绿色电力转型发展

Green power transformation development

2021年9月

September, 2021

一 **电力行业绿色发展成效**

Achievement of green power development

二 **电力行业转型发展挑战**

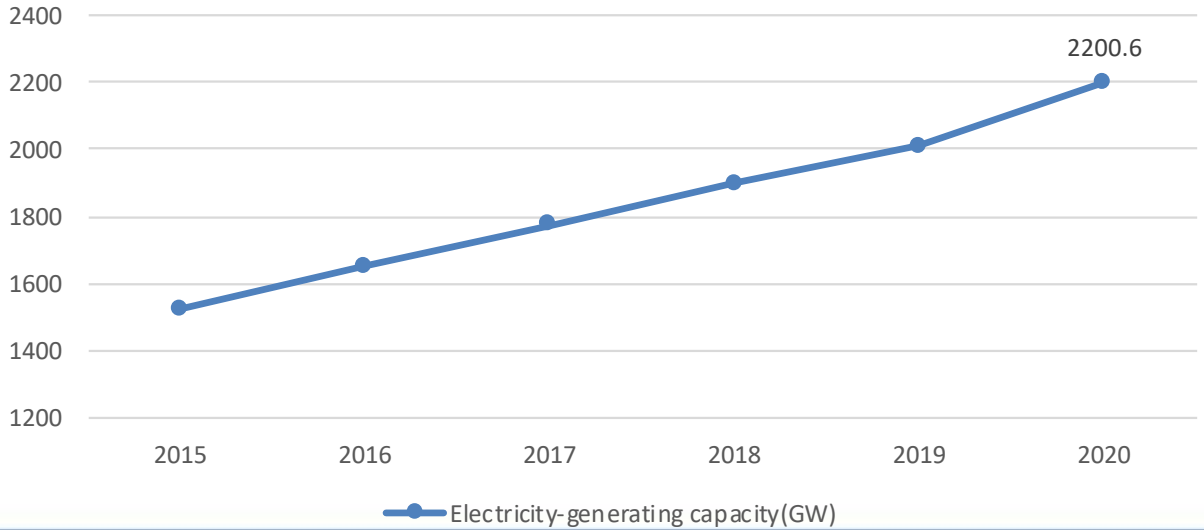
Challenge of power transformation

三 **电力行业发展展望**

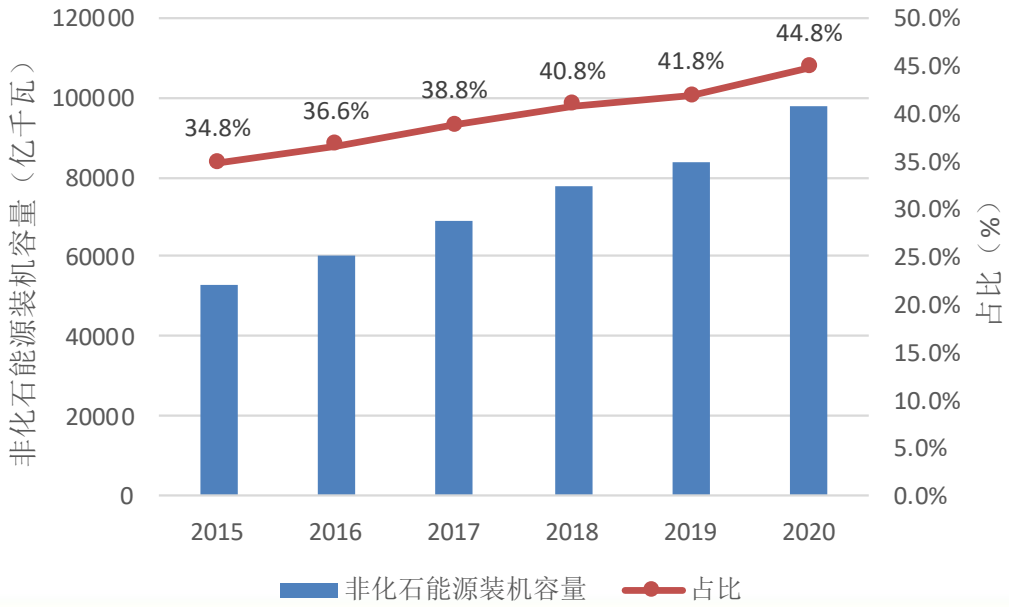
Prospect of power industry

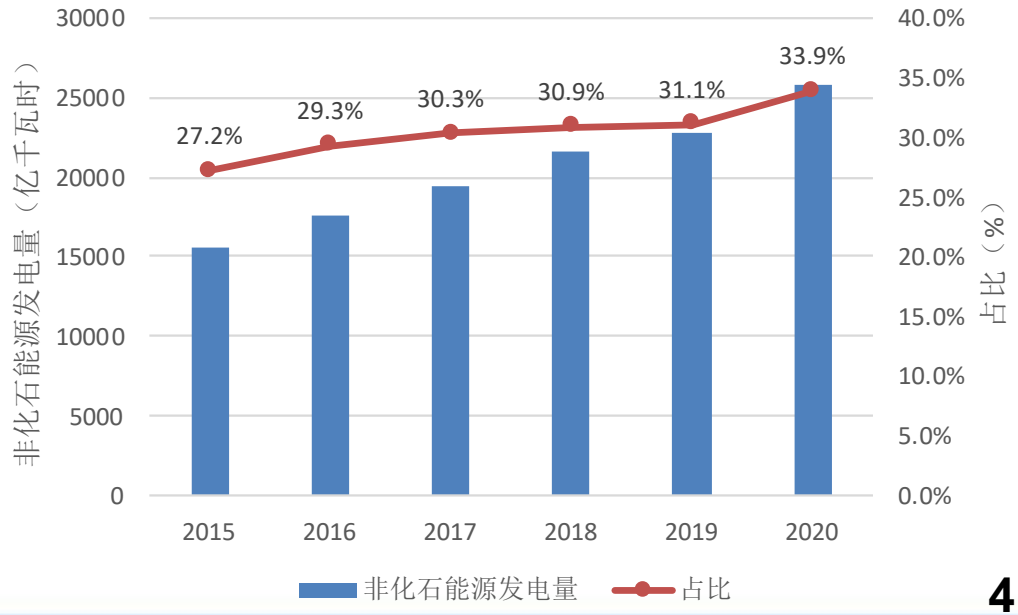
电力行业在绿色低碳转型中取得了显著成效
Power industry has gained remarkable achievements in green and low-carbon transformation

