emission per unit of GDP reduction targets		

Chapter 2 Statistical Indicators and Basic Statistical System

Through the establishment of a climate change statistical indicator system and a basic statistical and survey system for GHG emissions from sectors including energy , industrial processes, agriculture, land-use change and forestry, and waste, China's sectoral and local statistical and reporting system for climate change was initially formed. The statistical capacity to address climate change has been gradually improved.

2.1 Basic Statistical System for GHG Emission

To support GHG inventory preparation, NBS incorporated the basic statistical indicators for GHG emission accounting into the overall government statistical indicator system. First, the energy statistical system was updated by using more detailed energy categories as the statistical indicators as illustrated by coal being substituted by bituminous coal, anthracite, lignite, and others. Energy balance sheet has been modified and improved. The energy statistical system for industry, service and public institutions has been updated or modified. Transport enterprise energy consumption was monitored on pilot basis. Second, a statistical and survey system was preliminary put in place for activity data and parameters relevant to GHG emissions in industry, agriculture, land-use change and forestry, and waste.

2.2 Statistical Indicator System for Addressing Climate Change

To enhance climate change statistics using indicators scientifically reflecting climate change characteristics and the actual status of climate change responses and to present a full picture of China's efforts and achievements in coping with climate change, a climate change statistical indicator system was set forth for the first time in the *Opinions on Strengthening Climate Change Statistics* jointly issued by NDRC and NBS, consisting of 5 categories, namely, Climate Change and Impacts, Adaptation to Climate Change, GHGs Emission Control, Financial Inputs for Addressing Climate Change, Relevant Management on Climate Change Actions, 19 sub-categories and 36 specific indicators (Table 5-3). On the above basis, a climate change statistical and reporting system was established at the same time.

2.3 Statistical Mechanism for Addressing Climate Change

In 2014, NBS, together with NDRC and other relevant departments, set up a 23-member Leading Group on Climate Change Statistics. The operational mechanism is to put the government statistical authority at the core with collaboration and coordination from member departments. Since 2014, NBS issued a number of documents including the *Climate Change Statistical Indicator System*, *Regulations on Statistical and Reporting Operations of Departments Involved in Addressing Climate Change (Trial)* and the *Climate Change Statistical Data Sheet for Integrated Government Statistics System*. It also launched climate change statistical practice pilots in 15 provinces (autonomous regions, municipalities), through which the capacity of the statistical team was significantly enhanced.

Box 5-1 Regulations on Statistical and Reporting Operations of Departments Involved in Addressing Climate Change (Trial)

1. This regulation was formulated in reference to the *Opinions on Strengthening Climate Change Statistics* promulgated by the National Development and Reform Commission and the National Bureau of Statistics (NBS) pursuant to the *Statistics Law of the People's Republic of China* with the aim of enhancing climate change statistics and providing the statistical basis for the preparation of the National GHG Inventory and emissions accounting.

2. This regulation constitutes part of the national statistical and reporting system and contains comprehensive requirements of NBS for relevant departments (associations) under the State Council. Organized implementation and data submission by these departments (associations) are required in compliance with the prescribed national accounting methods and statistical version, scope and catalogue.

3. "Climate change statistics" contained in this regulation refer to the climate change statistical indicators and the activity data indicators under the five sectors of energy activities, industrial process, agriculture, land-use change and forestry, and waste.

4. This regulation relates to the annual synthesis report to be submitted by relevant departments (associations) under the State Council to NBS within the prescribed time frame. Survey reports are to be submitted once every five years. Survey years are to be fixed according to the need for the inventory preparation; survey methods are up to the decision of the initiating department at its discretion. No submission is required other than the year next to the survey year.

Source: NBS, 5 January 2015

Table 5-3 China's Climate Change Statistical Indicator System

Category	Sub-category	Indicator	Data Source
I. Climate Change and Impacts	1.GHG Concentration	(1) CO_2 Concentration	CMA
	2.Climate Change	(2) Annual average temperature of the provinces (autonomous regions, municipalities) (3) Annual average rainfall of the provinces (autonomous regions, municipalities) (4) Changes in sea level of all coastal provinces in China	CMA CMA SOA
	3.Climate Change Impacts	(5) Cropland area affected by floods and droughts (6) Direct economic loss incurred by meteorological disasters	National Commission for Disaster Reduction (NCDR), MCA, MOA, MWR NCDR, MCA, CMA
II. Adaptation to Climate Change	1. Agriculture	(1) Area of conservation tillage (2) Increase in grassland improvement area	MOA MOA
	2. Forestry	(3) Increase in area of desertification control	SFA
	3. Water Resources	(4) Irrigation water efficiency coefficient (5) Area of water-saving irrigation	MWR MWR
	4. Coastal Areas	(6) Area of offshore and coastal wetlands	SOA
III. GHG Emission Control	1. Overall	(1) Reduction rate of CO_2 emissions per unit of GDP	NDRC
	2. GHG Emissions	(2) Total GHG emissions (3) GHG emissions by sectors (emissions of 6 GHGs in 5 sectors)	NDRC, NBS NDRC, NBS, MIIT, MEP, MOA
	3. Industrial Restructuring	(4) Contribution of the added value of tertiary industry to GDP (5) Contribution of the added value of strategic emerging industries to GDP	NBS NBS
	4. Energy Conservation and Higher Efficiency	(6) Reduction rate of energy consumption per unit of GDP (7) Reduction rate of energy consumption per unit of added value of industries above designated size (8) Reduction rate of energy consumption per unit of building area	NBS NBS MoHURD
	5. Development of Non-Fossil Fuels	(9) Share of non-fossil fuels in total energy consumption	NBS, NEA

Category	Sub-category	Indicator	Data Source
	6. Increase of Forest Carbon Sink	(10) Forest coverage rate (11) Forest stock volume (12) Increased forest area	SFA SFA SFA
	7. Control of GHG Emissions from Industry, Agriculture and Other Sectors	(13) Replacement rate for wastes in the cement ingredient raw materials (14) Scrap charging ratio (15) Area of soil test and fertilizer formula (16) Annual biogas output	MIIT MIIT MOA MOA
IV. Financial Inputs for Addressing Climate Change	1. Science and Technology (S&T)	(1) Inputs for climate change related S&T	MOF, MOST
	2. Adaptation	(2) Inputs for flood control projects of major river	MWR, MOF
	3. Mitigation	(3) Energy conservation inputs (4) Non-fossil fuel development inputs (5) Inputs to increase forest carbon sink	NDRC, MOF NEA, MOF SFA, MOF
	4. Others	(6) MRV and capacity building inputs	NDRC, MOF
V. Relevant Management on Climate Change	1. Measuring, Standards and Certification	(1) Number of carbon emission standards (2) Number of certified low-carbon products	AQSIQ, NDRC, MIIT AQSIQ, NDRC, MIIT, MEP

Chapter 3 GHG Emission Accounting and Reporting System

The practices of preparing the national and provincial GHG inventories on regular basis, accounting the CO_2 emission control targets and filing analysis reports on yearly basis, formulating the guidelines for local GHG inventories preparation and key enterprise GHG emissions accounting, and establishing the national direct reporting platform for GHG emissions from key enterprises and local online reporting system have brought into shape a 3-level (national, provincial and enterprise-level) GHG emission accounting and reporting system.

3.1 Preparation of the National GHG Inventory and CO_2 Emission Accounting System

The national GHG Inventory System has been initially established. Under NDRC supervision, the preparation team comprises of the NCSC, Tsinghua University, CAS, CAAS, CAF and CRAES. The 2010 and 2012 inventories are being prepared by the above team. The National GHG Inventory Data Management System is under construction to offer necessary technical support to normalizing and standardizing the inventory preparation.

To better monitor and analyze the annual CO_2 emission accounting and progress in fulfillment of the carbon intensity target to ensure that the binding target of reducing national carbon emission intensity by 17% be achieved in the 12th FYP period, China has basically established a working mechanism for estimating the annual CO_2 emissions from energy activities and for accounting carbon intensity, putting the task in the care of the NCSC and others, and under the supervision of the NDRC. The carbon intensity accounting and related analysis were no longer conducted on yearly basis but on half-year and then quarterly basis from 2013 on. This adjustment was made in hope of having prompt information of the CO_2 emissions and policy effects to facilitate prejudgment over the trends and progresses in short terms.

3.2 Local GHG Inventory Guidelines and Preparation

In March 2011, NDRC issued the *Notice on Promulgating Guidelines (Trial) on the*

Preparation of Provincial GHG Inventories. The *Guidelines* pointed to major steps in preparing the provincial inventories, including: defining emission sources and removal sinks; selecting estimation methodologies to be used; collecting activity data and data related to emission factors; calculating emissions and removals; conducting QA and QC; making uncertainty assessments; and reporting results. The *Guidelines* ensured sound scientific bases for the provincial inventory preparation, and provided a code of practice to guarantee the operability and step-by-step guidance to make inventories with good methodologies, transparent data, format uniformity and comparable results. Beijing Municipal Development and Reform Commission had a localized version of the *Guidelines*.

Trainings, instructions and exchanges were provided for experts involved in inventory preparation at different levels. The result was that all provinces (autonomous regions, municipalities) and Xinjiang Production and Construction Corps compiled 2005 and 2010 inventories and submitted to NDRC by the end of 2014. In January 2015, NDRC General Office issued the *Notice on Launching Provincial GHG Inventory Preparation for the Next Stage*. It requires the 2012 and 2014 provincial inventories to be prepared at the provincial level. According to rough statistics, around 150 cities have their inventories ready up to now. At the local level, accountability assessment with regard to the provincial governments' fulfillment of the CO_2 emission per unit of local GDP reduction targets has been taken as an opportunity to enhance assessment, tracking and analysis of the local emission intensity targets.

3.3 GHG Emission Accounting and Reporting of Enterprises in Key Industries

NDRC initiated researches on the GHG emission accounting methodologies and reporting guidelines for enterprises in key industries including chemical industry, iron and steel, power generation, cement, and etc. Guidelines have been released for 23 key industrial sectors and 1 non-industrial sector in three groups since October 2013 (Table 5-4). The NDRC organized trainings on capacity building for 31 provincial (autonomous region, municipality) branches and technical support agencies. Based on the guidelines, the General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) and the Standardization Administration issued 11 national standards including the *General Provisions on the Accounting and Reporting of the GHG Emissions by Industrial Enterprises* in November 2015. The seven carbon emission trading pilots, i.e., Beijing, Shanghai, Tianjin, Chongqing, Guangdong, Shenzhen and Hubei, took the lead in having the GHG emission accounting methods developed for local enterprises in key industries involved in carbon emission trading and fulfilled annual reports.

NDRC issued the *Notice on the Preparation of GHG Emission Reports of Key Enterprises (public entities)*, making it clear that legal person enterprises (*public entities*) or independent accounting entities whose GHG emissions in 2010 reached 13,000 tons CO_2 eq or whose total energy consumption reached 5,000 tce were required to file reports in accordance with the guidelines promulgated by the national authority on GHG emission accounting and reporting for key enterprises. NDRC also initiated researches on and development of key enterprise GHG emission data direct reporting system, which integrate such functions as GHG emission accounting, reporting, monitoring, verification and publication.

Chapter 4 GHG Emission Control Target-Based Performance and Assessment

Efforts were made to update the provincial government carbon intensity target accountability assessment system, to gradually establish the provincial GHG inventory quality assessment system and the system of GHG emission verification on enterprises in key industries. The target-oriented, vertical co-mobilization and clear-cut responsibilities mechanism was strengthened to improve the quality of the provincial and enterprise-specific emission data.

4.1 Assessment of Provincial Government's Carbon Intensity Target-Based Accountability

In 2013, NDRC together with relevant departments, formulated the *Implementation Programme for the CO_2 Emission per Unit of GDP Control Target Assessment System in the 12th FYP Period*. Proposed in this document was an accountability assessment system consisting of 12 basic indicators plus one bonus indicator of the provincial governments' fulfillment of the GHG emission control targets. They are used to check upon target fulfillment, task and measure implementation, fundamental work and capacity building, and institutional innovations (Table 5-5). In 2014, NDRC released the *Measures of Accountability Assessment with Regard to Fulfillment of the CO_2 Emission per Unit of GDP Control Targets*. In accordance with the above documents, NDRC invited relevant departments and experts for yearly accountability assessments on 31 provincial (autonomous, municipality) governments in terms of their fulfillment of the CO_2 emission per unit of GDP control targets. In October 2015, the assessment results were announced: 19 provincial governments, including Beijing, Hebei, Jiangsu were accredited as excellent performers.

Table 5-4 List of Publicized Guidelines on the GHG Emission Accounting and Reporting for Enterprises in Key Industries

No.	Name	Time
1	*Guidelines on the GHG Emission Accounting and Reporting for Chinese Power Generation Enterprises (Trial)*	Oct. 2013
2	*Guidelines on the GHG Emission Accounting and Reporting for Chinese Power Grid Enterprises (Trial)*	Oct. 2013
3	*Guidelines on the GHG Emission Accounting and Reporting for Chinese Iron and Steel Enterprises (Trial)*	Oct. 2013
4	*Guidelines on the GHG Emission Accounting and Reporting for Chinese Chemical Enterprises (Trial)*	Oct. 2013
5	*Guidelines on the GHG Emission Accounting and Reporting for Chinese Electrolytic Aluminum Enterprises (Trial)*	Oct. 2013
6	*Guidelines on the GHG Emission Accounting and Reporting for Chinese Magnesium Smelting Enterprises (Trial)*	Oct. 2013
7	*Guidelines on the GHG Emission Accounting and Reporting for Chinese Plate Glass Enterprises (Trial)*	Oct. 2013
8	*Guidelines on the GHG Emission Accounting and Reporting for Chinese Cement Enterprises (Trial)*	Oct. 2013
9	*Guidelines on the GHG Emission Accounting and Reporting for Chinese Ceramics Enterprises (Trial)*	Oct. 2013
10	*Guidelines on the GHG Emission Accounting and Reporting for Chinese Civil Aviation Enterprises (Trial)*	Oct. 2013
11	*Guidelines on the GHG Emission Accounting and Reporting for Chinese Oil and Natural Gas Production Enterprises (Trial)*	Dec. 2014
12	*Guidelines on the GHG Emission Accounting and Reporting for Chinese Petrochemical Enterprises (Trial)*	Dec. 2014
13	*Guidelines on the GHG Emission Accounting and Reporting for Chinese Independent Coking Enterprises (Trial)*	Dec. 2014
14	*Guidelines on the GHG Emission Accounting and Reporting for Chinese Coal Production Enterprises (Trial)*	Dec. 2014
15	*Guidelines on the GHG Emission Accounting and Reporting for Paper-Making and Paper Product Enterprises (Trial)*	Jul. 2015
16	*Guidelines on the GHG Emission Accounting and Reporting for Enterprises in the Nonferrous Metallurgy, Rolling and Processing Industry (Trial)*	Jul. 2015
17	*Guidelines on the GHG Emission Accounting and Reporting for Electronic Device Manufacturing Enterprises (Trial)*	Jul. 2015
18	*Guidelines on the GHG Emission Accounting and Reporting for Machinery Manufacturing Enterprises (Trial)*	Jul. 2015
19	*Guidelines on the GHG Emission Accounting and Reporting for Mining Enterprises (Trial)*	Jul. 2015
20	*Guidelines on the GHG Emission Accounting and Reporting for Food, Tabaco, Liquor, Beverage and Refined Tea Enterprises (Trial)*	Jul. 2015
21	*Guidelines on the GHG Emission Accounting and Reporting for Public Building Operation Units (Enterprises) (Trial)*	Jul. 2015
22	*Guidelines on the GHG Emission Accounting and Reporting for Land Transport Enterprises (Trial)*	Jul. 2015
23	*Guidelines on the GHG Emission Accounting and Reporting for Fluorine Chemical Industrial Enterprises (Trial)*	Jul. 2015
24	*Guidelines on the GHG Emission Accounting and Reporting for Other Industrial Enterprises (Trial)*	Jul. 2015

4.2 Assessment and Joint Review of Provincial GHG Inventory Quality

To enhance the quality of the provincial GHG inventories and to guarantee comparability of the results, NDRC engaged relevant organizations in the design of a common reporting format (CRF) table to be used in the reporting of the provincial GHG inventories and a data quality and result comparability cross-checking system consisting of 42 indicators. The cross-checking panel is made up of experts from national and local organizations involved in inventory preparation and third-party experts. This practice greatly enhanced provincial inventory quality and inventory preparation capacity.

4.3 GHG Emission Verification for Key Enterprises and Certification for Voluntary Emission Reduction Projects

The *Notice on the Preparation of GHG Emission Reports of Key Enterprises (public entities)* issued by NDRC made it clear that provincial governing authority should assess and check upon the enterprise GHG emission reports by sampling and other means including the engagement of third-party institutions in the verification of the data contained in the reports. In its *Interim Measures for Managing Carbon Emissions Trading* issued in December 2014, NDRC further clarified that the State Council carbon emission governing authority together with relevant departments shall supervise validation and verification institutions who should follow the validation and verification guidelines released by the State Council governing authority. All emission trading pilots further developed their own validation and verification guidelines or regulations better suited to local conditions. To validate and verify the voluntary emission reduction projects, NDRC issued the *Guidelines for Validation and Verification of Voluntary GHG Emission Reduction Projects* which contained the documentation requirements on as well as working procedures and reporting formats for the validation and verification institutions of voluntary emission reduction projects. By the end of 2015, altogether 141 such projects have been documented and certified, with certified emissions reductions totaling more than 37.5 Mt CO_2 eq.