截至2020年底，全国发电装机容量22亿千瓦，2015年-2020年均增长7.6%。The electricity-generating capacity rose to 2200 GW by the end of 2020. The CAGR is 7.6% from 2015 to 2020.

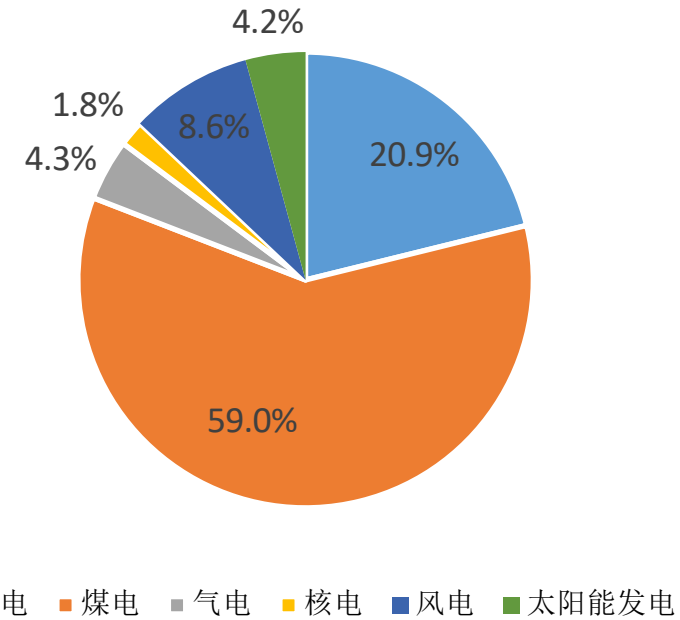


非化石能源装机年均增速13.1%，占比从34.8%上升至44.8%，提升10个百分点；发电量占比从27.2%上升至33.9%，提高6.7个百分点。 The generating capacity and electricity generation of non-fossil fuel energy account for 44.8% and 33.9% separately till the end of 2020, comparing to 34.8% and 27.2% in 2015.

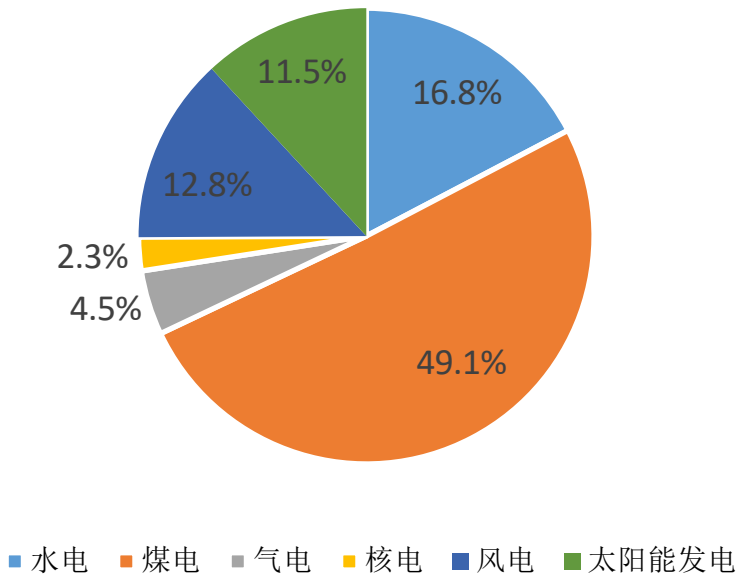




煤电装机容量占比从2015年的59%下降至2020年的49.1%，比重首次降至50%以下。 The generating capacity of coal power accounts for 49.1% till the end of 2020 comparing to 59% in 2015, for the first time below 50%.



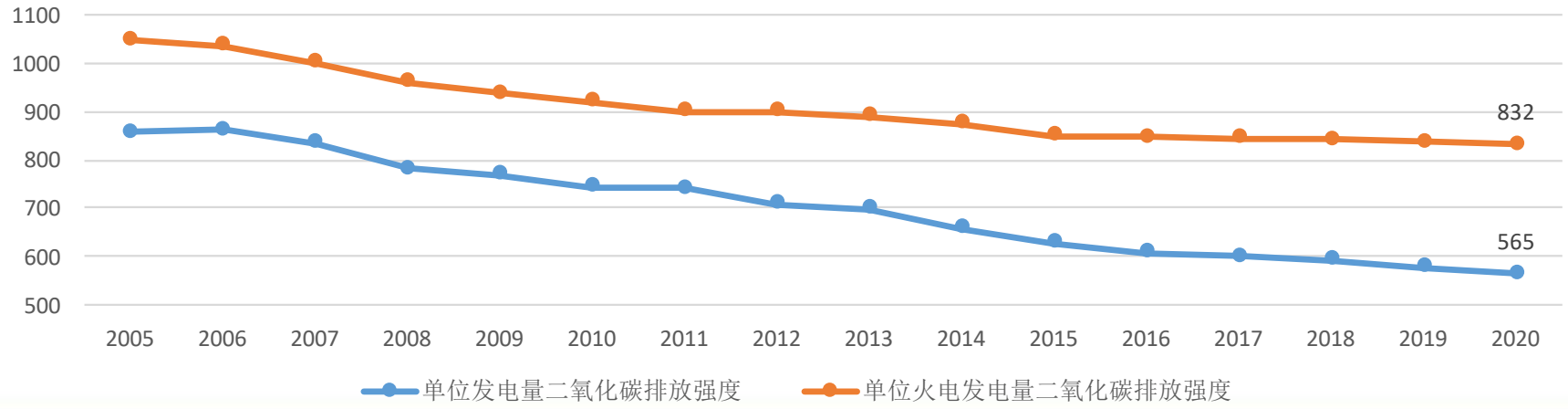
2015年我国电源装机结构



2020年我国电源装机结构

电力行业碳排放强度持续下降
The carbon emission intensity continued to decline

2020年，全国单位发电量二氧化碳排放约565克/千瓦时，比2005年下降34.1%。以2005年为基准年，电力行业累计减少二氧化碳排放约185.3亿吨。The carbon emission intensity of unit generation declined to 565 g/kWh, 34.1% down from 2005. The accumulative carbon reduction from 2005 is estimated 18.53 billion tons.



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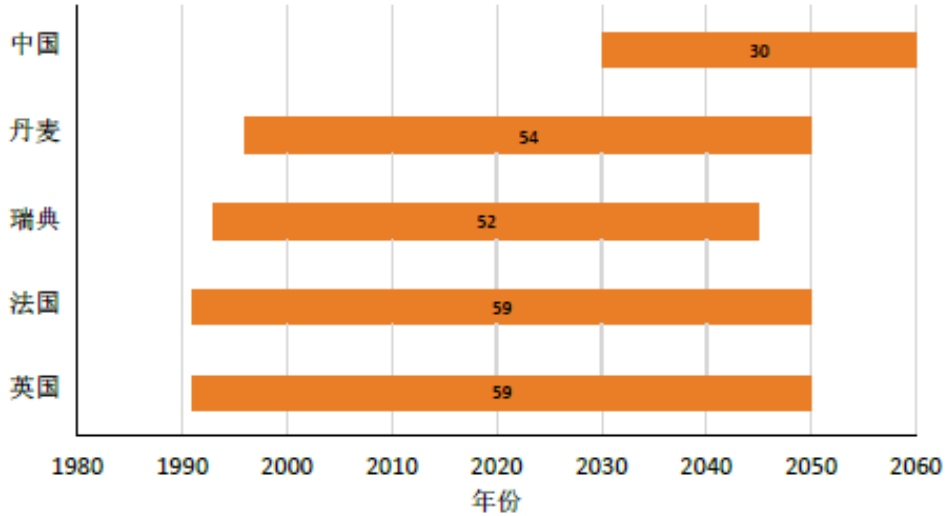
我国实现碳达峰碳中和时间短，任务重
The time from carbon peak to carbon neutrality is limited

发达国家从“碳达峰”到“碳中和”有50～70年过渡期。我国距离碳达峰目标已不足10年，从碳达峰到碳中和也仅有30年时间。The EU, USA and Japan used 50 to 70 years from carbon peak to neutrality, while China only has 30 years.