Table 5-5 Indicators for the Accountability Assessments on Provincial Governments with Regard to Their Fulfillment of the CO_2 Emission per Unit of GDP Reduction Targets

Assessment Items	**Assessment Indicators**	**Scoring**	**Scoring Bases**
I. Target Fulfillment (50 points)	1. CO_2 emission per unit of local GDP reduction target	25	Annual plan targets; fulfillment of the verified local annual reduction target
	2. Accumulated CO_2 emission per unit of local GDP reduction target in the 12th FYP period	25	Accumulated reduction target to be met in the current year; verified accomplished accumulated reduction target
II. Tasks & Measures (24 points)	3. Progress with the task of industrial restructuring	4	Results of the assessment made by governing authority in the same period; or changes in the GDP contribution of the tertiary industry added value against the previous year.
	4. Progress with the task of energy conservation and energy efficiency improvement	4	Results of the assessment made by governing authority in the same period
	5. Progress with the task of energy mix adjustment	4	Results of the assessment made by governing authority in the same period; or changes in the share of hydro, nuclear, wind and solar power in total energy consumption against the previous year or of coal in total energy consumption
	6. Progress with the task of increasing forest carbon sink	4	Results of the assessment made by governing authority in the same period; or up-to-standard afforestation/tending area increased for the year
	7. Progress with the task of low-carbon pilot and demonstration project development	8	Official documents; on-site verification
III. Fundamental Works & Capacity Building (26 points)	8. Target disaggregation and assessment by municipals or by industrial sectors	4	Official documents; on-site verification
	9. GHG emission statistical accounting system building and inventory preparation	6	Official documents; on-site verification
	10. Performance of the low-carbon product standards, labeling and certification system	4	Official documents; on-site verification
	11. Financial Support	6	Official documents; on-site verification
	12. Overall management and public participation	6	Official documents; on-site verification
IV. Others * (6 points)	Institutional innovation	6	Official documents; on-site verification
Sub-Total		100	

* Scores under this caption are for reference only, not to be taken into the total score, but to be used as a mere reflection of the local situations to be considered for general impression.

Part VI Other Information

As provided in the *Outline of the 12th Five-Year Plan for National Economic and Social Development,* China placed an equal emphasis on climate change mitigation and adaptation, strengthened research, observation and impact assessment, enhanced international exchanges and policy dialogues, and improved the ability to cope with climate change. The *China National Plan on Climate Change (2014-2020)* further highlighted a number of priority tasks, including stronger support from science and technology, better education, training and media guidance, enhanced cooperation with international organizations and developed countries, and deeper South-South cooperation.

Chapter 1 Climate System Observation

1.1 Atmospheric Observation

A well distributed comprehensive climate observing system has taken shape in China, which integrates ground-based and remote monitoring observation stations including over 2,000 national surface meteorological stations. During the 12th FYP period, China set up more than 4,000 new regional automatic weather stations, which covered 96% of townships, as well as realized operational application of both polar-orbiting and geostationary meteorological satellite constellations. China selected 18 areas with representative land surface features out of 16 key climatic regions to measure essential climate variables and supplementary variables (Table 6-1). It also expanded and improved the atmospheric composition observing system, which consisted of the global atmospheric watch (GAW) stations, regional atmospheric background observation stations, atmospheric composition observation stations, dust storm observation stations, acid rain measurement stations, and environmental meteorological stations. Online observations are made available for the concentration of major GHGs (CO_2, CH_4, N_2O, SF_6, etc.) at Mount Waliguan (Qinghai), Shangdianzi (Beijing), Lin'an (Zhejiang), Longfengshan (Heilongjiang), and Xianggelila (Yunnan) atmospheric background stations, and for the concentration of Halogenated GHGs (HFCs, PFCs, etc.) at Shangdianzi (Beijing) atmospheric background station. The bottle/can sampling & analysis as well as online observations for GHGs are also made available in 7 key areas, including major part of the Qinghai-Tibet Plateau, Beijing-Tianjin-Hebei Economic Circle, Yangtze River Delta Economic Circle, Northeast Plain, Yunnan-Guizhou Plateau and Southwest China Economic Zone, Northern Xinjiang Economic Zone, and Jianghan Plain and Lake Dongting Plain along the middle reaches of Yangtze River. The *China Bulletin on Climate Change Monitoring* and the *China Bulletin on Greenhouse Gases* have been publishing annually since 2011 and since 2012 respectively.

1.2 Marine and Ecological Observation

During the 12th FYP period, the capacity of marine observation in China has been further elevated. At the end of 2015, the number of marine observing sites stood at 124, an increase of 17% compared with the end of 11th FYP, while the number of buoys of all types reached 57, an increase of 63% (Table 6-2). *China Bulletin on Sea Level Changes* is published every year in order to outline the sea level rise and its impact on coastal areas in China. In 2012, the *Special Report on the Impact Assessment of Sea Level Rise* was prepared, which provided projections and risk assessments on the sea level rise by 2020, 2050 and 2100 respectively. The monitoring system of CO_2 flux at offshore sea-air interface has been gradually established. More than 20 ship-based voyage monitoring sections have been outlined, and 6 shore/island based stations and 5 buoys are under construction. The ecological restoration of island coastlines and ocean continued to be strengthened. 21 marine ecological monitoring zones were designated, and pilot monitoring for marine areas ecologically sensitive to climate change was carried out. Five scientific expeditions over the Antarctic and two over the Arctic Ocean were organized. In 2015, 34 voyage oceanic surveys were organized, through which a large amount of basic data used to understand polar and global climate change were collected.

Table 6-1 Development of Comprehensive Meteorological Observing Facilities During the 12th FYP Period

No.	Stations (facilities)		Numbers		Change in Numbers
			Year 2010	Year 2015	
1	National reference surface meteorological stations		143	212	69
2	National unmanned automatic weather stations		346	463	117
3	Regional automatic weather stations		30347	55680	25333
4	New-generation weather radars		130	181	51
5	Agrometeorological stations		653	653	0
6	Automatic soil moisture observation stations		1210	2075	865
7	Wind energy measurement stations		400	345	-55
8	Solar radiation observation stations		100	100	0
9	GAW stations		7	7	0
10	Dust storm observation stations		29	29	0
11	Wind profile radar		24	69	45
12	GNSS/MET observing stations (including China Continental Tectonics Environmental Monitoring Network)		433	950	517
13	Meteorological satellites	FY-2	3	4	1
14		FY-3	2	3	1

Table 6-2 Development of Marine Observing Facilities During the 12th FYP Period

No.	Stations (facilities)	Numbers		Change in numbers
		Year 2010	Year 2015	
1	Marine observation stations (sites)	102	124	22
2	Buoys	35	57	22
3	Offshore oil & gas observing platforms	4	6	2
4	Radar stations	38	38	0
5	Mobile emergency observing platforms	11	13	2
6	GPS observation stations	56	56	0

1.3 Gap and Prospect

China strengthened the collection, integration, quality control and data sharing of observational information in order to better understand the laws of climate change and to engage in climate change research and their applications. However, systematization, operation and standardization of the integrated climate observing system still need further improving. First, the observations of climate change by different authorities are incoherent in standard, incomplete in observational elements, insufficient in observation precision, and less reasonable in observational site layout, and the observation of marine climate and subsurface profile are weak. Second, the observations of variables of multi-sphere interactions, which are essential to the research and understanding of climate change, are incomplete, while the observations are still missing for the interaction processes in many key areas affected by climate change and in areas with typical surface features and anthropogenic activities. Third, an improved system and mechanism to share data of the multi-layer climate system has not been put in place. In addition, the quality control of observational data and the ability to integrate and apply multi-source observational data need to be further strengthened.

In the future, China will further strengthen the planning and building of the national climate observing system, improve the distribution of the existing observing networks for various components of the climate system, enhance the observations of essential climate variables in sensitive, typical and key climate zones and in regions where such variables are not previously observed, and improve the observing techniques of essential climate variables with the accuracy being raised up to the standards of Global Climate Observing System. At the same time, China will actively participate in various international programs and activities, including Coordinated Research Programs on Earth Observation and Prediction Systems, Integrated Global Observing System of the World Meteorological Organization, and global programs on atmospheric and marine observations. China will also strengthen the coordinated management and efficient use of multidisciplinary observation data through establishing climate change information sharing and service system with a multi-departments center as the core and wide participation of departments and user groups.

Chapter 2 Advances in Climate Change Research

2.1 Climate Change Science

A series of researches have yielded results during the 12th FYP period, which focused on the observations and historical reconstruction of climate change, laws and mechanisms of global climate change, integrated analysis of climate change data, development of Earth system models and geologic record of climate change. With respect of the impacts of and adaptation to climate change, efforts were made to improve research capacities on the mechanisms governing climate change and on the assessment methodology in various sectors which include water resources, agriculture, forestry, marine, human health, ecosystems, key infrastructure projects, and disaster prevention and reduction, to enhance theoretical research and technology development for adaptation, and to promote scientific and technological progress and innovation in the field of climate change. Research on climate change strategy and policy were mainly focused on international trade strategies and policies in response to climate change, technical support systems for China's carbon emissions trading scheme, strategic measures and action plans for climate change adaptation, and major development strategies on cutting-edge technology in climate change.

A number of research results on the climate change science in China, which are characterized by the Chinese uniqueness and global significance, were highly recognized internationally. The *Second China National Assessment Report on Climate Change*, the *Third China National Assessment Report on Climate Change, China National Assessment Report on Risk Management and Adaptation of Climate Extremes and Disasters,* and other scientific assessment reports on climate change published during 12th FYP period presented a number of significant scientific findings in China, which covered the past-century observations and future projections of climate change in China, impacts and risks of climate change on ecosystems and socio-economic systems, trends of extreme weather and climate events in the context of climate change and the responsive measures, GHG emissions and their mitigation potential, role of technological progress in increasing energy efficiency and reducing carbon emissions, and China’s participation in international climate governance. The influence of academic papers published by the

Chinese scientists has ever increasingly felt in the international scientific community and their findings were frequently cited by the *Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)*. Many findings were cited in IPCC AR5, in particularly the fields of atmospheric observations, regional climate change and its impacts, paleoclimate, clouds and aerosols, climate models, freshwater resources, food systems and food security, and climate change mitigation pathways.

According to the *Third China National Assessment Report on Climate Change,* the average temperature increase in China’s land area was 0.9-1.5 ℃ over the past century (1909-2011), the coastal sea level of China rose by 2.9mm/year during 1980-2012, which is higher than the global average. From 1970s to early 21st century, the extent of glaciers in China decreased by about 10.1%, and the area of permafrost reduced by about 18.6%. The extreme events will continue to increase in the future. Heavy rain, strong storm surges, and large-scale drought will occur more frequently and severely, and the flood intensity and sea level will continue to rise. The overall findings show that climate change brings about more negative impacts, in particular adverse impacts on the quality and quantity of food, water resource, marine environment and ecology and the urban area. The level of natural disaster risk in China stays relatively high, and is highly sensitive to climate change. The adverse impacts of climate change are significantly permeating various economic and social sectors.

2.2 Research and Development of Low Carbon Technology

China speed up its research and development on common and critical technologies for energy conservation and emission reduction, which involved high-parameter ultra-supercritical power generation, integrated gasification combined cycle, unconventional gas resource exploration and development, generation & storage & on-grid of the large-scale renewable energy, new energy vehicles and low-carbon alternative fuels, energy efficiency at energy supply side and end-use side in urban areas, energy efficiency in buildings, energy-saving and utilization of large-scale residual energy and heat in the production processes of steel, metallurgy, chemicals, and building materials, carbon sequestration and sink increase in agriculture, forestry livestock and wetland, and carbon capture and storage. In order to promote the commercialization and application of low-carbon technologies, demonstration projects were first set up in power, petrochemical, cement, iron and steel, nonferrous metals, transportation, agriculture, forestry and other major GHG emitting industries in order to promote technologies that have been proved to be effective.

By promoting the development of low-carbon technologies to address climate change, China has improved its core and key technologies for mitigation. China has embraced a number of invention patents with independent intellectual property rights and achieved important results in the fields of clean and efficient energy, energy-saving technologies and equipment in key sectors (e.g. industry, building and transportation), industrial development pattern in low-carbon economy, and integration and application of key technologies. A number of low carbon technologies such as affordable low-carbon building materials, low-carbon transportation, green lighting, clean and efficient use of coal have been widely used. China is also promoting the use of new technologies such as cost-effective solar photovoltaic cell, solar building integration, high-power wind energy, distributed natural gas, geothermal power generation, ocean power generation, smart and green grids, power storage for new energy vehicles, and carbon capture, utilization and storage with independent intellectual property rights. A number of national laboratories and industrial alliances on technology and equipment for energy conservation and emission reduction were set up.

Although China has made a rapid progress on climate change research, there are still some gaps comparing with the world's leading countries: 1) scientific researches are lagging and comprehensive research is insufficient, which cramps deeper understanding of climate changes mechanisms; 2) more innovations are required for modeling tools and research approaches, and integrated climate change assessment models are insufficient, and; 3) core technologies for climate change mitigation and adaptation should be further developed. In the future, China is expected to further its research on climate change science, impacts and adaptation, mitigation, and sustainable economic and social development.

Chapter 3 Climate Change Adaptation

The *Outline of the 12th Five-Year Plan for National Economic and Social Development of the People's Republic of China* published in 2011 explicitly called for strengthened adaptation to climate change, in particular capacity building in response to extreme climate events. It also required to accelerate the research, development and application of adaptation technologies in such priority sectors as agriculture, forestry and water resources. Relevant plans and policies were developed to directly or indirectly support climate change adaptation in such sectors as agriculture, forestry, marine, meteorology, disaster prevention and reduction, and health.

In 2013, the *China National Strategy for Climate Change Adaptation* was developed by the NDRC, MOF, MoHURD, MOT, Ministry of Water Resources (MWR), MOA, SFA, China Meteorological Administration (CMA), and State Oceanic Administration (SOA). In regards to adaptation capacity improvement, the Strategy stressed on capacity building in response to extreme climate events and the improvement of the adaptation capacity in such priority sectors as agriculture, forestry, water resources and health and in coastal areas and ecologically vulnerable areas. It also required to develop adaptation policies and measures for agriculture and forestry in order to ensure food and ecological security, reasonably exploit and better distribute water resources, and enhance water saving policies and measures. In addition, the Strategy called for enhanced marine and coastal ecosystem monitoring and preservation in order to increase coastal resilience to marine disasters, and improved emergency response plan, triggering mechanism and multi-hazards early warning system for extreme weather events. In the meantime, the Strategy identified 14 pilot adaptation projects including the Shanghai urban infrastructure to defend extreme weather and climate events, protective treatment of black soil in major grain producing areas in Jilin province, water conservation in Lake Poyang, ecological restoration and marine disaster emergency response in Hainan province.

In urban area, NDRC and MoHURD jointly launched the *Action Plan on Climate Change Adaptation in Urban Areas,* which provided guidance on city planning, infrastructure, building, water system, urban greening and disaster risk management with the aim to enhance urban resilience to climate change. The *Working Plan for A Pilot Program on Climate-Adaptable Urban Development* was issued to select about 30 pilot cities to carry out climate-adaptable urban development initiatives targeting to prominent urban issues in a proactive and innovative manner to facilitate the adaptation actions for sectors, areas and communities which are prone to climate change in cities, and enhance the urban adaptation capacity to climate change. It is planned that by 2020, climate adaptation initiatives in the pilot cities will be mainstreamed into their socio-economic and industrial development planning process and urban construction standards so that concepts and knowledge of climate change adaptation will be extensively spread, and management of climate change adaptation will be dramatically improved in pilot cities.

In agriculture, actions were taken to accelerate the transformation and modernization of China's agricultural production mode, as well as to promote conservation tillage. By the end of 2014, the farmland with conservation tillage amounted to 129 million Mu (86,000 km^2), and the eroded farmland reduced by 64.5 million tons. China started infrastructure construction for farmlands, enhanced soil fertility, and spread the use of technologies in the area of water-saving irrigation, rain-fed agriculture, drought relief and soil moisture, soil testing and fertilizer, and green pest/disease control. China continued its efforts in agricultural water projects, including saving water to increase grain yields in Northeast China, saving water and increasing efficiency in Northwest China, saving water and limiting the exploitation of ground water in North China, building five types of small water conservancy facilities in Southwest China, and saving water and reducing emissions in southern China.

In water resources, China promoted eco-civilization. It continued to implement the most stringent water management system, strengthen the management of rivers and lakes and the preservation of water resources, intensify the construction of major water conservancy projects, and accelerate the comprehensive control of soil erosion. By the end of 2014, the area covered by the comprehensive soil and water loss prevention program has reached 74,000 square kilometers. China enhanced its flood prevention system. It intensified the treatment on all sizes of rivers and the prevention of flash floods, and speed up the capacity building to respond to floods due to extreme heavy rains. China implemented its *National Anti-Drought Plan* in full, which has systematically improved the responsive capacity to extreme drought events.