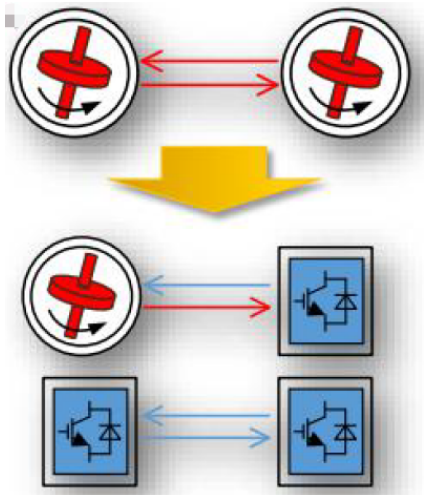


部分国家碳达峰到碳中和所用时间

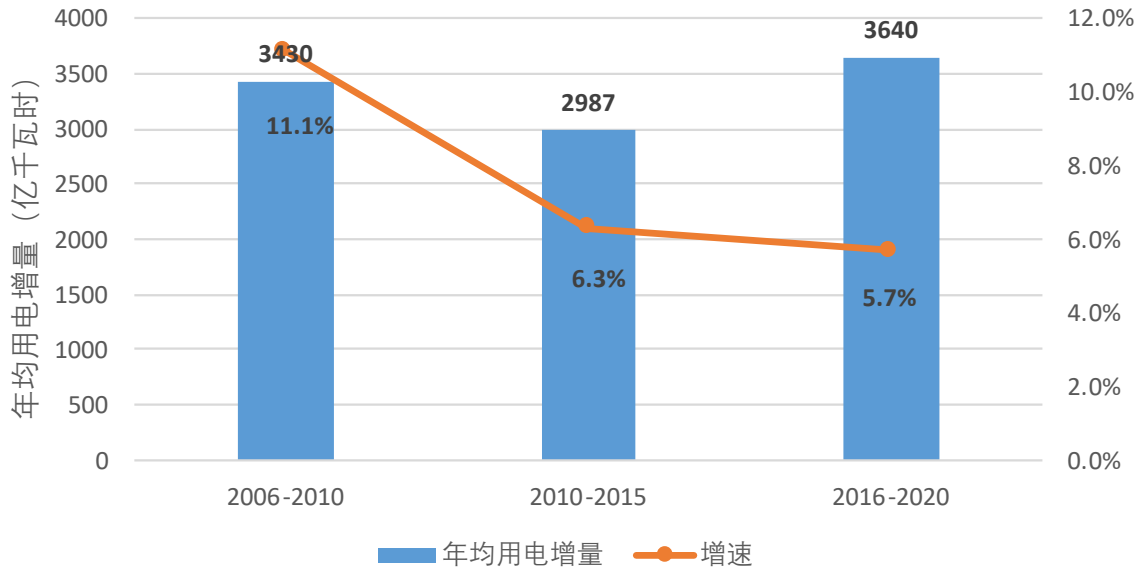
要处理好减碳与安全的关系
Handle well with carbon reduction and power system safety

电力行业既要减碳又要保障电力安全供应，服务经济社会发展，保障电力安全供应的任务更为艰巨。Carbon reduction and economic and social development are equally important, making power supply safely a more difficult task.