In forestry and other ecosystems, China strengthened the strategic guidance, comprehensive forest management, and ecological preservation in natural forestry reserve, and wetland. In 2014, China developed the *Action Plan for Climate Change Adaptation in Forestry (2015-2020)* which set forth adaptation measures and targets in forestry by 2020. In terms of the ecological and meteorological services, China conducted impact assessments of climate change on key areas and featured industries, and impact assessments of typical regional climate change on biodiversity in Qinghai-Tibetan Plateau, Northeast China and Hainan. China enhanced the ecological preservation in grassland, provided subsidy incentives and implemented projects to preserve grassland ecology, enforced fundamental systems for grassland management and preservation, and extensively treated 4.45 million hectares of grasslands with severe degradation and fragile ecology in 2014. China also intensified its efforts on the preservation and restoration of wetlands. It completed the 2nd national survey on wetland resources and implemented national wetland preservation program. The extent of wetland in China has increased by 6 million mu (4,000 km^2) and additional 300,000 mu (200 km^2) wetlands have been restored. By the end of 2015, 12 new internationally important wetlands were appointed, 561 new national wetland parks opened, 2.4 million mu (1,600 km^2) of degraded wetlands were restored, and the function of wetland as a carbon sink has steadily elevated. China strengthened the ecological protection system for desertification. It completed 5th Desertification and Desertification Monitoring Initiative, launched pilots on subsidy for closed preservation of desertified land and construction of national desert parks. China treated 150 million mu (100,000 km^2) of desertified land. The overall trend of desertification has appeared to be contained and ecological state in priority areas has been obviously improved.

In the coastal areas and relevant sea waters, China strengthened the observation, early warning and emergency management on marine disasters, started the monitoring of sea level changes, provided refined forecast for the coastal areas/targets with significance, and continued to improve the marine disaster risk assessment. China exercised stringent review on marine projects in order to restrict the occupancy of important marine ecological space. In order to preserve the marine ecosystems, China has already established 260 oceanic preservation areas in different types and levels, which covers a total of over 100 thousand km^2 area and accounts for about 3.3% of the total marine area under China's jurisdiction. China also promoted the construction of integrated demonstration zones for marine disaster mitigation and the construction of islands' infrastructure for disaster mitigation and climate change adaptation, which improved islands' infrastructure for disaster prevention and mitigation and islands' capacity to combat climate change.

In extreme weather and climate events and disaster forecasting and early warning sectors, China improved the 4-tier meteorological disaster early warning system which cut across the national, provincial, municipal and county levels, and prepared the *National Management Rules on the Issuance of Warning Information for Emergency Events.* China carried out researches on climate disaster risk assessment and management mechanisms in respect of adaptation, and gradually developed the technical methodologies, processes and technical specifications of the risk assessment and management for major climate disasters in China. It also developed the *Atlas of the Severe Weather and Climate Disasters in China (1961-2013)*, surveyed heavy rain and flood events as well as their risks at county level, assessed the risks of major disasters (including typhoons, heavy rain and drought), produced risk map, and completed the integrated climate change impact assessment reports for watersheds and regions, and put forward policies and measures related to climate change adaptation.

In human health sector, China implemented the prevention and control of the diseases closely related to climate change, strengthened the studies on the health problems relevant to climate change and its adaptation, and launched the *Project on the Adaptation to Climate Change to Protect Human Health*. The project selected 30 typical cities across China based on climate risks, size and function as climate resilient pilot cities to explore innovative solutions to the prominent urban problems in the context of climate change. At the same time, China strengthened adaptation actions targeted at urban sectors, areas and communities which were sensitive and vulnerable to climate change, enhanced urban adaptation capacity to climate change, summarized and replicated adaptation experience and practices learned from relevant sectors and areas, carried out urban vulnerability assessments on climate change, prepared city-specific climate change action plans, and established a sound management system to adapt to climate change.

Chapter 4 Education, Outreach and Public Awareness

China is active in publicizing the scientific knowledge on climate change and raising public awareness of climate change and low-carbon development, and has motivated NGOs and the media to participate. China mobilized multiple channels and adopted various measures to encourage all citizens to take actions against climate change. The pattern for publicity and educational activities in China has been formed, in which the government plays a leadership role, civil organizations organize the activities, and the public widely participate in. Governments from central to local levels as well as civil societies have vigorously carried out education and publicity campaigns on climate change, and have made remarkable achievements.

4.1 Education and Outreach

The Chinese government has developed and improved a series of policies and measures to publicize the knowledge of climate change and build the capacity of the public in coping with climate change. The Chinese government released *China's Policies and Actions on Climate Change* every year, and organized China Pavilion at the COP of UNFCCC held at the end of each year to give an overview of China’s policy, actions and progress on climate change. Different departments and local governments have also launched a series of education and outreach activities on climate change fit for their own circumstances. In September 2012, the State Council of China approved to establish National Low Carbon Day on the third day of annual National Energy Conservation Week from 2013. The National Low Carbon Day has been held every year since 2013, where activities were held, for instance, theme slogan and poster contests and expert lectures centering around such themes as ‘low-carbon energy practice for a beautiful homeland’ and ‘Joining hands with low-carbon energy to build a clean water and blue sky’ in order to increase low-carbon awareness. In the meantime, outreach activities with diversified forms and themes were carried out to increase the awareness on the climate change and low-carbon development. Outreach activities were also conducted at other important events, including the Disaster Prevention and Reduction Day, World Meteorological Day, World Environment Day, World Earth Day, and National Energy Conservation Week. Ministries, agencies and local governments organized various forms of activities, for example, quiz competitions on low-carbon knowledge, thematic exhibitions, collection of low-carbon cases and role models of low-carbon, to advocate the entire society the ways of low-carbon consumption and production, and publicize their low-carbon policies and actions (Figure 6-1). In June 2013, UN Secretary-General Ban Ki-moon visited the thematic exhibition of climate change held on the National Low Carbon Day and spoke highly of the exhibition. Both 2014 Davos Forum in Tianjin and 2014 Guiyang International Forum on Eco-Civilization included a session on Climate Change to discuss eco-civilization and green and low-carbon development. The English version of the *Advances in Climate Change* was listed as a source of CSCD during 2015-2016, which is a core journal in China briefing the latest observations and scientific understanding on global climate change, adaptation and mitigation measures and technological results, and international climate regime and diplomatic negotiations processes.

Figure 6-1 Activities on National Low-carbon Day

4.2 Education and Training

In order to enhance the climate change awareness of different groups among the public, lectures, seminars and training workshops introducing the latest domestic and international development on climate change were respectively offered for decision-makers at all levels, researchers, teachers and students of higher education, business and social groups, and communities. The Development and Reform Commission at the central and local levels, MOST and other ministries held annually training workshops on climate change and low carbon development for tens of thousands of staff members in five years. Special training events were launched for businesses involving the carbon market, with an aim to train a group of professionals familiar with the carbon market policies and regulations and proficient in reporting, registration and transaction systems. The training on climate change science was also provided to more than 1,200 young people who were awarded Environment-friendly Messenger. The National Environment Education Bases offered the public, especially young people the education on climate change with the assistance of 'Time Machine' and other electronic interactive exhibition. More than 500 community residents and volunteers were taught on curbing HCFCs, protecting the ozone layer and climate change under a community-based outreach program called the Chinese Public Making Up the Sky: Hydrochlorofluorocarbons (HCFCs) Phase-out. A number of outreach meetings for IPCC Fifth Assessment Report were held, which focused on concepts and policy measures of climate change science, adaptation, and low carbon development from Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX), three IPCC Working Group Reports, and the Synthesis Report (Figure 6-2). The yearly International Seminar on the Climate System and Climate Change jointly sponsored by various authorities has attracted thousands of young scholars from China and other developing countries to participate in.

Figure 6-2 Brochures on IPCC AR5

4.3 Media Outreach

The media groups and media organizations at all levels in China continued to work with the government to enhance the media coverage on climate change, energy conservation and low carbon development. TV programs were produced and broadcast on TV channels, mobile TV on public buses, outdoor screens and mainstream websites, and video programs and brochures were presented at international conferences and public gathering, which played an effective role in educating and outreaching. At the annual press conference to release the *China's Policies and Actions on Climate Change,* which is convened by the State Council Information Office, leaders from authorities would introduce the latest development of the Chinese government in coping with climate change and elaborate the fundamental positions in the international negotiation process. The media, including the China Central TV, produced a number of documentaries, including Facing Climate Change, Watching Climate Change, Climate Change Has No Border, and the Warming Earth which won the 28th China Film Golden Rooster Award for Best Science Film with hundreds of millions of audience. Since 2014, many news media, including the Xinhua News Agency, People's Daily, China Central Television, China Radio International, China Daily, and China News have kept watching closely the important events in the field of climate change and made all-round coverage through multiple media, like photographs, text and video, for instance, the United Nations Climate Summit, Sino-US Joint Statement on Climate Change, Lima Climate Conference, and China's NDC Submission. The China Climate Change Info-Net was developed as a government website to disseminate international and domestic information on climate change, and in 2012 the website was enhanced through revision to better publicize the knowledge of climate change domestically and internationally.

4.4 Public Participation

The Chinese NGOs and the general public were also actively involved in activities related to climate change, and took concrete steps to address climate change. In 2011, NDRC solicited publicly the comments on climate change legislation. The public participated in the wide range of energy efficiency and low carbon campaigns, such as bringing their own shopping bags, printing double-side, controlling air-conditioning temperature, refusing to use disposable chopsticks, buying energy-saving products, low-carbon trips, and low-carbon energy activities. They practiced their low-carbon lifestyle through the daily life in clothing, food, shelter and travel. The primary and secondary schools and universities across China advocated the low-carbon and environmental-friendly way of life. Some universities proposed to build a green university, which was widely echoed.

The public throughout the country was very supportive to the Earth Hour Campaign, appealing that everyone should take action to address climate change and expressing their willingness to protect the global climate (Figure 6-3). In addition, ordinary people learned how to deal with climate change and practice low-carbon development concept through various ways, including such social network platforms as Wechat and Weibo, and discussion at microblogging and Wechat public account. The public also increased their awareness on climate change, low-carbon development, energy efficiency and emission reduction and willingness to cope with climate change through various forms of climate change education and training events.

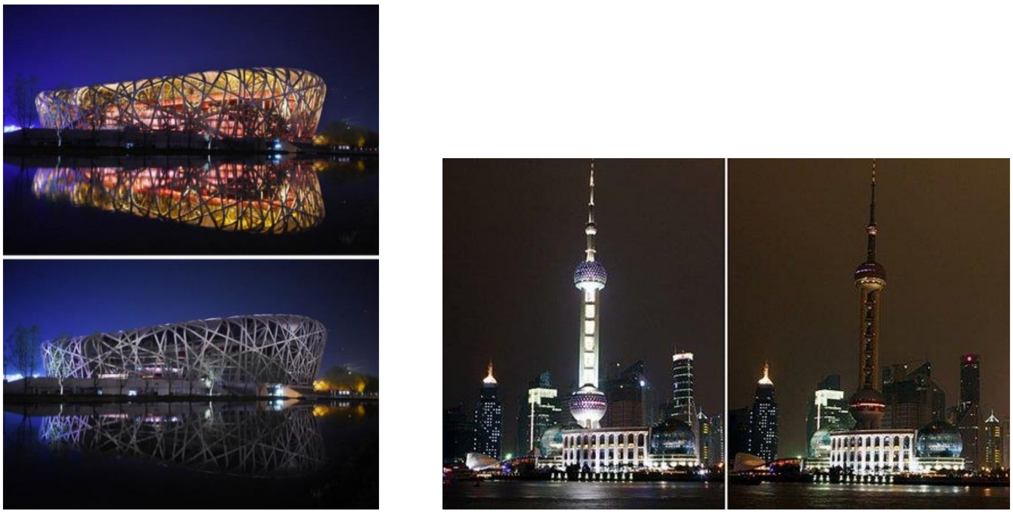

Figure 6-3 Earth Hour Campaign (Left: Bird's Nest; Right: Shanghai Oriental Pearl TV Tower)

Chapter 5 International Exchanges and Cooperation

The Chinese government attaches great importance to the international exchanges and cooperation on climate change, through which it aims to increase the knowledge on climate change science, enhance the development and application of climate change technologies, foster and promote the development of low-carbon industries, and transform China into a low carbon economy. The Chinese government has promoted pragmatic cooperation with other governments, international organizations and international agencies in accordance with the principles of mutual benefit, win-win, pragmatism and effectiveness, signed a series of cooperative agreements, and implemented a number of research projects involving climate change science, mitigation and adaptation, climate smart/low-carbon city, and climate change policies and measures.

5.1 High-Level Dialogues and Bilateral Cooperation

During 12th FYP period, China announced with the United States, European Union, France, United Kingdom and other countries respectively bilateral declarations on climate change by taking advantage of high-level visits and establishing climate change working groups, which increased the understanding among countries, expanded their consensus, and made important contribution to the process of multilateral climate change negotiations, in particular to the achievement of the Paris Agreement. China stepped up bilateral exchanges and dialogues on climate change. It held ministerial and working-level dialogues and consultations with the United States, European Union, Australia, New Zealand, United Kingdom, Germany and other countries. In addition, it, together with Brazil, South Africa and India, held BASIC Ministerial Meeting on Climate Change every year, issued joint statements, and established a mechanism for the expert exchange. The China National Panel of Experts on Climate Change promoted expert exchanges between China and US, EU, the UK, France and India. The bilateral cooperation with developed countries in the area of climate change was deepened, which advanced the cooperation on technology, research, energy efficiency, alternative energy, and renewable energy. Founded in 2013, the China-US Climate Change Working Group became a comprehensive framework for China and US to understand and tackle climate change. The Working Group continued to expand their cooperative scope, and by far it has carried out practical cooperation in such areas as emission abatement in trucks and other vehicles, power systems, CCUS, energy efficiency in buildings and industry, GHG data collection and management, climate change and forests, climate smart/low-carbon city, GHGs measurement, industrial boiler efficiency and fuel switching, and green ports and ships. The Working Group also held China-US Summit on Climate Smart/Low-carbon City, and conducted the exchanges focusing on green and low-carbon urban development, low-carbon urban planning, the carbon market, low-carbon transport, low-carbon buildings, low-carbon energy, and climate change adaptation. China and the EU launched a Capacity-Building Project on Carbon Trading. China and Germany signed a *Memorandum of Understanding on Climate Change Cooperation*, which established a strategic partnership in electric vehicles and delivered the cooperation in solar, wind and other new energies as well as building's energy efficiency and low-carbon eco-city. China and Japan strengthened the cooperation on the science and technology in energy efficiency and environmental protection, and launched cooperation on building the capacity of low-carbon development. China worked with Australia in the geological storage of carbon dioxide, while carried out the carbon capture and storage demonstration projects with EU, Italy and UK to deepen cooperation on energy and energy efficiency. China also signed bilateral MOU on climate change with Australia, New Zealand, Sweden, Switzerland and other countries. China started together with Switzerland the Phase II of China Climate Change Adaptation Project, and reached agreement on climate change agreement with Republic of Korea in order to bring the bilateral cooperation to a new level.

5.2 Partnership with International Organizations

China carried out a pragmatic cooperation with a wide range of international organizations. It signed a Memorandum of Understanding with the UNEP to strengthen South-South cooperation in addressing climate change. It worked with the World Bank to launch the Partnership for Market Readiness Project and with the GEF to launch the Project of Promoting the Development of Clean, Green and Low-carbon Urban China through International Cooperation. China made a steady progress in implementing GEF

Project on Increasing the Ability, Knowledge and Technical Support of Climate Resilience for Vulnerable Developing Countries where World Bank was designated by GEF as project agency, and a grant Project on Needs Assessment on Climate Change Technologies in China. Based on the memorandum of understanding on climate change cooperation, China and the Asian Development Bank co-sponsored the International Seminar on the Adaptation to Climate Change in Urban Area, and carried out ADB's Technical Assistance project on Carbon Capture and Storage (CCS) Roadmap. China actively participated in the conferences sponsored by Green Climate Fund, the financial mechanism under UNFCCC, GEF, Adaptation Fund and Technology Executive Committee, and took part in the activities organized by the Global Methane Initiatives, R20 Regions of Climate Action and other multilateral organizations. In addition, China participated in the meetings of Global Alliance for Clean Cookstoves hosted by UN Foundation, and carried out pilot activities in China. China, together with the Global CCS Institute and other relevant organizations held site seminars and field trips on carbon capture, utilization and storage, and established the alliance relationship with the International Energy Agency to work on energy security, energy data and statistics, and energy policy analysis. China actively involved in the Intergovernmental Panel on Climate Change (IPCC), reached out and interpreted the outcomes of IPCC Fifth Assessment Report at different levels, and played a positive role in nomination and election of IPCC bureau for the Sixth Assessment Report.

China also actively involved in the international scientific and technological cooperation on global environmental change, such as the World Climate Research Program (WCRP) under the framework of the Earth System Science Partnership (ESSP), International Geosphere-Biosphere Program (IGBP), International Human Dimensions Programme on Global Environmental Change (IHDP), and DIVERSITAS, as well as the Group on Earth Observation, Global Climate Observation System (GCOS), the Future Earth Plan. China conducted research on global changes which was characterized by the Chinese uniqueness and global significance. The all-round and multi-level cooperation between China and other countries has contributed to the international political consensus on climate change and promoted scientific progress and technology applications.

Chapter 6 South-South Cooperation

During the period of 2011-2015, the Chinese government carried out a broad range of cooperation with nearly 100 developing countries across Asia, Africa, Latin America, and south Pacific region in the fields of emergency response, meteorological satellite monitoring, clean energy development and utilization, agricultural anti-drought technology, forest and wild animal protection, water resource use and management and desertification prevention and treatment. Nearly 500 climate change projects have been implemented to provide whole sets of materials and goods, technical assistance and disaster rescue. China signed joint statements, memorandum of understanding, and/or cooperation agreements on climate change with South Africa, India, Brazil, South Korea and other countries, through which they established climate change cooperation mechanisms, strengthened the cooperation in such areas as meteorological satellite monitoring, new energy development and utilization, and aided other developing countries with hundreds of clean energy and environmental protection projects. In 2014, China signed agreements respectively with Zambia and Ghana on Renewable Energy Technology Transfer Project in order to promote and apply renewable energy technologies in Africa. China stepped up the scientific and technological cooperation with Africa. It has implemented 100 Sino-African joint scientific and technological research and demonstration projects, built agricultural demonstration centers, dispatched technical experts in agriculture, trained African agricultural technicians, and enhanced food security in Africa. China also provided support and assistance to small island countries, including those from the South Pacific and the Caribbean. It built more than 130 projects for Pacific Island countries to enhance their ability to mitigate and adapt to climate change. China prepared the *Technical Handbook on South-South Cooperation of Climate Change Science and Technology*, and offered 13 international training programs on climate change for developing countries, which covered biomass, solar energy, biogas, desertification control, water-saving and efficient agricultural development, and other subjects. China implemented a number of overseas aid projects with focus on the use of renewable energy, research and capacity-building on marine disaster early warning, LED lighting product development and application, straw utilization technology demonstration with an aim to help other developing countries to increase their ability in climate change adaptation. Various promotional materials produced in 2011-2012 were widely received by developing countries, for instance, the *Network of International Science and Technology Cooperation in Climate Change and Sustainable Development, China-United Nations-Africa Water Science and Technology Cooperation Action, Textbook of South-South Cooperation in Combating Climate Change*, and *China-Africa Science and Technology Partnership Program*.

In 2012, China announced at the Rio+20 Conference that it would spend RMB 200 million yuan to launch three-year South-South cooperation on climate change and establish contacts with 41 developing countries. Since 2014, China has signed memoranda of understanding with Maldives, Bolivia, Tonga, Samoa, Fiji, Antigua and Barbuda, Ghana, Barbados, Myanmar and Pakistan, and expanded gift product categories according to the needs of developing countries. In 2014, China announced again that it would further South-South cooperation on climate change by doubling the current annual funding level from 2015 and establishing the China South-South Cooperation Fund on Climate Change. China has already spent US$ 6 million to support the UN Secretary-General's efforts to promote South-South cooperation on climate change. In the spirit of equality and mutual trust, mutual tolerance, cooperation and win-win, China signed Memoranda of Understanding on the Donation in Kind for the Purpose of Climate Change with 24 developing countries, and provided them with energy-saving lamps, energy-saving air-conditioners, PV street lights, PV power generation systems, and other green low-carbon products.

During the 12th FYP period, China sponsored more than 300 training seminars on climate change, green and low-carbon development for 5 thousands of officials, experts, scholars and technicians in the field of climate change from developing countries. Over 1,000 people received the technical training on deforestation and land degradation monitoring and assessment in the context of climate change, climate change and extreme weather and climate events, multi-hazard early warning, climate service systems, and marine disaster monitoring and early warning. In November 2015, President Xi Jinping announced at the Paris Conference on Climate Change to establish the China South-South Cooperation Fund on Climate Change with a contribution of RMB 20 billion yuan. He also announced to launch a new initiative called Ten-Hundred-Thousand Project in 2016, namely implementing 10 low-carbon demonstration zones and 100 climate change mitigation and adaptation projects in developing countries, and providing 1,000 people with climate change training, and continue to advance the international cooperation in clean energy, disaster prevention and reduction, ecological preservation, climate resilient agriculture, low-carbon and smart urban development. Through the Project, China aimed to provide financial, technical and capacity-building support to the least developed countries, small island countries and African countries in response to climate change. At present, China has developed implementation plans and launched the projects in a row.

Part VII Basic Information of Hong Kong SAR on Addressing Climate Change

Hong Kong is a special administrative region of the People's Republic of China, which is characterized by its mild climate, limited natural resources, high population density, highly developed service sector and dynamic activities. It is also an eminent international financial, trading and shipping hub. Since 2010, the SAR Government has introduced a series of policies and actions in response to climate change with positive results.

Chapter 1 Regional Circumstances

1.1 Natural Conditions and Resources

The Hong Kong Special Administrative Region (hereinafter "HKSAR") is in the southern part of China, neighbouring Shenzhen City of Guangdong Province to its north and surrounded by sea on the other three sides. It has a land area of 1,105 square kilometers, comprising Hong Kong Island, Kowloon, the New Territories and Outlying Islands. It is hilly with only less than 300 square kilometers developed for living and economic activities. More than 500 square kilometers of land have been designated as "protected areas", including countryside parks, special areas and conservation areas. Hong Kong is located within the sub-tropical region with mild climate. The annual mean temperature is 23.3°C, with the average highest being 25.6°C and the average lowest 21.4°C. The average yearly rainfall is about 2,400 mm. Extreme weather conditions that occur in Hong Kong include tropical cyclones, strong monsoons, monsoon troughs and strong convective weather. The vegetation of Hong Kong is mainly characterized by sub-tropical evergreen broadleaf forest. Its marine waters are suitable for both tropical and temperate flora and fauna with a rich assemblage of fish and crustaceans. However, fresh water resource is relatively scarce and it is mainly supplied by Dongjiang River in Guangdong Province.

1.2 Population and Society

The population of Hong Kong was around 7.242 million in 2014. The average annual rate of increase in population is 0.8% from 2010 to 2014. The size of the labour force in 2014 was around 3.88 million, of which 51.3% were males and 48.7% were females. In 2014, there were some 280,000 primary students and 350,000 secondary students studying in public and subsidised schools. Public expenditure on education amounted to HK$73.7billion in the 2014-15 financial year, which accounted for 18.6% of the total public expenditure.

1.3 Economic Development

Hong Kong is a highly urbanized economy. The Gross Domestic Product (GDP) of Hong Kong in 2014 was approximately HK$2.26 trillion, or about HK$311,835 per capita (at current market prices). Hong Kong's economy is predominately tertiary industry based, and its share in GDP was 92.7% in 2014. In 2014, the total value of merchandise trade was HK$7.89 trillion, of which import was HK$4.22 trillion and re-export was HK$3.62 trillion. The primary industry accounted for a relatively small percentage of Hong Kong's GDP and also a relatively small proportion of the total workforce in 2014.

Hong Kong is an international financial centre. As of the end of 2014, there were 1,752 companies listed in the Hong Kong Stock Exchange with a total market value of HK$25.07 trillion. Hong Kong is also a hub for global trading, shipping, finance and telecommunication. Its volume of passenger traffic and cargo throughput is among the highest in the world. The values of direct investment liabilities and assets of Hong Kong are massive, which were HK$12.7 trillion and HK$12.4 trillion respectively at the end of 2014. They were 5.63 and 5.47 times of Hong Kong's GDP in 2014 respectively.

On the whole, Hong Kong does not have primary energy production. In 2014, the local primary energy demand was 20.5586 Mtce. The demand for coal products and oil products were 11.6546 and 7.789 Mtce respectively. Local thermal power is the main electricity supply in Hong Kong and nuclear power from Guangdong Province is a main supplement. In 2014, coal, natural gas, and nuclear power accounted for 59%, 19% and 22% of Hong Kong's electricity supply respectively.

The public transport system in Hong Kong on average carried 12.51 million passenger trips daily in 2014. This represented 90% of the total passengers, amongst which, 5.26 million passenger trips were served by rail transport. In 2014, there were around 770 thousand registered vehicles in Hong Kong, around 540 thousand being private cars.

Tourism is one of the pillar industries in Hong Kong. In 2014, a total of 60.84 million visitors came to Hong Kong, among which 47.25 million were from the Mainland.

The agriculture and fishing sector in Hong Kong is relatively small. In 2014, its added value was HK$1.4 billion. The total number of employees in the sector was about 17,000. Fresh fish is one of the most important primary products in Hong Kong. In 2014, fish captured and cultured were around 164,000 tons, totaling HK$2.7 billion.

The statistics on the summary of Hong Kong’s circumstances in 2012 and 2014 are set out in Table 7-1.

Table 7-1 Summary of HK's Circumstances in 2012/2014

Criteria	2012	2014
Population (million, mid-year)	7.155	7.242
Land area (km^2)	1104	1105
GDP (HK$ billion, at current market prices)	2037.059	2258.215
Per capita GDP (HK$, at current market prices) (based on mid-year population)	284720	311835
Percentage share of industry in GDP [1]	6.9	7.2
Percentage share of services in GDP	93.0	92.7
Percentage share of agriculture and fishing in GDP	0.1	0.1
Land area for agriculture purposes [2] (km^2)	51	51
Number of livestocks(head)		
Cattle	1730	1616
Horse	2012	2030
Pig	70109	69511
Sheep	321	350
Forest area(km^2)	738	738
Life expectancy at birth (year)	Male: 80.7 Female: 86.4	Male: 81.2 Female: 86.9

Note: [1] Industry includes mining and quarrying, manufacturing, electricity, gas and water supply, waste management and construction;
[2] Arable land.

1.4 Institutional Arrangements for Addressing Climate Change

The HKSAR Government has all along been committed to combating climate change. To effectively manage and coordinate the work on addressing climate change, the HKSAR Government set up an Inter-departmental Working Group on Climate Change (the Working Group) in 2007. The Working Group coordinates, in close consultation with relevant bureaux and departments and other bodies concerned, present and future work and activities to implement provisions of the United Nations Framework Convention on Climate Change (UNFCCC). It monitors and coordinates efforts of relevant bureaux and departments in formulating and carrying out measures to control greenhouse gas emissions and facilitate adaptation to climate change, as well as monitors closely the latest international developments on climate change and makes recommendations for appropriate actions taking account of these developments. It also formulates and coordinates other activities to promote public understanding of climate change and its effects.

The Working Group, led by the Environment Bureau, spearheads efforts across relevant Government bureaux and departments to address climate change. The key bureaux and departments include: the Development Bureau, Economic Analysis and Business Facilitation Unit of the Financial Secretary's Office, Education Bureau, Food and Health Bureau, Transport and Housing Bureau, Security Bureau, Agriculture, Fisheries and Conservation Department, Architectural Services Department , Buildings Department, Civil Engineering and Development Department, Drainage Services Department, Electrical and Mechanical Services Department, Environmental Protection Department, Food and Environmental Hygiene Department, Department of Health, Home Affairs Department, Hong Kong Observatory, Housing Department, Leisure and Cultural Services Department, Planning Department, Transport Department and Water Supplies Department which are 6 bureaux and 16 departments in total. Among them, the Environment Bureau/Environmental Protection Department is responsible for coordinating and preparing the basic information of HKSAR on addressing climate change in national communications and biennial update reports.

Chapter 2 Hong Kong's Greenhouse Gas Inventory of 2012

In the process of compiling the Hong Kong GHG inventory, references had been made to the *Revised 1996 IPCC Guidelines*, the *IPCC Good Practice Guidance and 2006 IPCC Guidelines*. The reporting year was 2012, and it covered emission of GHGs from energy, industrial processes, agriculture, land-use change and forestry (LUCF), as well as waste. The reported GHGs cover CO_2, CH_4, N_2O, HFCs, PFCs and SF_6.

2.1 The 2012 GHG Inventory

In 2012, Hong Kong's GHG emissions amounted to 43.176 Mt CO_2 eq. After deducting the carbon sink of 0.466 Mt CO_2 eq from LUCF, Hong Kong's net GHG emissions in 2012 stood at 42.711 Mt CO_2 eq. Amongst which CO_2 accounted for 39.572 Mt CO_2 eq, or 91.7%; CH_4 2.202 Mt CO_2 eq, or 5.1%; N_2O 0.342 Mt CO_2 eq, or 0.8% (Table 7-2, Table 7-3); HFCs 0.99 Mt CO_2 eq, or 2.3%; and SF_6 about 0.07 Mt CO_2 eq, or 0.2% of the total

(Table 7-4). Table 7-3 sets out Hong Kong's emissions inventory of CO_2, CO_2 and N_2O in 2012 by categories. Table 7-4 sets out the major sources and inventory of fluorinated gas emissions in Hong Kong in 2012.

Table 7-2 Hong Kong's GHG Emissions in 2012

Unit: 10^4 t CO_2 eq

	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Total
Energy	3894.9	3.8	14.3				3913.0
Industrial processes	60.7	NE	NE	99.0	0.0	7.0	166.7
Agriculture		1.2	1.8				3.0
Waste	1.6	215.2	18.1				235.0
Land-use change and forestry	-46.6	NE	NE				-46.6
Total emission (excluding LUCF)	3957.2	220.2	34.2	99.0	0.0	7.0	4317.6
Net emission (including LUCF)	3910.6	220.2	34.2	99.0	0.0	7.0	4271.1

Note: 1) Shaded cells do not require entries.

2) Due to rounding, a slight discrepancy may exist between table breakdowns and the total figure.

3) NE (Not Estimated) for existing emissions and removals which have not been estimated.

Table 7-3 Hong Kong's GHG inventory of anthropogenic emissions by sources and removals by sinks of GHG not controlled by the Montreal Protocol

Unit: 10^4 t

GHG source and sink categories	CO_2	CH_4	N_2O
Total emission (excluding LUCF)	**3957.2**	**10.5**	**0.1**
Net emission (including LUCF)	**3910.6**	**10.5**	**0.1**
1. Energy	**3894.9**	**0.2**	**0.0**
Fuel combustion	3894.9	0.1	0.0
Energy industries	2931.5	0.1	0.0
Manufacturing industries and construction	75.6	0.0	0.0
Transport	738.4	0.0	0.0
Other sectors	149.4	0.0	0.0
Fugitive emission		0.1	
Oil and natural gas system		0.1	
Solid fuels		NO	
2. Industrial processes	**60.7**	**NE**	**NE**
3. Agriculture		**0.1**	**0.0**
Enteric fermentation		0.0	
Manure management		0.0	0.0
Rice cultivation		NO	
Agricultural soils		NO	NO
Prescribed burning of savannahs		0.0	0.0
4. Land-use change and forestry	**-46.6**	**NE**	**NE**
Changes in forest and other woody biomass stocks	-46.6		
Forest conversion	NE	NE	NE
5. Waste	**1.6**	**10.2**	**0.1**
Solid waste disposal on land		10.0	NO
Wastewater handling		0.2	0.1
Waste incineration	1.6	NE	NE
Memo Items			
Special regional aviation	174.6	0.0	0.0
Special regional marine	969.7	0.1	0.0
International aviation	1260.8	0.0	0.0
International marine	1679.8	0.1	0.0

Note: 1. Shaded cells do not require entries. Being rounded to nearest whole numbers, the sums of all sub-items may slightly differ from the totals. 0.0 indicates calculation results that are negligible;

2. NO (not occurring) for activities or processes that do not occur for a particular gas or source/sink category within Hong Kong;

3. NE (Not Estimated) for existing emissions and removals which have not been estimated;

4. Values given in 'Memo Items' are not counted in the total emission;

5. Special regional aviation and special regional marine represent aviation and marine between Hong Kong and the Mainland China, which have been counted into total China's GHG inventory as domestic aviation and navigation.

Table 7-4 Emissions of Fluorinated Gas in Hong Kong in 2012

Unit: 10^4 CO_2 eq

GHG source and sink categories	**HFCs**					**PFCs**				**SF_6**	**Total**
	HFC-134a	**HFC-404a**	**HFC-407c**	**HFC-410a**	**HFC-227ea**	**$C_8F_{16}O$**	**$C_{12}F_{27}N$**	**$C_{15}F_{33}N$**	**$C_9F_{21}N$**		
Industrial processes	87.8	3.2	2.2	0.4	5.3	0.0	0.0	0.0	0.0	7.0	105.9
Halocarbons and SF6 consumption	87.8	3.2	2.2	0.4	5.3	0.0	0.0	0.0	0.0	7.0	105.9

Energy activity is the primary source of GHG emissions in Hong Kong. In 2012, energy accounted for 90.6% of the total GHG emissions, while disposal of waste, industrial processes and agriculture accounted for 5.4%, 3.9% and 0.1% of the total emissions respectively. Figure 7-1 illustrates Hong Kong GHG inventory by sources.

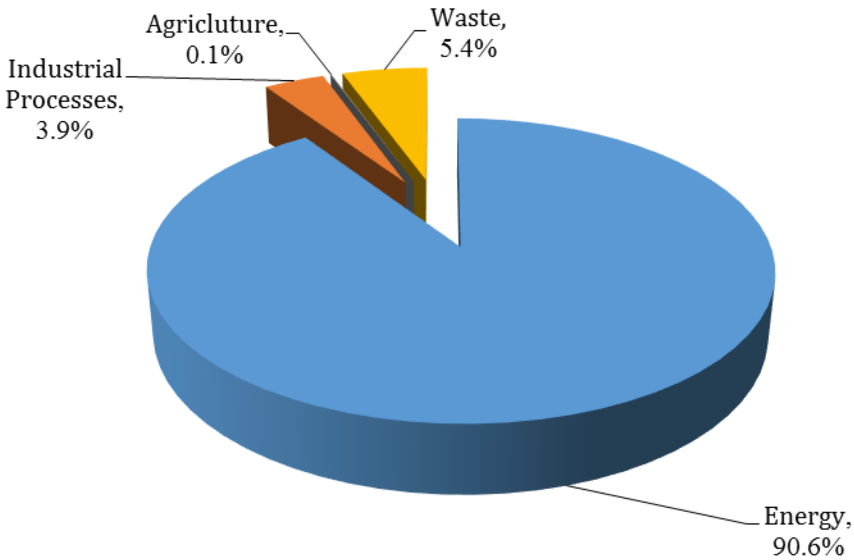

Figure 7-1 Hong Kong's GHG emissions by sector in 2012

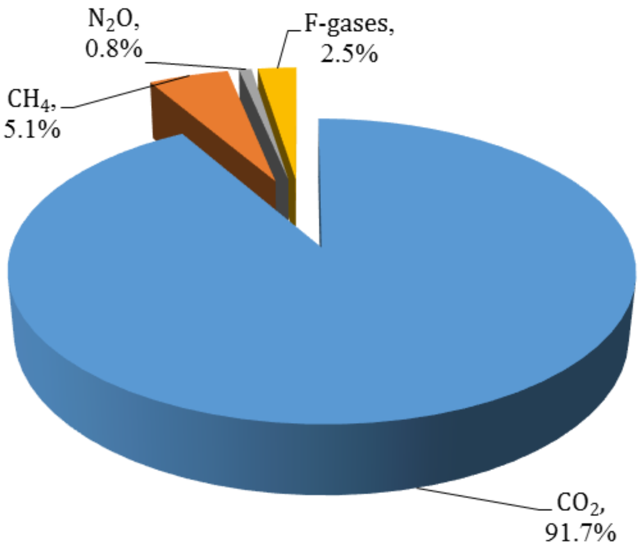

Figure 7-2 Hong Kong's GHG emissions by gas in 2012

CO_2 is the primary source of GHG emissions in Hong Kong. In 2012, CO_2 accounted for 91.7% of the total emissions, while CH_4, fluorinated gases and N_2O accounted for 5.1%, 2.5% and 0.8% of the total emissions respectively (See Figure 7-2).