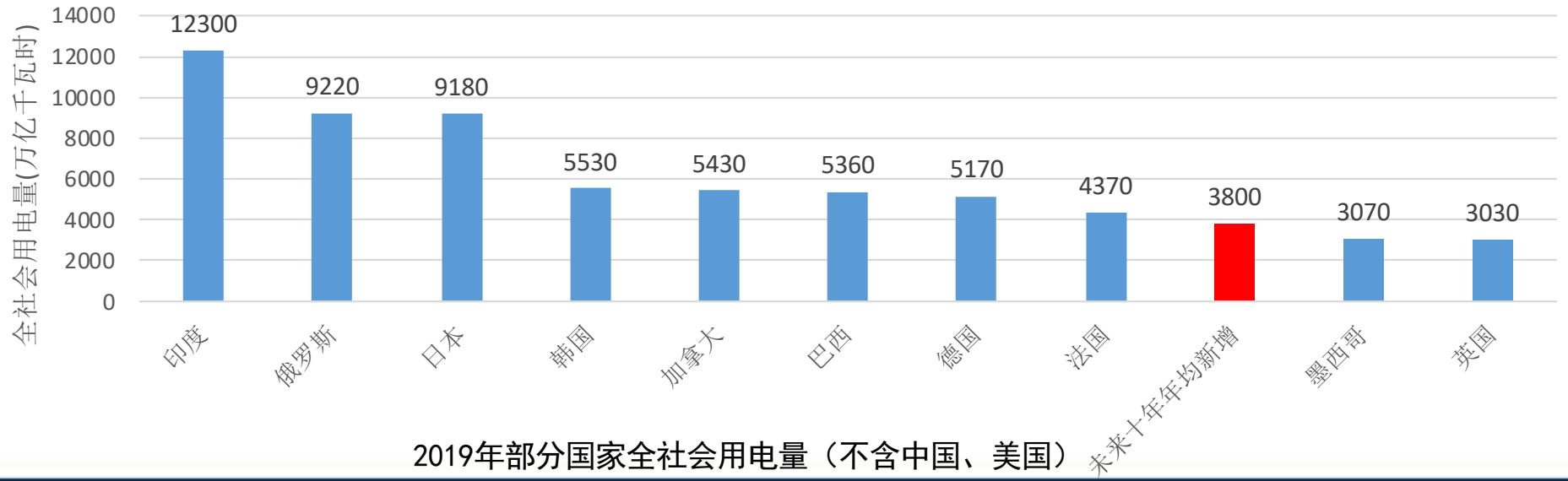
今年2月，美国得州遭遇大范围寒潮，风电机组因叶片覆冰导致的受阻容量1200万千瓦，占得州风电总装机的50%，成为引发大停电的重要原因， 值得警惕！The cold wave in Texas aroused blackout due to the wind turbine froze and power lost reached to 12 GW.



中国电力需求持续刚性增长，2016年-2020年，新增用电量1.82万亿千瓦时，年均增加3640亿千瓦时。The electricity demand will grow for a long period. The additional electricity consumption is 1820 TWh from 2016 to 2020, 364 TWh annually.

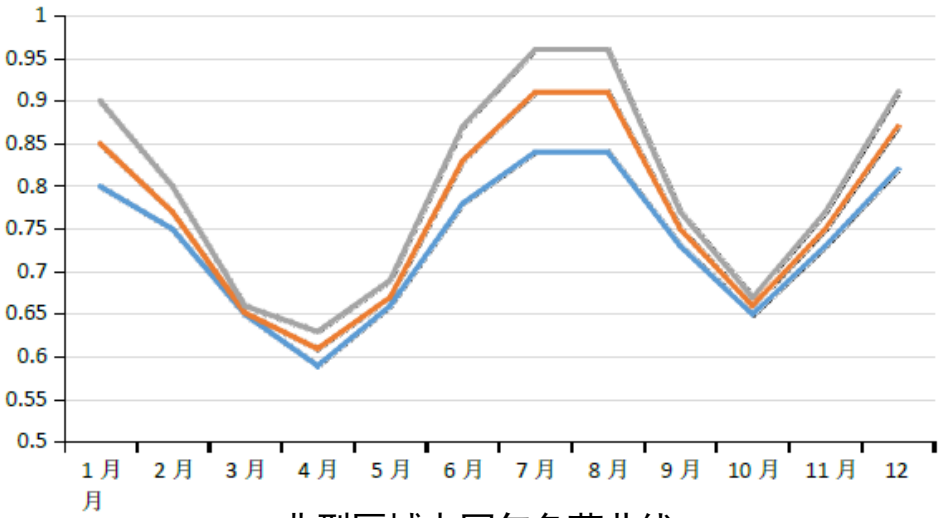


预计2021年-2030年，中国全社会用电量年均增加约3800亿千瓦时，这个增量相当于世界排名第十位国家的全年用电量总额。The annual additional electricity consumption is estimated to 380 TWh from 2021 to 2030, which equals to the total electricity consumption of the world's 10th largest country.