In 2012, the GHG emissions from special regional routes and international bunker fuel of Hong Kong amounted to 41.116 Mt CO_2 eq, which included 11.541 Mt CO_2 eq from special regional marine and aviation emissions, and 29.575 Mt CO_2 eq from international marine and aviation. The aforesaid emissions were deemed as memo items and not counted in the total emissions. The special regional aviation and marine have been counted into total China's GHG inventory as domestic aviation and navigation.

2.2 Energy

2.2.1 Scope

The reporting of GHG emissions from energy activities mainly includes: emissions of CO_2, CH_4 and N_2O from fossil fuel burning in energy industry, manufacturing industry, construction industry, transportation sector and other sectors; fugitive CH_4 emissions of oil and gas systems.

2.2.2 Methodologies

The calculation of emissions from energy activities in Hong Kong is mainly based on the *2006 IPCC Guidelines*. Tier 3 method was adopted to calculate emissions of CO_2, CH_4 and N_2O in electricity production. Tier 2 method was adopted to calculate CO_2 emissions while Tier 1 method was adopted to calculate CH_4 and N_2O emissions in towngas production. Tier 2 method was adopted to calculate CO2 emissions, while Tier 1 method was adopted to calculate CH_4 and N_2O emissions in utilizing landfill gas for energy purpose. Tier 2 method was adopted to calculate CO_2 emissions, while Tier 1 method was adopted to calculate CH_4 and N_2O emissions of manufacturing and construction industries and other sectors.

Tier 1 and 2 methods were adopted to calculate emissions of CO_2, CH_4 and N_2O from local aviation and navigation, rail, non-road transport and road transport sources.

Special regional transport means aviation and marine transport activities departing from Hong Kong with destinations in other parts of China; while international transport means aviation and marine transport activities departing from Hong Kong with destinations in places other than China. Tier 3a method was adopted for calculation of emissions of CO_2, CH_4 and N_2O from special regional and international aviation. Tier 1 method was adopted to calculate emissions of CO_2, CH_4 and N_2O from special regional and international marine.

Tier 3 method was adopted to calculate fugitive emissions of CH_4 in the whole fuel systems, except for the calculation of that from gas transmission using Tier 1.

2.2.3 Emissions Inventory

In 2012, GHG emissions from energy activities in Hong Kong amounted to 39.13 Mt CO_2 eq, or 90.6% of Hong Kong's total emissions. Among them 38.949, 0.038 and 0.143 Mt CO_2 eq were emissions of CO_2, CH_4 and N_2O respectively. CO_2 emissions from energy accounted for 98.4% of the total of such emissions.

Of 2012 Hong Kong's emissions from energy activities, 29.427 Mt CO_2 eq, or 75.3% were from energy industry (electricity and towngas production); 7.424 Mt CO_2 eq, or 19% were from transport; 1.497 Mt CO_2 eq, or 3.8% were from other sectors (including commercial and residential sector); 760 kt CO_2 eq, or 1.9% were from manufacturing and construction industries; 22 kt CO_2 eq, or about 0.1% were from fugitive emission of CH_4.

2.3 Industrial Processes

2.3.1 Scope

Industrial processes mainly cover emissions of CO_2 from production of cement; HFCs and PFCs emissions from refrigerating, air-conditioning and fire fighting equipment; and SF_6 emissions from electrical equipment.

2.3.2 Methodologies

According to clinker production and related data, Tier 2 method of the *Revised 1996 IPCC Guidelines* was adopted in estimating CO_2 emissions from cement production. At the same time, related parameters of the *2006 IPCC Guidelines* were also referenced. Tier 2(b) method of the *2006 IPCC Guidelines* was adopted to calculate HFCs emissions from air-conditioning of buses, rail trains, large-scale commercial establishments and government buildings, as well as industrial refrigeration. Tier 2(a) method was adopted to calculate HFCs emissions from air conditioning of motor vehicles, goods vehicles, industrial/commercial buildings, and refrigeration for domestic and commercial uses. Tier 1 method of the *2006 IPCC Guidelines* was adopted to calculate PFCs emissions from solvents. Tier 1(a) method of the *2006 IPCC Guidelines* was adopted to calculate emissions of HFCs and PFCs from fire fighting equipment. Tier 3 method of the 2006 IPCC Guidelines was adopted to calculate emissions of SF_6 used in electrical equipment.

2.3.3 Emissions Inventory

In 2012, 1.667 Mt CO_2 eq of GHG were released from industrial processes in Hong Kong, which accounted for 3.9% of the total emissions. Among which, 607,000 t CO_2 eq or 36.4% were from cement production. There were 990,000 t, 0 t and 70,000 t CO_2 eq of HFCs, PFCs and SF_6 emissions respectively from refrigeration, air-conditioning, fire fighting and electrical equipment in Hong Kong.

2.4 Agriculture

2.4.1 Scope

The reporting of emissions from agriculture mainly includes: CH_4 and N_2O emissions from livestock enteric fermentation and manure management; N_2O emissions from agricultural soils and emissions of CO_2, CH_4 and N_2O from savanna burning.

2.4.2 Methodologies

Tier 1 method of the *Revised 1996 IPCC Guidelines* was adopted and reference was made to the default emission factors in the *2006 IPCC Guidelines* in calculating CH_4 emissions from enteric fermentation. Tier 1 method of the *2006 IPCC Guidelines* was adopted to calculate the direct and indirect emissions of NO_2 from agricultural land. Tier 1 method of the *2006 IPCC Guidelines* was adopted to calculate the emissions of CH_4 and N_2O from savanna and grassland burning.

2.4.3 Emissions Inventory

In 2012, Hong Kong emitted approximately 30,000 t CO_2 eq from agriculture, or 0.1% of its total emissions. CH_4 and N_2O emissions from livestock enteric fermentation and manure management amounted to 16,000 t CO_2 eq while the N_2O emissions from agricultural soil were approximately 14,000 t CO_2 eq.

2.5 Land-use Change and Forestry

2.5.1 Scope

The reporting under LUCF mainly covers: changes in biomass carbon stock caused by conversion of forestland, cropland and grassland.

2.5.2 Methodologies

Tier 1 method of the *2006 IPCC Guidelines* was adopted and reference was made to relevant emission factors in estimating CO_2 emissions/removals in relation to changes in biomass carbon stock caused by conversion of forestland, cropland and grassland. Tier 1 method of the *2006 IPCC Guidelines* was also adopted to calculate the emissions and removals of CO_2 caused by changes in biomass stock of forestland and other woody biomass.

2.5.3 Emissions Inventory

In 2012, as carbon sinks, LUCF activities had a net removal of CO_2 totaling approximately 466 kt, all being carbon absorbed through conversion of forestland and grassland that lead to carbon stock increase in forestry and other woody biomass.

2.6 Waste

2.6.1 Scope

The reporting under waste mainly includes: CH_4 emissions from solid waste landfilling; CH_4 and N_2O emissions from treatment of domestic sewage and industrial wastewater; and CO_2 emissions from waste incineration.

2.6.2 Methodologies

The calculation of emissions from waste disposal is mainly based on the *2006 IPCC Guidelines*. Tier 2 method was adopted to calculate CH_4 emissions from landfilling of solid waste. Tier 1 method was adopted to calculate the emissions of CH_4 and N_2O from wastewater treatment, and Tier 1 method was also adopted to calculate the emissions of CO_2 from chemical waste treatment.

2.6.3 Emissions Inventory

In 2012, Hong Kong emitted 2.35 Mt CO_2 eq from waste treatment, which accounted for 5.4% of its total emissions. Most of such emissions were CH_4 which amounted to 2.152 Mt CO_2 eq, or 97.8% of the total emissions of CH_4 in Hong Kong.

2.7 Quality Assurance and Quality Control of the GHG Inventory

2.7.1 The Quality Assurance and Quality Control Efforts in the Present Inventory Compilation Process

The institutions engaged in inventory preparation were always mindful of enhancing the quality assurance and quality control efforts in the preparation of the inventory to improve the quality of the inventory compilation. The efforts mainly include:

In selecting the methodology for compilation, the guidelines provided by the IPCC were strictly observed to ensure the scientificity, comparability and transparency of the inventory compilation;

During the process of collection and analysis of activity data, the institutions worked closely with the relevant departments to acquire authoritative first-hand official information, which was managed, checked and examined by specialised personnel, to ensure the authoritativeness and rationality of the data used.

In determining emission factors, emission factors in compliance with Hong Kong's actual circumstances were adopted as far as practicable. In the absence of emission factors with characteristics of Hong Kong, reference was made to the default emission factors provided by the IPCC Guidelines to ensure the accuracy of the inventory outcome.

2.7.2 Uncertainties Analysis

Efforts to minimize uncertainties. Measures to reduce the uncertainties mainly included the following two-pronged approach. Firstly, official statistics, local measured emission factors and parameters, as well as the latest parameters of the *2006 IPCC Guidelines*, were adopted with a view to improving the data collection process. Secondly, based on data availability, higher-tiered methods were used where appropriate to assess the emissions inventory.

Uncertainties that exist in the inventory. According to the propagation of error analysis in the *2006 IPCC Guidelines*, the uncertainty of Hong Kong's GHG inventory in 2012 is around 4.3%. Emissions produced in the process of coal-fired power generation are the major reason for the uncertainty due to the limitation of the statistics on the type and quantity of coal consumption at power plants.

2.8 Hong Kong's Greenhouse Gas Inventory in Past Years

In the past, Hong Kong contributed and submitted the 2005 Hong Kong GHG Inventory for the Second National Communication. In order to maintain the consistency with other parts of this report, this section will also provide an overview of the inventory information for the two historical years of the First and Second National Communications, i.e. 1994 and 2005. For better comparison among inventories of different years in terms of emission scope and source, Hong Kong will re-evaluate and update the 2005 GHG inventory in the Third National Communication accordingly.

2.8.1 Hong Kong's Greenhouse Gas Inventory in 1994

In 1994, Hong Kong's GHG emissions excluding LUCF amounted to 35.729 Mt CO_2 eq. Amongst which CO_2, CH_4, N_2O and fluorinated gas accounted for 94.3%, 4.3%, 1.1% and 0.4% respectively (Table 7-5); the carbon sink from LUCF amounted to 0.469 Mt CO_2 eq. After deducting the carbon sink, Hong Kong's net GHG emissions in 1994 stood at 35.260 Mt CO_2 eq. Amongst which CO_2, CH_4, N_2O and fluorinated gas accounted for 94.2%, 4.4%, 1.1% and 0.4% respectively.

Table 7-5 Hong Kong's GHG Emissions by gas in 1994

GHG	Excluding LUCF		Including LUCF	
	CO_2 eq (10^4t)	**Percentage (%)**	**CO_2 eq (10^4t)**	**Percentage (%)**
CO_2	3367.7	94.3	3320.9	94.2
CH_4	154.7	4.3	154.7	4.4
N_2O	37.7	1.1	37.7	1.1
Fluorinated Gas	12.7	0.4	12.7	0.4
Total	3572.9		3526.0	

2.8.2 Hong Kong's Greenhouse Gas Inventory in 2005

In 2005, Hong Kong's GHG emissions excluding LUCF amounted to 41.565 Mt CO_2 eq. Amongst which CO_2, CH_4, N_2O and fluorinated gas accounted for 91.7%, 5.2%, 1.0% and 2.1% respectively (Table 7-6); the carbon sink from LUCF amounted to 0.412 Mt CO_2 eq. After deducting the carbon sink, Hong Kong's net GHG emissions in 2005 stood at 41.153 Mt CO_2 eq. Amongst which CO_2, CH_4, N_2O and fluorinated gas accounted for 91.6%, 5.3%, 1.0% and 2.1% respectively.

Table 7-6 Hong Kong's GHG emissions by gas in 2005

GHG	Excluding LUCF		Including LUCF	
	CO_2 eq (104t)	**Percentage (%)**	**CO_2 eq (104t)**	**Percentage (%)**
CO_2	3812.0	91.7	3770.8	91.6
CH_4	217.8	5.2	217.8	5.3
N_2O	39.9	1.0	39.9	1.0
Fluorinated Gas	86.8	2.1	86.8	2.1
Total	4156.5		4115.3	

Chapter 3 Mitigation Measures and Their Effects

Being an international city, Hong Kong has all along attached much importance to the issue of climate change. To echo with national actions, Hong Kong has spared no efforts in mitigating climate change by promoting green and low-carbon communities, and effectively keeping GHG emissions in check through various policies and measures, including revamping the fuel mix for power generation, improving energy efficiency, promoting green road transport, promoting the use of cleaner fuel in vehicles, turning waste into energy and tree-planting.

The series of GHG mitigation measures implemented in Hong Kong has gained public support and active participation. Public awareness of energy efficiency and low-carbon living continues to rise, which has led to reduced growth of energy consumption in Hong Kong in recent years. From 2005 to 2012, Hong Kong's population growth was 5.0% and the real GDP growth was 29.2%, but electricity consumption in the same period only rose by 7.4%. From 2005 to 2012, Hong Kong's per capita GHG emissions remained at 6.0 tonnes CO_2 eq, while the CO_2 emissions per unit GDP dropped by around 20%. Details of the quantitative emission reduction measures are set out in Table 7-7.

3.1 Emission Reduction by Energy Industry

Electricity generation is Hong Kong's major source of CO_2 emissions. Major mitigation policies and actions taken in Hong Kong's electricity sector include: revamping the fuel mix for electricity generation, proactively developing renewable energy, and enhancing the management of greenhouse gas emissions from power companies. Regarding the revamp of fuel mix for electricity generation, the Hong Kong Government announced in 2015 a cleaner fuel mix option for 2020, i.e. to increase the proportion of natural gas generation to 50% with nuclear power import accounting for around 25% of the total fuel mix. The Hong Kong Government also plans to develop more renewable energy and step up efforts to promote energy saving. In addition, despite the limited potential to develop renewable energy in Hong Kong under the existing technological level due to constraints from geographical and climatic conditions, the power companies have been making efforts to promote the development of renewable energy and the construction of Hong Kong's largest solar photovoltaic system (with a capacity of up to 1 megawatt) was completed in 2013.

3.2 Buildings

Electricity consumption of buildings accounts for about 90% of Hong Kong's total electricity consumption. Major mitigation policies and actions taken in Hong Kong's buildings include:

Enhancing energy efficiency of buildings. To enhance the energy saving ability of residential buildings, the Buildings Department issued *the Guidelines on Design and Construction Requirements for Energy Efficiency of Residential Buildings* in September 2014, which require the roofs and walls of new residential buildings to be designed and constructed in compliance with the Residential Thermal Transfer Values in the Guidelines for obtaining floor area concessions for green/amenity features and non-mandatory/non-essential plant rooms and services. *The Buildings Energy Efficiency Ordinance* was enacted in 2010 and came into full effect in September 2012. It requires key building services installations such as air-conditioning, lighting, electrical, and lift and escalator installations to comply with the energy saving requirements under the Building Energy Code (BEC), as well as the energy audit requirements for particular categories of buildings specified in the Energy Audit Code (EAC). The first comprehensive review of BEC and EAC was completed and both the BEC 2015 Edition and EAC 2015 Edition were gazetted in December 2015. In January 2011, the HKSAR Government issued the Sustainable Building Design Guidelines to regulate building separation and greenery coverage. It also encourages buildings to register for certification under BEAM Plus, the latest version of the *Hong Kong Building Environmental Assessment Method (HK-BEAM)*.

Enhancing the energy efficiency of electrical appliances. The Government has introduced a *Voluntary Energy Efficiency Labelling Scheme* which covers 13 types of electrical appliances, 2 types of gas appliances, 7 types of office equipment, and 1 type of petrol private vehicle. This Scheme facilitates the selection and use of more energy efficient products by the general public. The HKSAR Government enacted the *Mandatory Energy Efficiency Labelling Scheme* in 2008 to cover room air-conditioners, refrigerating appliances, compact fluorescent lamps, washing machines and dehumidifiers. The grading standards for room air-conditioners, refrigerating appliances and washing machines were revised in November 2015. The new standards have now been fully implemented.

Promoting carbon audit for buildings. The HKSAR Government has published *Guidelines to Account for and Report on Greenhouse Gas Emissions and Removals for Buildings (Commercial, Residential or Institutional Purpose) in Hong Kong*, which provides guidance on a systematic and scientific approach to report on the GHG emissions of buildings, facilitating voluntary reduction and offsetting of GHG emissions. A three-year programme was also completed in 2015 to conduct energy-cum-carbon audits for 120 government buildings and public facilities, including public markets, public swimming pools, indoor sports centres, secondary schools, office buildings, healthcare facilities, community halls and markets, etc. To encourage more bureaux and departments to carry out regular carbon audits for government buildings and public facilities, 10 seminars on carbon audits were held in 2015.

3.3 Transport

Mitigation policies and actions for the transport sector include:

Promoting the wider use of electric vehicles. The major measures implemented by the HKSAR Government are as follows: First Registration Tax for Electric Vehicles (EVs) is waived till 31 March 2017; more than 1300 EV chargers have been set up for public use; the HKSAR Government has taken the lead in using EVs; a HK$300 million Pilot Green Transport Fund has been set up in March 2011 to support the testing of green and innovative technologies applicable to the public transport sector and goods vehicles; the HKSAR Government has allocated HK $180 million to subsidize the franchised bus companies to purchase 36 single-deck electric buses for trial runs to assess their operational efficiency and performance under local conditions.

Tax concession. From April 2007 to end March 2015, the HKSAR Government offered First Registration Tax concession for newly registered low emissions, high fuel efficiency environmentally-friendly petrol private car[1].

3.4 Waste Management

Hong Kong encourages energy saving, waste reduction and green living style. Mitigation policies and actions in respect of waste management are as follows:

Support waste reduction. The HKSAR Government has promoted source-separation of waste and advocated waste reduction, recovery and recycling. In 2014, 52% of municipal solid waste generated in Hong Kong was recovered.

Waste to energy. All operating strategic landfills in Hong Kong utilize landfill gas to generate electricity for use by their own infrastructural facilities and energy for use by their leachate treatment plants. CH_4 gas generated in the four large-scale secondary sewage treatment plants in Hong Kong is directly used for electricity generation for use by the plant facilities, and as fuel for boilers for plant heating.

Enhance recycling of waste. By around 2017, it is anticipated that the first phase of the Organic Waste Treatment Facilities would be completed for operation, which is the first food waste treatment plant in Hong Kong. The facilities would adopt biological treatment technologies to turn food waste from commercial and industrial sectors into useful resources such as compost products and biogas. A sludge treatment facility with advanced incineration technology has commenced operation, and the HKSAR Government is planning for the development of the first phase of the Integrated Waste Management Facilities employing incineration technology to turn waste into energy.

3.5 Tree-planting and Urban Greening

Since 2010, about 36 million trees and shrubs have been planted in Hong Kong and about 4 million of them are trees. In recent years, the HKSAR Government has promoted adoption of a comprehensive and sustainable approach in dealing with quality urban

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[1] First Registration Tax concession for Environment friendly Petrol Private Car has come to an end on 1 April 2015.

landscape design and tree management initiatives, including the formulation and implementation of green master plans, as well as the use of vertical landscape, rooftop landscape, permeable paving materials and rainwater harvesting, etc. By early 2014, Hong Kong has designated a total of 24 country parks and 22 special areas and the total area was as large as 443 square kilometres, representing around 40% of land in Hong Kong. Such protected land, in addition to helping maintain the rich biodiversity in Hong Kong, can further enhance Hong Kong's CO_2 removal capacity.

3.6 Achievements

The series of GHG mitigation measures implemented in Hong Kong has gained public support and active participation. Public awareness of energy efficiency and low-carbon living continues to rise, which has led to reduced growth of energy consumption in Hong Kong in recent years. The quantitative emission reduction measures are set out in Table 7-7. From 2005 to 2012, Hong Kong's CO_2 emissions per unit GDP dropped by around 20%.

3.7 International Market Mechanism

On 1 December 2009, the HKSAR Government announced the *Supplementary Notes on the Implementation of Projects under the CDM by Hong Kong Enterprises on the Mainland*, clearly setting out the requirements and related application procedures for Hong Kong enterprises to develop CDM projects on the Mainland. Those Hong Kong enterprises meeting the requirements may present the Letter of Certification for Hong Kong enterprises under the *Measures for Operation and Management of CDM Projects in China* issued by the Environmental Protection Department to apply as Chinese enterprises to NDRC for developing CDM projects. Those qualified Hong Kong enterprises may utilise the additional funds and technologies provided by foreign institutions to develop CDM projects on the Mainland. The Environmental Protection Department already issued 73 Letters of Certification for Hong Kong enterprises, from that NDRC approved 50 projects, of which 48 had been registered with the United Nations. The emission reduction projects mainly included wind power, hydro power, reuse of waste heat, solar power, biomass thermal energy and waste combustion. The projects were widely distributed throughout 24 provinces of the country, including Shandong, Liaoning, Jiangsu, Guangdong, Jilin, Hubei, Sichuan and Inner Mongolia, etc.

3.8 Measurement, reporting and verification of mitigation actions

Regarding Hong Kong's mitigation actions, the Secretariat of the Interdepartmental Working Group on Climate Change has consolidated and recorded the progress of mitigation actions taken by bureaux and relevant departments. The HKSAR Government organised a seminar in the first quarter of 2016 to enhance the understanding of bureaux and relevant departments on the measurement, reporting and verification of mitigation actions.

To facilitate the development of GHG certification and verification, Hong Kong introduced the accreditation service for GHG certification/verification providers in December 2012. Accredited organisations are permitted to verify GHG emission reports in accordance with ISO14064 certification standard.

Chapter 4 Finance, Technology and Capacity-Building Needs and Support Received

4.1 Needs for Funding

Major needs for funding include those for compilation of GHG inventories, organisation of seminars and workshops on capacity building, implementation of mitigation and adaptation measures, and participation in international conferences and training, etc. At present, the relevant expenses and human resources input are covered by HKSAR Government's recurrent expenditure.

4.2 Needs for Technologies

Major needs for technologies for mitigating climate change include those on building energy efficiency, new wall materials, hybrid power and electric power vehicles (including large public vehicles), high efficiency fast recharging facilities for electric vehicles, high efficiency batteries and materials, renewable energy (in particular building-integrated photovoltaics (BIPV) system), etc.

Major needs for technologies for adaptation to climate change include those for the protection of habitats and ecosystems, climate risk assessment for built environment and infrastructure developments, forecast of energy demand and supply changes, and analysis of the impacts on food chain, food hazards and water resources, etc.

4.3 Needs for Capacity Building

Major requirements of capacity building include strengthening the team and capacity building for enhancing information exchange and compiling the GHG emissions inventory; enhancing the current legislation and management; formulating new legislation; stepping up monitoring; enhancing the government's and enterprises' capability; updating the disaster management and contingency plans; conducting researches and studies, as well as raising the government and public awareness of climate change and their abilities to combat climate change.

Chapter 5 Other Relevant Information

Hong Kong has kicked off a series of activities in combating climate change, including strengthening monitoring of and research on climate systems; enhancing public education, publicity and capacity building on climate change; encouraging public engagement; enhancing public awareness; and developing co-operations and exchanges with counterparts in the country and abroad.

5.1 Monitoring and Research on Weather Systems

The Hong Kong Observatory (HKO) undertakes the monitoring of and conducting research in climate change in Hong Kong. Over the years, HKO has been conducting meteorological and climate monitoring and related research work. HKO provides weather forecasts, real-time weather information, tropical cyclone information, weather maps, radar and satellite imageries and extreme weather warnings. HKO also conducts research on climate change, analyses the impacts of weather and climate on society, and forecasts annual rainfall and yearly number of tropical cyclones affecting Hong Kong. It has updated the projections of Hong Kong's annual temperature, rainfall and extreme weather events by making use of the latest climate model data and observations.

5.2 Education, Publicity and Public Awareness

Hong Kong has attached much importance to education and publicity work in the areas of environmental protection and climate change with a view to enhancing public awareness. The topic of climate change has been included in subjects such as General Studies, Geography, Science, Technology Education and Liberal Studies of the primary and secondary school curricula. To enrich knowledge on climate change among primary and secondary students, a series of reading materials have been published in Hong Kong. Different departments of the HKSAR Government have also made efforts through various channels to enhance public awareness on climate change, extreme weather, energy conservation and greening, and strive to lead a change in lifestyle and behaviour within the community.

On public education and promotion of awareness on climate change, the HKO has revamped the climate change webpage published a number of educational articles online and provided information on extreme weather events and climate projection data to share with the public the latest information and research findings. The HKO has also worked with other Government departments and organizations to hold climate change talks for the general public, schools, universities, Government departments and professional bodies. Moreover, it has published a climate change pamphlet and launched an online climate quiz to enhance the community's knowledge of climate change.

The Environmental Protection Department has organised a "Green Hong Kong · Carbon Audit" campaign to encourage various community sectors to carry out carbon audits and carbon reduction activities in buildings. It also launched a carbon footprint repository for listed companies in December 2014 to encourage private companies to reduce emissions.

The HKSAR Government has established an Environment and Conservation Fund to subsidise local non-profit making organisations to implement projects and activities related to environmental and nature conservation. The scope of the Fund covers small-scale demonstration projects such as rooftop greening and installation of renewable energy facilities and energy saving devices in non-profit making organisations and schools, which further enhance the understanding of climate change in the community and among students.

5.3 Strengthening Co-operations with Other Places in China and Abroad

Exchanges and co-operation were conducted on researches in regional development strategies on clean energy and renewable energy, including the promotion of development and application of clean energy and renewable energy; support to energy saving and emission reduction at enterprises; implementation of climate change-related scientific researches; development and application of technologies; education and capacity building work.

Hong Kong has become a member of the C40 Cities Climate Leadership Group (C40) Steering Committee since 2011, promoting collaboration amongst cities in the world to combat climate change and enhance energy efficiency. The Hong Kong-Guangdong Joint Liaison Group on Combating Climate Change (JLGCCC), co-chaired by the Secretary for the Environment of the HKSAR Government and the Director of the Guangdong Development and Reform Commission, was set up in 2011 to negotiate issues on combating climate change, promote scientific research and data sharing on GHG emission and climate change, as well as to co-operate and exchange on the relevant scientific studies, technology development and application and publicity education.

Table 7-7 List of Hong Kong's Mitigation Actions

No.	Action Name	Targets or Major Components	Sectors / GHG covered	Time frame	Nature of action (mandatory/ voluntary, government/ market)	Supervision department	Status (under planning/ in progress/ completed)	Progress information	Methodologies and assumptions	Estimated emission reduction effect	Supported by
1	Maximising energy efficiency: Energy Saving Plan for Hong Kong's Built Environment 2015-2025+	The plan is the first-ever energy saving blueprint for Hong Kong. It analyses energy use in Hong Kong and sets out the policy, strategy, target and key actions that can help Hong Kong achieve the new target.	All sectors /CO_2	2015-2025+	Mandatory/government	ENB	In progress	Electricity demand reduction	Emission reduction=energy savings* emission factors	Emission reduction expected to be 1 400 kt/year by 2025	The SAR Government
2	Maximising energy efficiency: Buildings Energy Efficiency Ordinance	The Buildings Energy Efficiency Ordinance came into operation in September 2012 and since then commercial buildings have been required to carry out energy audits within the specified period. The Building Energy Codes (BEC) cover lighting, air conditioning, electrical and lift & escalator installations, which stipulate the minimum energy performance standards (MEPS) of these installations. It will be regularly reviewed at 3 years interval to keep pace with technological development.	Buildings /CO_2	2012-present	Mandatory/ government	EMSD	In progress	Electricity demand reduction	Emission reduction=energy savings* emission factors	Emission reduction expected to be 1 900 kt/year by 2025	The SAR Government
3	Maximising energy efficiency: Mandatory Energy Efficiency Labelling Scheme (MEELS)	MEELS covers five types of electrical appliances prescribed products, namely room air conditioners, refrigerating appliances, compact fluorescent lamps (CFLs), washing machines and dehumidifiers, which together account for about 60% of the annual electricity consumption in the residential sector.	All Sectors / CO_2	2009-present	Mandatory/ government	EMSD	In progress	Electricity demand reduction	Emission reduction=energy savings* emission factors	Emission reduction expected to be 682.5 kt/year by 2025	The SAR Government

No.	Action Name	Targets or Major Components	Sectors / GHG covered	Time frame	Nature of action (mandatory/ voluntary, government/ market)	Supervision department	Status (under planning/ in progress/ completed)	Progress information	Methodologies and assumptions	Estimated emission reduction effect	Supported by
4	Maximising energy efficiency: District cooling system (DCS) in the Kai Tak Development (KTD)	The DCS at KTD is a large scale centralised air-conditioning system. It utilises sea water to produce chilled water at the central plants and distributes the chilled water to consumer buildings in the KTD through underground water piping network. The project would be implemented in 3 phases from 2011 to 2022.	Energy/ CO_2	2011-2022	Construction: Mandatory/ government Use: Voluntary/ market	EMSD	In progress	Electricity demand reduction	Emission reduction= energy savings*emission factors	The estimated emission reduction is 59.5 kt/year once DCS is fully implemented.	The SAR Government
5	Maximising energy efficiency: Wider use of energy efficient water-cooled air-conditioning system using fresh water cooling tower	Over 2 000 cooling towers were built and have commenced operation since the launch of the Fresh Water Cooling Tower Scheme in 2000 to the end of 2015. It is estimated that construction of about 1 500 cooling towers will be completed from 2016 to 2025. The EMSD will continue to promote wider use of fresh water cooling towers.	Energy/ CO_2	2000 onwards	Voluntary/ government	EMSD/ ENB	In progress	Electricity demand reduction	Emission reduction= energy savings*emission factors	The estimated emission reduction is 500 kt/year by 2025.	The SAR Government
6	Turning waste to energy: Construction of a dedicated Sludge Treatment Facility	The Phase 1 operation of a dedicated Sludge Treatment Facility at Tsang Tsui, Tuen Mun commenced in April 2015. It adopts advanced incineration technology to handle sewage sludge generated from the sewage treatment works. Thermal energy generated from incineration is turned into electricity to fully meet the energy needs of the Facility. Surplus electricity from the Facility is exported to the public power grid as a secondary power source for the community of Hong Kong.	Energy and Waste/CO_2, CH_4	2010-present	Mandatory / government	EPD	In progress	Reduction of GHGs	Emission reduction=Amount of alternative fossil energy*emission factors	260 kt/year	The SAR Government

No.	Action Name	Targets or Major Components	Sectors / GHG covered	Time frame	Nature of action (mandatory/ voluntary, government/ market)	Supervision department	Status (under planning/ in progress/ completed)	Progress information	Methodologies and assumptions	Estimated emission reduction effect	Supported by
7	Turning waste to energy: Organic Waste Treatment Facilities (OWTF)	By around 2017, it is anticipated that the first phase of the OWTF would be completed for operation. The facilities would adopt biological treatment technologies to turn food waste from commercial and industrial sectors into useful resources such as biogas and compost products.	Energy and Waste/CO_2, CH_4, N_2O	2017 onwards	Construction: Government Use: Voluntary/market/ government	EPD	Under planning	Reduction of GHGs	Emission reduction=Amount of alternative fossil energy*emission factors	25 kt/year for Phase 1	The SAR Government
8	Turning waste to energy: Integrated Waste Management Facilities (IWMF) Phase 1	The HKSAR Government is planning for the Phase 1 the IWMF which will adopt modern waste-to-energy technology to substantially reduce the volume of municipal solid waste and turn waste into energy.	Energy and Waste/ CO_2	2023	Mandatory/ government	EPD	In progress	Reduction of GHGs	Emission reduction=Amount of alternative fossil energy*emission factors+ Avoiding the generation of landfill gas	440 kt/year	The SAR Government

Part VIII Basic Information of Macao SAR on Addressing Climate Change

Macao is a Special Administrative Region (SAR) of the People's Republic of China. It is a city with mild climate, limited natural resources, high population density and well-developed gaming industry. Being full of vibrancy, it is also a world famous leisure centre for tourists. Since 2010, Macao SAR has taken a series of policies and actions in addressing climate change which have achieved positive results.

Chapter 1 Regional Circumstances

1.1 Natural Conditions and Resources

The Macao Special Administrative Region (hereinafter referred to as Macao SAR) is situated in the west side of the estuary of the Pearl River Delta on the South China coast, bordering the Zhuhai City of the Guangdong Province in the north, overlooking the Hong Kong SAR which is located in the east side of the Pearl River's estuary, facing the South China Sea to the south, being separated by seawater from the adjacent Wanzai and the Hengqin islands of the Zhuhai City to the west. With its three sides being engulfed by sea, Macao mainly consists of 4 components: Macao Peninsula (hereinafter referred to as Macao), Taipa and Coloane islands as well as Cotai land area reclaimed from sea.

Under the subtropical maritime climate, Macao is significantly influenced by monsoon. Macao has a mild climate with its annual mean temperature of 22.6°C based on climate data from 1981 to 2010; January is the coldest month and the monthly mean temperature is 15.1°C; July is the warmest month and the monthly mean temperature is 28.6°C. Its annual average precipitation is 2,058.1 mm with significant seasonal differences. Macao's rainy season lasts from April to September, accounting for more than 84% of its total annual precipitation, during which extreme heavy-precipitation events may lead to a maximum daily rainfall above 300 mm. The extreme weather and climate events that influence Macao include tropical cyclones and associated storm surges, strong monsoons, rainstorms and thunderstorms. About 5 or 6 tropical cyclones impact Macao on annual average, among which 1 or 2 may bring high winds up to Force 8 or even beyond in Beaufort wind scale to Macao.