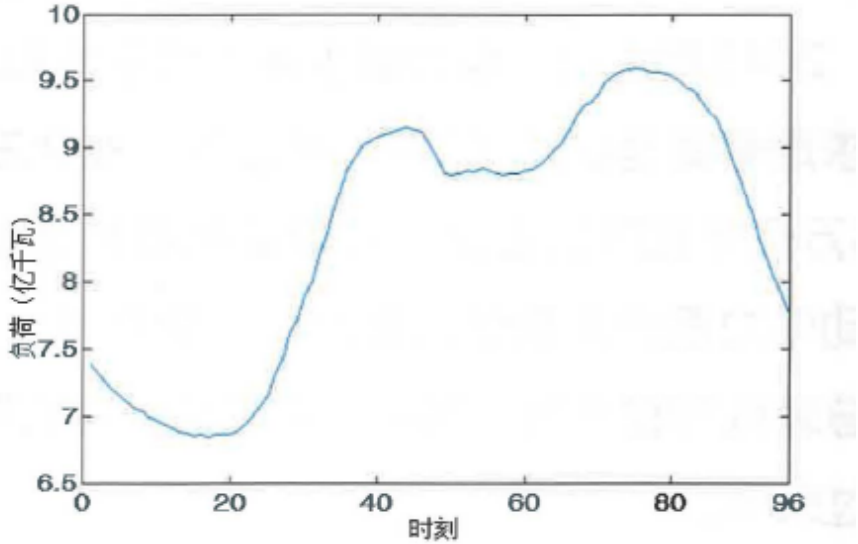


2019年部分国家全社会用电量（不含中国、美国）

我国用电需求呈现冬、夏“双峰”特征，电力系统呈现高比例可再生能源、高比例电力电子设备的“双高”特征，保障大电网运行安全的压力持续增加。The load characteristic has seasonal peak feature and intraday peak feature, while the proportions of renewable energy and electronic equipments are high.



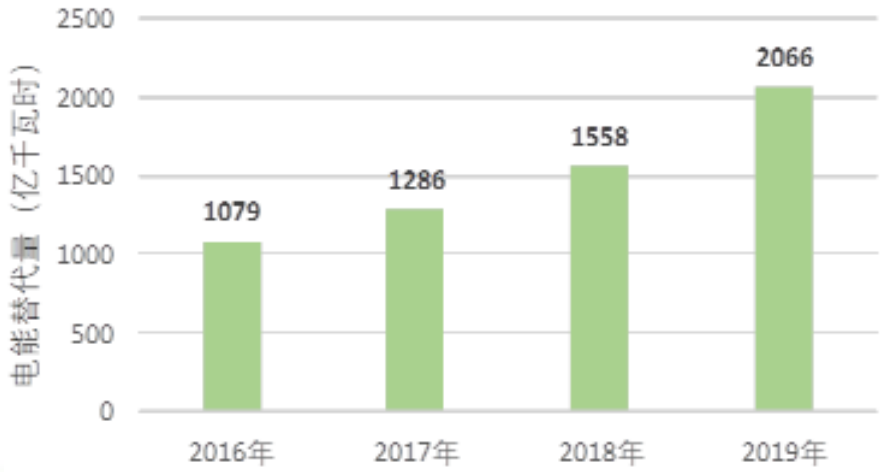
典型区域电网年负荷曲线



冬季典型日负荷曲线

要处理好整体与局部的关系
Handle well with global and partial relationships

电力行业既有实现自身的碳减排要求，还要服务全社会电气化水平提升，支撑钢铁、有色、石化、建材、建筑、交通等行业减碳。Both carbon reductions have been satisfied not only in power industry, but also in other industries such as steal, non-ferrous metal, petrochemical, building materials, construction, transportation, etc.

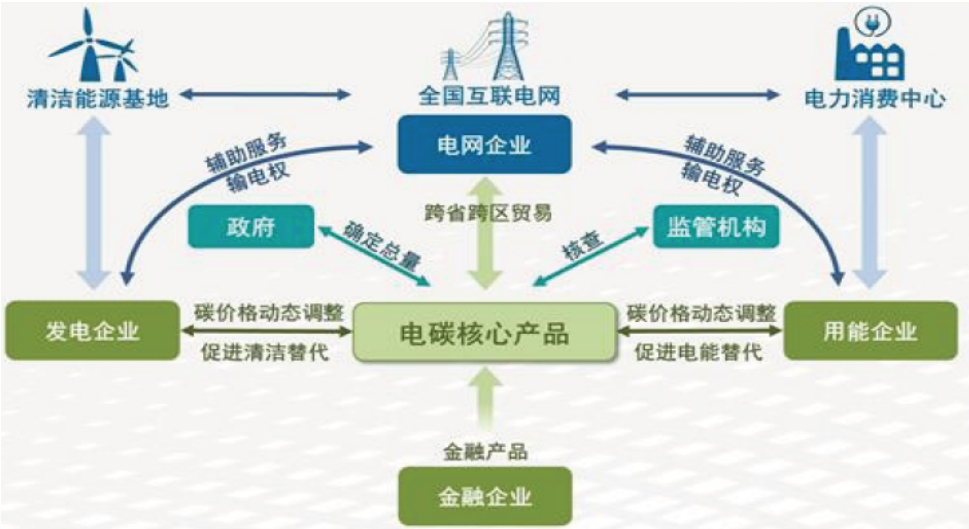


要加大技术创新
Enhance technological innovation ability

以新能源为主体的新型电力系统尚在研究探索中，还需在新能源、核电、特高压、电力系统控制等方面加强创新能力；加快部署新型储能、氢能等关键技术的研发、推广和应用。The new type power system is still in research and exploration, the innovation ability should be enhanced in the areas such as new energy, nuclear power, ultra-high voltage, power system control. The development of new storage and hydrogen energy should be speeded up.

适应新形势的电-碳市场体系建设任重道远
Long way to go of electro-carbon market system

电力市场化改革逐步深入，需进一步捋顺电价形成机制等；全国碳市场建设刚刚起步，与电力市场缺乏统筹协调。The mechanism of electricity price should be rationalized as the electricity market reform go into depth. The lack of electricity market and carbon market coordination should be improved due to the national carbon market construction has just started.



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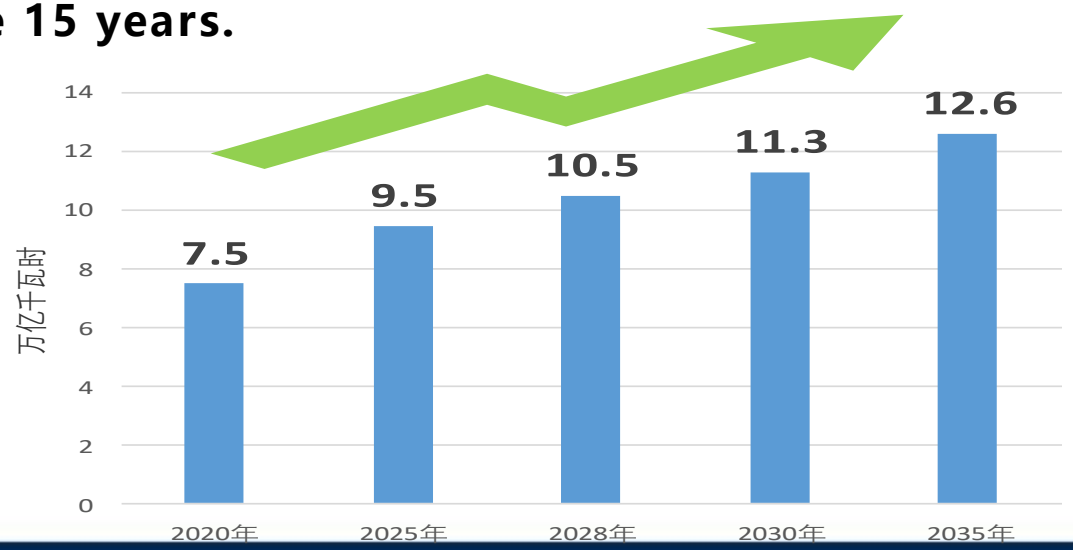
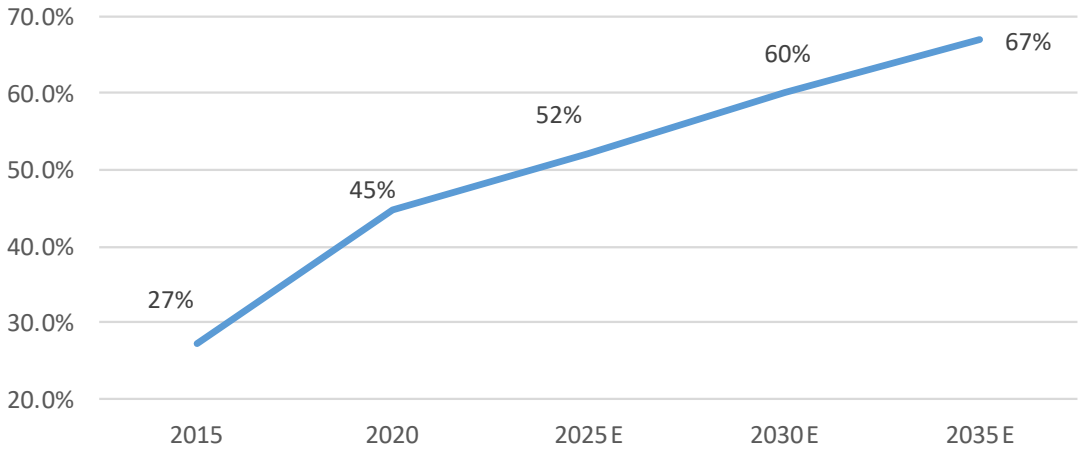
（一）用电需求预测Electricity demand forecast

预计2025年，全社会用电量9.5万亿千瓦时，年均增长4.8%，人均用电量约6640千瓦时/人。2035年全社会用电量将达到12.6万亿千瓦时，2020年~2035年年均增速为3.6%。人均用电量约9000千瓦时/人。The electricity consumption will be 9500 TWh and 12600 TWh in 2025 and 2035, 6640 kWh and 9000 kWh per capita. The CAGR is 3.6% in the future 15 years.