Macao's land resources are extremely limited, and traditionally its land area has been increased through reclamations from sea. Through the new Reclamation Program approved by the Central Government of China in 2009, additional 361.65 hectares of land was expanded as a new urban space. In addition, Macao SAR officially took over Hengqin Campus, University of Macao whose land area was 1.4 km^2 on 20 July 2013. In 2014, its total land area was 30.3 km^2, an increase by 2.0% relative to 2010.

The local water storage facilities in Macao are insufficient, and over 95% of its drinking water needs to be introduced from Guangdong Province. In 2014, Macao's total water consumption was up to 83.49 million m^3, of which the business sector and industries accounted for 51%, followed by the household water consumption accounting for 42%, and the remaining 7% were consumed by governmental and other facilities.

1.2 Population and Society

Macao is among the most densely populated region in the world. In 2014, Macao's total population was 636 thousand, increasing by 27.0% compared to 2010, and its density was approximately 21 thousand persons per square kilometer. The estimated total labour force in Macao was about 395,000, of which 388 thousand were employed population. The employed population in the primary industry accounted for only 0.2% of the total labour force, and that in the secondary and tertiary industries accounted for 15.7% and 84.1% respectively.

Based on the educational statistics for 2014/2015 by Education and Youth Affairs Bureau, the total number of schools in Macao was 74, with 69,500 students receiving regular education. There were also 10 tertiary education schools with about 31,000 students, of whom the resident ones accounted for 60.3%, and the non-resident for 39.7%.

In 2014, there were 1,592 doctors, 1,990 nurses and 1421 hospital beds in Macao. The spending on hospitals totaled 5.3 billion Patacas in 2014, accounting for 9.2% of the total expenditure of the SAR government, which was equivalent to 1.2% of Macao's GDP.

1.3 Economic Development

With rapid economic development, in 2014 the GDP (based on current price, the same below) was 443.5 billion Patacas, and the per capita GDP was 713 thousand Patacas. The GDP has continued to grow for a decade with an average annual growth rate of 11%. In Macao's GDP, the contribution from the primary industry was barely null, but that from the secondary and tertiary industries accounted for 5.2% and 94.8% respectively. The gaming industry, a pillar of Macao's economy, accounted for 58.3%; in addition, real estate, wholesaling/retailing and construction were also very important industries in Macao, accounting for 8.3%, 5.2% and 4.3% respectively. Tourism played an important role in the economic development. In 2014, the number of visitors to Macao was 31.53 million, most of whom were from China's mainland, accounting for 67.4% of the total.

In 2014, Macao's total energy consumption was about 0.718 Mtce, of which the light diesel accounted for 34.2%, kerosene for 20.1%, gasoline for 15.1%, heavy oil for 10.6%, natural gas for 10.5% and petroleum gas for 9.5% respectively. Of the total energy consumption, road transportation accounted for 25.1%, air transportation for 19.4%, the energy processing and conversion sector for 18.7%, waterway transportation for 13.0%, commercial, catering and hotel sector for 11.7%, manufacturing industries and construction for 9.0%, households for 2.6%, and the rest for 0.5%.

Macao's power consumption is dominated by electricity input from the Guangdong Province, which is supplemented by local power generation by heavy oil and natural gas. Since 2007, the local power generation has been continuously decreased with increasing electricity input. In 2014, Macao's local power generation was only 640 million kWh, and the electricity input was 4.09 billion kWh.

The transportation system in Macao consists of 3 components: land roads, waterway and aviation. In 2014, the total road length in Macao was 424 km, with 240 thousand vehicles and 141 thousand passenger ferry trips. The commercial flights by destinations to and from the Macao International Airport totaled 24 thousand.

The basic information of Macao SAR in 2012 and 2014 is shown in Table 8-1.

Table 8-1 Basic information of the Macao SAR in 2012 and 2014

Criteria	2012	2014
Population (in 10,000 at year end)	58.2	63.6
Land area (km^2)	29.9	30.3
GDP (in 100 million US$, 1 US$ = 7.9899 Patacas)	430.3	555.1
per capita GDP (US$)	75531	89287
Percentage share of industry in GDP①	4.1	5.2
Percentage share of services in GDP	95.9	94.8
Percentage share of agriculture in GDP	0	0
Land area for agriculture purposes (km^2)	0	0
Percentage share of urban population in total	100	100
Livestock (head)	569	438
Cattle	5	5
Horse	548	419
Pig	3	3
Sheep	13	11
Forest area (km^2)	2.98	2.98
Population in poverty (in 10,000 persons)②	2.8	2.3
Life expectancy at birth (year)	Male: 79.3 Female: 85.8	Male: 79.6 Female: 86.0
Literacy rate (%)③	95.6	95.6

Note: ① The industrial sectors here include mining, manufacturing, water, electricity and gas production and supply, as well as construction that belong to the secondary industry;

② The data here refer to employed people with low income (an average monthly income of less than 4,000 Patacas);

③ The data are based on the literacy rate of population aged over 15 shown in the census of Macao in 2011.

1.4 Institutional Arrangements for Addressing Climate Change

The Government of the Macao SAR has always attached great importance to climate change issues. In order to effectively manage and coordinate the efforts in response to climate change, Macao SAR has established an Inter-departmental Working Group on Climate Change (hereafter referred to as the Working Group), which is responsible for coordinating the arrangements relating to the implementation of the United Nations Framework Convention on Climate Change, including the development of “measurable, reportable and verifiable” mitigation actions, and for promoting the mitigation and adaptation efforts within the private sectors and the general public for mobilizing the public to involve in addressing climate change.

The Working Group, led by the Secretariat for Transport and Public Works, has organized a total of 14 governmental departments to address climate change in synergy, including Civic and Municipal Affairs Bureau, Economic Services, the Statistics and Census Service, Health Bureau, Education and Youth Affairs Bureau, Tourist Office, Marine and Water Bureau, Housing Bureau, Environmental Protection Bureau, Civil Aviation Authority, Transport Bureau, Energy Sector Development Office, Transportation and Infrastructure Office and Macao Meteorological and Geophysical Bureau. Among them, Macao Meteorological and Geophysical Bureau coordinates the preparation of the basic information of Macao on addressing climate change for the *National Communications* and *Biennial Update Reports*.

Chapter 2 Macao's Greenhouse Gas Inventory of 2012

To prepare the Macao's GHG Inventory in 2012, the methodologies recommended by the *Revised 1996 IPCC Guidelines* and the *IPCC Good Practice Guidance* have been mainly utilized with individual parameters and default emission factors from the *2006 IPCC Guidelines.* According to the actual condition and the availability of related data, the reporting scope of Macao's GHG Inventory in 2012 mainly covers GHG emissions from energy and waste sectors. The estimated GHGs include CO_2, CH_4 and N_2O. However,HFCs, PFCs and SF_6 are excluded from the Macao's inventory due to lack of data.

2.1 Overview of the 2012 Inventory

In 2012, Macao's total GHG emission was 978 kt CO_2 eq (Table 8-2), of which the emission from energy accounted for 97.6%, and the emission from waste 2.4% (Figure 8.1). The total emissions of CO_2, CH_4 and N_2O were 939 kt, 5 kt CO_2 eq and 34 kt CO_2 eq, accounting for 96.0%, 0.5% and 3.5% of the total GHG emission respectively (Figure 8.2).

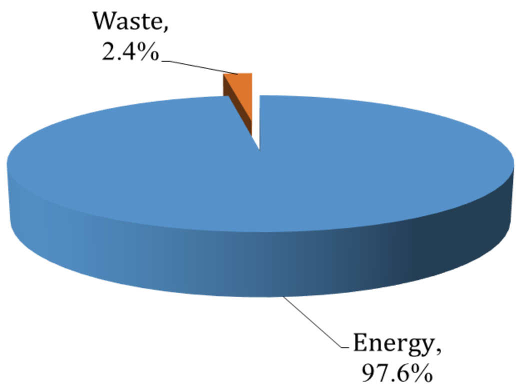

Figure 8-1 GHG emissions by sector in Macao in 2012

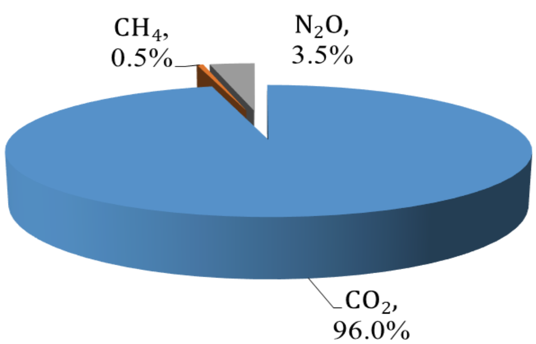

Figure 8-2 GHG emissions by gas in Macao in 2012

Table 8-2 Macao's GHG Inventory of anthropogenic emissions by sources and removals by sinks of GHG not controlled by Montreal Protocol in 2012 (10^4 tons of CO_2 eq)

GHG source and sink categories	CO_2	CH_4	N_2O	Total
Total (including LUCF)	93.9	0.5	3.4	97.8
1. **Energy**	93.5	0.5	1.5	95.5
Fuel combustion	93.5	0.5	1.5	95.5
Energy industries	28.2	0.1	0.1	28.4
Manufacturing industries & construction	11.3	0	0	11.3
Transport	33.9	0.3	1.3	35.5
Other sectors	20.1	0.1	0.1	20.3
Fugitive emission from fuels		NE		NE
2. **Industrial processes**	NO	NO	NO	NO
3. **Agriculture**		NO	NO	NO
4. **Land-use change and forestry**	NE	NO	NE	NE, NO
5. **Waste**	0.4	0	1.9	2.3
Solid waste disposal on land		NO		NO
Wastewater handling		NE	1.8	1.8
Waste incineration	0.4		0.1	0.5
Others		NO	NO	NO
Memo Items				
Special regional marine	19.2	0.0	0	19.2
Special regional aviation	17.7	0.0	0.2	17.9
International marine	NO	NO	NO	NO
International aviation	18.8	0	0.2	19.0
CO_2 emissions from biomass	8.4			8.4

Note: 1) Shaded cells do not require entries;

2) Due to rounding, the aggregation of various items may have slight difference with the total;

3) NO (Not Occurring) for activities or processes that do not occur for a particular gas or source/sink category within Macao;

4) NE (Not Estimated) for existing emissions and removals which have not been estimated;

5) Memo Items are not counted in the total emissions. CO_2 emissions from biomass combustion only include those from biogenic waste incineration;

6) Special regional marine and special regional aviation refer to the marine and aviation between Macao and the Mainland China, which have been counted into the total China GHG inventory as domestic aviation and navigation.

In 2012 the total emission from international aviation and special regional aviation in the Macao SAR was 369 kt CO_2 eq, and that from special regional marine 192 kt CO_2 eq. The emissions from the above sources, which are provided as Memo items, were not included in Macao GHG inventory. But special regional aviation and marine have been counted into the total China GHG inventory as domestic aviation and navigation. In addition, the GHG emissions resulting from biomass combustion of urban waste were about 84 kt CO_2 eq, which was listed in the Memo items. The total emissions from above mentioned sources are not counted in the total GHG emission in Macao.

2.2 Energy

2.2.1 Scope

For energy activities, the reporting scope of the Macao's GHG Inventory in 2012 mainly covers the CO_2, CH_4 and N_2O emissions from fossil fuel combustion in energy industries, manufacturing industries and construction, road transport and other sectors. Considering the fact that waste incineration is the major approach, and the power generation from waste incineration delivers to Macao's power grid, therefore the GHG emissions from fossil components (like cloth and plastic) combustion are counted into energy activities, while CO_2 emissions from biomass combustion of urban waste are not counted into the total emissions but only listed as a Memo item. Additionally, special regional marine, international aviation and special regional aviation are listed together under the Memo items.

2.2.2 Methodologies

For the GHG inventory for energy activities, Tier 1 method recommended in the *Revised 1996 IPCC Guidelines* has been applied for CO_2, CH_4 and N_2O emissions caused by fossil fuel combustion from energy industries, manufacturing industries and construction, other sectors as well as special regional marine, while for those from the road transport, international and special regional aviation, the Tier 2 method recommended in the *Revised1996 IPCC Guidelines* was utilized.

The activity data were the statistical and sectoral data that have been publicized in Macao. Both sector and fuel type classifications are basically the same as those given in the *Revised 1996 IPCC Guidelines*. The emission factors were mainly adopted from the *Revised 1996 IPCC Guidelines,* while for those unavailable, the default values were taken from the *2006 IPCC Guidelines*.

2.2.3 Emissions Inventory

In 2012, Macao's total GHG emissions from energy activities were 0.955 Mt CO_2 eq, accounting for 97.6% of the total, of which the emissions of CO_2, CH_4 and N_2O were 935 kt, 5 kt CO_2 eq and 15 kt CO_2 eq respectively. The CO_2 emissions from energy activities accounted for 99.6% of Macao's total CO_2 emissions.

Among Macao's total GHG emission from energy activities, 355 kt CO_2 eq was from the road transport, accounting for 37.2%; 284 kt CO_2 eq from the energy processing and conversion, for 29.7%; 113 kt CO_2 eq from the manufacturing and construction sectors, for 11.8%; and 203 kt CO_2 eq from other sectors (including commercial business, restaurants, hotels and residential), accounting for 21.3%.

2.3 Waste

2.3.1 Scope

The reporting scope of Macao's GHG inventory for waste disposal mainly covers CH_4 and N_2O emissions from urban sewage treatment, and CO_2 and N_2O emissions from waste incineration. As urban sewage treatment is based on the aerobic bioremediation with extremely little methane emissions in this process, the methane emission is ignored in this GHG Inventory.

2.3.2 Methodologies

Methodologies given in the *Revised 1996 IPCC Guidelines* have been utilized.

Activity data of N_2O emissions from wastewater handling were based on the total population provided by the Macao Statistics Bureau (MSB) and Macao's per capita annual protein consumption in 2012 from the Food and Agriculture Organization of the United Nations, and N_2O emission factors are based on IPCC default values; CO_2 and N_2O emissions from waste incineration were estimated using the activity data provided by MSB and IPCC recommended default emission factors.

2.3.3 Emissions Inventory

In 2012, Macao's GHG emission from waste sector was 23 kt CO_2 eq, accounting for 2.4% of the total, of which emissions from wastewater handling and waste incineration were 18 kt CO_2 eq and 5 kt CO_2 eq, accounting for 78.3% and 21.7% of the total respectively.

2.4 Uncertainty Analysis

2.4.1 Quality Assurance and Quality Control in the Process of the Inventory Preparation

To reduce uncertainties of the inventory, from methodological perspective, methodologies from the *Revised 1996 IPCC Guidelines* and the *IPCC Good Practice Guidance* have been adopted while taking into account the approaches from the *2006 IPCC Guidelines* to ensure that the methodologies were scientific, comparable and consistent. The institutions engaged in the preparation of the inventory in Macao have selected the higher-tier methods as many as condition allows. For instance, Tier 2 method has been adopted for road transport, international aviation and special regional aviation. As for activity data, the institutions have used the data verified by Macao SAR governmental departments such as the Macao Statistics and Census Service, Civil and Municipal Affairs Bureau, Environmental Protection Bureau, Transport Bureau and other governmental departments as much as possible to ensure the authority of the activity data. The national inventory team was invited to review the Macao GHG Inventory during the preparation process.

2.4.2 Uncertainties

Although the great efforts have been made in reporting scope, methodology and quality by the Macao Inventory team in the preparation of its 2012 GHG Inventory, some uncertainties still exist.

Tier 1 method from the *IPCC Good Practice Guidance* has been used to calculate uncertainties, taking into account the emission factor uncertainty estimation approach in the *Revised 1996 IPCC Guidelines* and the *2006 IPCC Guidelines*, and the overall uncertainty of GHG emissions in Macao is about 3.3%.

2.5 Inventory for Previous Submission Years

In the *Second National Communication*, Macao reported its 2005 GHG inventory. The total GHG emission in Macao in 2005 was 1.803 Mt CO_2 eq. The total GHG emissions in 2012 decreased by 0.825 Mt CO_2 eq or 45.8%, relative to 2005. The main reason was that the increase in outsourced electricity has resulted in lower emissions of local energy activities.

The Macao's 2012 and 2005 Inventories were the same in methodologies and GHG categories, but in the former, the CO_2 emissions from urban waste biomass combustion were included under the Memo items.

Chapter 3 Mitigation Actions and Their Effects

Macao has always attached great importance to climate change mitigation, and has been dedicated to building a low-carbon economy and society by taking policies and measures on energy mix optimization, energy conservation, energy efficiency improvement, and preference to public transport.

3.1 Policies and Targets for GHG Emission Control

In 2010, the SAR government proposed a concept of 'building a low-carbon Macao, creating green living together' to actively support and synergize with national policies and actions in addressing climate change. Macao's target for GHG emission control is to reduce GHG emissions per unit of GDP by 40-45% relative to 2005 level by 2020.

The Macao Environmental Protection Plan (2010-2020) developed in 2010 serves as an important program for environment protection and related emission reduction in Macao before 2020. With "sustainable and low-carbon development, public participation and regional cooperation" as the four core concepts, the plan which will be implemented in three stages, that is near-term (2010-2012), medium-term (2013-2015) and long-term (2016-2020), is aimed to improve the living environment and protect the health of the people. The near-term objective is to gradually improve environmental quality and enhance the environmental management. The medium-term objective is to bring the environmental pollution under control, initially form a good and secure ecological environment, and gradually develop environmental management regulations and technical standards. The long-term objective is to build a better system of environmental laws and regulations as well as technical norms, improve regional environmental quality, and form a harmonious, healthy and balanced ecosystem.

3.2 Actions for GHG Mitigation

3.2.1 Energy industry

Gradually increase the share of natural gas power generation. With the rapid economic development and increasing power demands, the electricity purchased by the SAR government from the Mainland China is showing a rising trend year by year. In order to reduce the power related emissions, Macao has introduced electricity generated by natural gas since 2008 to gradually replace heavy oil, with the share of natural gas increasing to 55.2% in 2014 relative to 34.5% in 2008.

Provide natural gas to public housing residents. Macao SAR government launched a public natural gas pipeline network construction project in early 2012. The Coloane receiving and decompression station was formally put into operation in 2013 by starting to supply natural gas to Coloane residents to improve the energy consumption and reduce CO_2 emissions in Macao. By 2015, 74.6% of the main pipeline network in Cotai Island has been constructed, which laid as a foundation for providing diversified clean energy.

Promote renewable energy including photovoltaic power generation. Macao SAR government has been actively promoting renewable energy. As early as 2010 in the electricity franchise contract, the power companies were required to receive renewable energy power to create the conditions for the solar photovoltaic grid connection. Since 2010, the solar photovoltaic power generation has been employed in a number of public sectors and institutions. With *Regulations on Solar Photovoltaic Grid Connection Safety and Installation* coming into effect in January 2015, Macao SAR government has not only provided the industry with the technical specifications, but also developed a tariff system to encourage investors to install a photovoltaic system, which has promoted solar photovoltaic power generation.

Additionally, Macao SAR government has launched programs and studies on urban energy demand and new energy application by issuing *Practice Guide on Solar Water Heating Application in Macao* and *Technical Guidelines on Building Energy Efficiency Optimization*. Moreover, it has tested and demonstrated the waste heat recovery technology for the central air conditioning system in selected public sectors and institutions.

3.2.2 Transport

Participate in "Airport Carbon Accreditation Program". The Macao International Airport received the "Reduced" level certification of "Airport Carbon Accreditation Program" launched by Airports Council International in 2014. Since 2012, Macao has been replacing the lighting systems and ground vehicles with energy-efficient lighting systems and environmentally friendly vehicles from year to year. It identified a specific target in 2015, which was to reduce carbon emissions per taking-off/landing by 20% in 2018 relative to 2012.

Implement "Public Transport Priority". Macao SAR government released the *General Policy Framework for Transit and Land Transportation in Macao* (2010-2020) in 2010 to establish a low-carbon and green transportation environment focused on "Public Transport Priority". The program was to be implemented in three stages which are near-term (2012), medium-term (2015) and long-term (2020). In addition to the public transport system consisting of light rail, bus, taxi, bicycle and pedestrian networks and the idea of the public transport to be given priority, the policy is aimed to improve the transport network, implement the control of vehicle growth, and promote the environmentally friendly vehicles, actions to be taken to compliment the New Reclamation Initiative in particular.

Promote the use of environmentally friendly vehicles. In order to promote the use of environmentally friendly vehicles, the government has taken a series of measures: encouraging buyers to give priority to environmentally friendly vehicles; shortening the mandatory period of inspection; updating the vehicle emission standard; requiring the bus sector to adopt environmentally friendly buses. By 2015, 310 Euro IV/V environmentally friendly buses were introduced with 20 being natural gas powered.

3.2.3 Energy Conservation and Efficiency Improvement

Energy conservation in Enterprises. Macao SAR government established *Environmental Protection and Energy Conservation Fund – Environmental Protection, Energy-saving Products and Equipment Subsidy Scheme* in 2011 to provide funding to Macao commercial and social communities to encourage them to use energy-saving products and equipment, thereby improving the quality of the local environment.

Energy conservation in public sectors and institutions. Macao SAR government set up an energy management mechanism in 2007 to improve the energy efficiency in public sectors with over 50 sectors and institutions involved so far. It implemented a plan on energy efficiency assessment for public sectors and institutions in 2015, developed an energy consumption capping standard appropriate to Macao based on sectoral per capita electricity consumption, and identified energy-saving targets to continuously improve and optimize energy management.

Energy conservation in public outdoor lighting systems. Macao government issued *Guidelines on Public Outdoor Lighting Design in Macao* in 2008 to vigorously promote LED application to outdoor lighting. The first segment lights replacement project was implemented in the new port reclamation in 2015 to replace 420 street lights with LED ones. Thanks to their significant efficiency, the government decided to gradually replace the street lights across districts and planned to replace the lights on three cross-sea Bridges in 2016, an action that would be replicated in the whole Macao then.

Energy conservation in hotels. Since 2007, Macao has held the "Green Hotel Award" every year to promote the hotel and related industries in an environmentally-friendly, low-carbon and clean way. Since the establishment of the Award, the number of participating hotels has been increasing continuously.

3.2.4 Urban Greening

Increase green coverage. The Macao SAR government has continuously planted trees, actively expanding the green space. Since 1982, Macao has held "Macao Green Week" every year to promote the importance of green environment and nature conservation through a series of events. The "Macao Green Week and Tree-Planting Activities" results in the planting of over 1,000 trees every year, leading to an increase of the total green coverage to about 8.59 million square meters in 2013.

Explore space greening. To become a green city, Macao began in 2011 to expand greening to the tops and façades of public garbage rooms, driving bridge piers and waiting stations, and carry out a thin-type fencing space greening experiment at the narrow streets, exploring to increase greening space in many ways.

3.3 Achievements

The Macao SAR government has actively promoted energy-saving and green-living ideas and increased the proportion of outsourced electricity for many years, with mitigation polices and measures having achieved initial results. The *Macao Energy Efficiency Status 2013* shows that the energy efficiency of the society as a whole has been partially improved and partially stabilized relative to the status in 2011. The energy consumption per thousand Patacas added value of the commercial buildings for retailing, restaurants and non-governmental organizations has decreased by 40.4%, 29.8% and 7.2% respectively. It is estimated that in 2012, per capita GHG emissions in Macao decreased by about 54.9% compared with 2005, GHG emissions per unit of GDP decreased by about 76.4% relative to 2005. The quantified measures to reduce emissions are shown in Table 8-3.

Table 8-3 List of Macao's Mitigation Actions

No.	Name	Action Target or Main Content	Sectors /GHG Covered	Time frame	Nature of Action[a]	Supervision Department	Status[b]	Progress	Methodology and Assumption	Expected Mitigation Effects	Supported by
1	Gradually increase the share of natural gas	Macao has introduced electricity generated by natural gas since 2008	Energy/CO_2	Since 2008	Government	Energy Industry Development Office	in progress	The percentage of power by natural gas increased from 34.5% in 2008 to 55.2% in 2014	Emission reduction =(electricity output from natural gas *average emission factor for Southern grid in 2008-2014)－(consumption of natural gas for power *natural gas emission factors) Starting year: 2008	From 2008 to 2014, total reduction: 188.4 kt CO_2	Macao SAR Government
2	Participating in Airport Carbon Accreditation Scheme launched by the Airports Council International	Reducing carbon emissions per aircraft taking-off/landing by 20% in 2018 relative to 2012. By increasing energy and fuel efficiency, and strengthening waste management and recycling to reduce airport carbon emission.	Transportation, waste/CO_2, CH_4, N_2O	2012-2018	Voluntary	Civil Aviation Authority	in progress		Carbon reductions per aircraft taking-off/landing = Carbon emissions per aircraft taking-off/landing for the current year - Carbon emissions per aircraft taking-off/landing for the base year Base year: 2012 Emission source boundary: Based on the requirement for Class II in Airport Carbon Accreditation Scheme, the amounts from direct emission and indirect energy emission shall be computed.	Carbon emission per aircraft taking-off/ landing was reduced by 14.47% in 2015 relative to 2012.	Macao International Airport Company Limited, Macao Airport Management Co., Ltd and Energy Saving Fund
3	Promote the use of environmentally friendly vehicles	New vehicles which can meet the environmental emission standard can enjoy tax concessions. The main target is to encourage citizens to use environmentally friendly vehicles in order to reduce emissions of CO_2 and exhaust pollutants.	Energy/CO_2	Since 2012	Government /Voluntary	Environmental Protection Bureau is responsible for the development of measures and standards. Finance Bureau and Transport Bureau are responsible for the implementation.	in progress		Emission reduction = fuel savings * CO_2 emission factors caused by gasoline combustion Reference year: 2012	From 2012 to 2015, total emission reduction: 14.7 kt CO_2	Macao SAR Government
4	Environmental Protection And Energy-Saving Fund – Environmental Protection, Energy-Saving Products And Equipment Subsidy Scheme	"Environmental Protection and Energy-saving Fund" aims to improve the environmental quality and promote the energy-saving and emission mitigation in Macao. It provided funding to business enterprises and groups to buy or replace energy-saving products: LED lighting, energy-saving air-conditioners, and environmentally friendly cooking utensils.	Energy/CO_2	2011–2015	Government /Voluntary	Environmental Protection Bureau	Completed	After the assessment, the Administrative authority acknowledged that the Programme has achieved the expected results and decided not to extend its implementation. The application was closed on December 31, 2015.	Emission reduction = Power savings * average emission factor for the Southern grid in 2011-2014 Reference year: 2011	From 2011 to 2015, total emission reduction: 41 kt CO_2	Macao SAR Government

No.	Name	Action Target or Main Content	Sectors /GHG Covered	Time frame	Nature of Action[a]	Supervision Department	Status[b]	Progress	Methodology and Assumption	Expected Mitigation Effects	Supported by
5	Energy efficient and energy-saving plan for public sectors and institutions	By developing their own energy-saving plans to manage their daily energy use, the public sectors/institutions annually reduced energy consumption by 5%.	Energy/CO_2	Since 2007	Government /Voluntary	Energy Industry Development Office	in progress	Launched in 2007, the project has saved a total of 6,028,345 kWh power.	Emission reduction = Electricity savings * average emission factor for the Southern grid in 2008-2014 Reference year: 2008	From 2008 to 2014, total emission reduction: 4.3 kt CO_2	Macao SAR Government
6	LED public outdoor lighting application	Based on "Guidelines on Public Outdoor Lighting Design in Macao", the demonstration projects were conducted to identify the effect of LED lighting outdoors and it is planned to replace all the street lights across the whole Macao. The power savings were up to 30% relative to the old lights.	Energy/CO_2	Since 2010	Government	Energy Industry Development Office	in progress	The street lights in the New Port Reclaimed Zone will be replaced in 2015-2016. 13,000 street lights across Macao will begin to be replaced in late 2016.	Emission reduction = electricity savings* average emission factor for the Southern grid in 2014 Reference year: 2016	Expected emission reduction in the year of project completed: 4.3 kt CO_2	Macao SAR Government

Note: a) mandatory/voluntary/government/market;

b) under planning/in progress/completed

Chapter 4 Finance, Technology and Capacity-Building Needs and Support Received

Macao highly values the technologies and capacity building in the field of climate change with a great deal of funds having been invested to the mitigation of climate change. There is a greater demand for technology support in related fields and from domestic and abroad.

4.1 Needs for Technologies

Lists of needs for mitigation and adaptation technologies are shown in Table 8-4 and Table 8-5.

Table 8-4 List of Needs for Mitigation Technologies

Sector	Name of Technologies
Renewable Energy	Offshore wind power technology, solar power and heating technology
Energy	Smart grid construction and application
Building	Building energy-saving technology, energy efficient lighting systems
Transport	High-performance electric vehicle battery charging technology

Table 8-5 List of Needs for Adaptation Technologies

Sector	Name of Technologies
Water Resources	Reclaimed water utilization technology, rainwater recycling technology
City	Urban climate vulnerability assessment, assessment of severe weather and sea level changes, urban disaster monitoring and prevention, enhancement of urban disaster resilience
Ecology	Assessment of the impact of climate change on ecology; species conservation

4.2 Needs for Capacity-Building

The needs of Macao SAR government for capacity building can be divided into the following five aspects:

1) Preparation of GHG Inventory

The appropriate working mechanism should be established to acquire more accurate activity data and emission factors through investigation and consultation with relevant departments or institutions. Additionally, to support the annual inventory updates and ensure the completeness, transparency and comparability of the inventory, Macao should further optimize routine data collection and set up a database system to archive, manage and utilize the activity data and emission factors.

2) Mitigation Actions and Their Effects Assessment

To further enhance the capability of government institutions to develop and implement mitigation policies, a "measurable, reportable and verifiable" (MRV) mechanism for mitigation actions should be set up for some emission sources of large mitigation potential. The Guidelines and user's manual on MRV should be developed and implemented to improve the understanding and implementation by relevant institutions and personnel. Meanwhile the national or international MRV experts should be invited to share their experience to enhance the capacity building of related government agencies and private sector.

3) Assessment of Vulnerability and Resilience

As a coastal city which is vulnerable to climate change, Macao should strengthen the assessment of the urban vulnerability and resilience, and take corresponding measures including: impact of and response to sea level rise; capacity building in urban disaster monitoring and prevention, and in the identification and prevention of the relationship between infectious diseases and climate change.

4) Technical Exchanges and Cooperation

Through the establishment of an exchange and cooperation platform with national and international institutions, Macao aims to enhance its capacity building in GHG Inventory preparation, mitigation technologies and their effects assessment and disaster warning and response.

5) Education, Outreach and Public Awareness

Macao SAR government needs not only to implement mitigation and adaptation polices and measures, but also to enhance education and outreach in energy-saving, environmental protection and low-carbon, thereby promoting general public participation in addressing climate change.

Chapter 5 Other Relevant Information

Macao has initiated a series of activities to enhance climate system observations and relevant research, to conduct education, outreach and training on climate change, to raise the awareness of climate change, and to encourage public participation.

5.1 Climate System Observation

Despite its small size, Macao has a rather dense atmospheric and coastal water level observing network, including 13 automatic weather stations, 1 climate observation station, 1 atmospheric radiation monitoring station, 5 air quality monitoring stations, 2 tide monitoring stations and 1 sea wave monitoring station. Additionally, in response to seawater intrusions caused by storm surges plus astronomical tides, 17 land-based automatic water level monitoring stations were set up in 2009 and 2014 to monitor water levels and inundations in Macao's coastal zones.

5.2 Climate Change Research

Macao's long history of meteorological observation has left it systematic and detailed records. By compiling these data, the Macao Meteorological and Geophysical Bureau has created a 100-year data set (1901-2000) and conducted extensive research. For example, analyzing Macao's climate change in 20th century; introducing data of multiple GCM models; analyzing and assessing climate change impacts on Macao through downscaling; and assessing the risks brought by extreme weather events such as tropical cyclone, storm surges and strong precipitation.

Apart from its continued conventional meteorological and sea-level related analyses and studies, Macao has enhanced the observation of those ecological systems which are comparatively less in quantity and shorter in time sequence. Since 2011, Macao has carried out regular and systematic research on wild animals (insects) and plants in attempt to understand the impact of climate change on the ecosystem through a survey on the species, distribution, population density and phenological characteristics of flora and fauna together with meteorological data.

5.3 Education, Outreach and Public Awareness

Climate change education. Based on the *Curriculum Framework for Formal Education of Local Education System* and the *Requirements for Basic Academic Attainments for Formal*

Education of Local Education System, Macao has continued to optimize the teaching material relating to climate change and its impact across various teaching stages in order to strengthen students' awareness of climate change, energy saving and environmental protection. The Education and Youth Affairs Bureau has developed *"Character and Citizenship"* for primary to high school stages and *"Geography of Macao"* for Junior High schools as complementary materials to promote climate change related education and publicity. Additionally, with the energy education introduced in 2006, Macao SAR government encouraged all schools to organize "Energy-saving Events in Campus" spontaneously in line with energy teaching activities in 2008. The "Green School Partnership" event which was launched in 2010 continues to provide diversified environmental education activities in this connection. By December 2015, a total of 66 schools turned into green ones, meanwhile the teachers and students participating in the "Green School Partnership" event accounted for more than 80%. Moreover, Macao SAR government has held a number of seminars and training programs in cooperation with private educational institutions to deliver presentation on energy management, energy audit and new trends in energy saving technology, keeping the business community informed of the latest technology in the energy field.

Climate change outreach. Macao SAR government holds various thematic events every year to increase the public awareness of energy conservation and emission reduction, for example, promoting low-emission travel modes through "World Car Free Day"; arousing public awareness of bringing green elements into life through "Macao Green Week"; gathering together the whole society for environmental protection information through "Macao Environmental Protection Week"; promoting the public practice of diverse environment actions through "Environmental Protection Fun" incentive programs; increasing public awareness of energy saving through "Macao Energy-saving Week" activities. In addition, multiple channels such as electronic media, radio, newspaper, journals and posters are used to increase public awareness of emission reduction.

Exchange and cooperation. In order to promote the exchange of environmental business, techniques and information between the Pan Pearl River Delta Region and the international market, Macao SAR government holds major environmental outreach events in cooperation with Hong Kong and neighboring Chinese cities to enhance the exchange in environmental protection with neighboring regions. In addition, the "Macao International Environmental Cooperation Forum and Exhibition" has been held annually basis since 2008 to discuss climate change, energy-saving and carbon trading and other items as an environmental industry platform, on which environmental information is disseminated and advanced environmentally friendly and energy-saving technologies and products are introduced.

The results of “Macao Public Environmental Awareness Survey” in 2014 showed that the environmental awareness of Macao residents has been increasing year by year.