（二）电源装机预测Generating capacity forecast

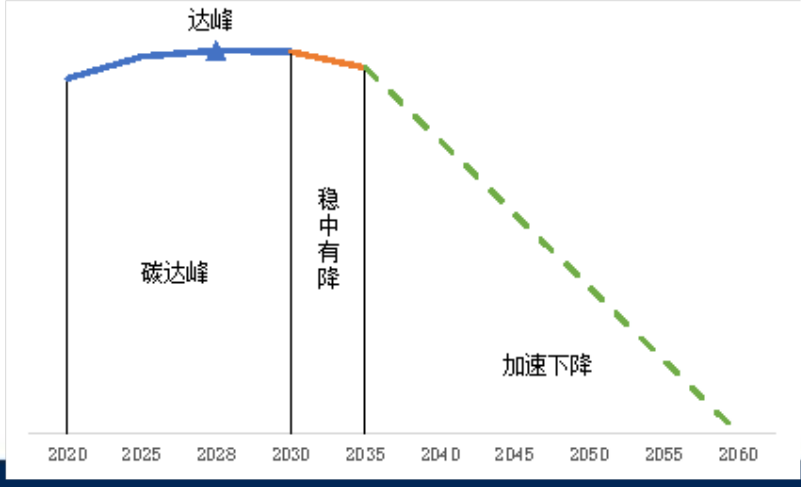
预计2025年，电源装机30亿千瓦，非化石能源发电占比52%；2030年电源装机达到39亿千瓦，非化石能源发电占比60%；2035年电源装机50亿千瓦，非化石能源发电占比达到67%。The generating capacities will be 3TW, 3.9TW, 5TW in 2025, 2030 and 2035. The proportions of non-fossil fuel generating capacity account for 52%, 60% and 67%.



（三）电力碳中和展望Carbon neutrality outlook

从发展趋势看，电力行业实现碳中和可分为三个阶段
Achieving carbon neutrality in the power sector can be divided into three stages

电力行业实现碳中和总体经历平台期、稳中有降、加速下降三个发展阶段。2020～2030年，电力碳排放总量进入平台期，并于2030年前达到峰值。2030年～2035年稳中有降阶段。2035～2060年加速下降阶段。The plateau stage refers to 10 years from 2020 to 2030. The carbon emission will reach to peak before 2030. The declined slightly stage refers from 2030 to 2035, while the declined rapidly stage refers from 2035 to 2060.



从技术层面看
Key technologies

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清洁替代技术Clean energy technology

光伏电池转换效率进一步提高，风电单机容量和效率、机组电网友好性提升，大型混流式水轮机、变频调速抽蓄机组进一步发展，小型模块化压水堆、高温气冷堆、铅冷快堆核电技术得到积极发展。

High photovoltaic conversion efficiency, large wind power capacity, francis water turbine, small PWR, HTGR, LFR.

新型储能技术New storage technology

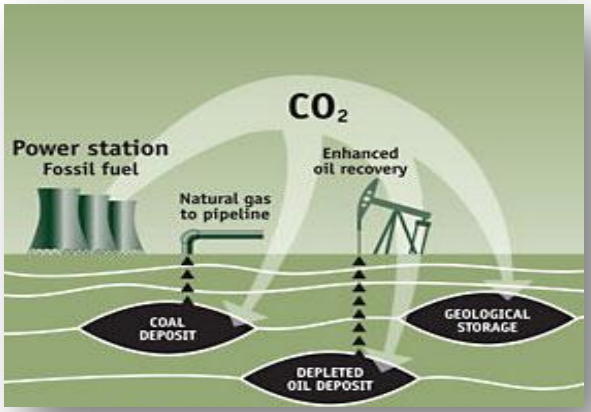
抽水蓄能系统效率和机组性能进一步提高；电化学储能成本降低，循环次数将大幅度提升，安全问题得到有效解决。

High pumped storage efficency, low-cost, high cycles and security electrochemical energy storage.

氢能利用技术Hydrogen technology

有机物储氢、金属储氢等新型储氢技术得到应用，储氢成本进一步降低，新型燃料电池技术和大型氢燃气轮机设计制造技术得到应用。

Low-cost organic hydrogen storage and metal hydrogen storage, solid oxide fuel cells (SOFC), hydrogen gas turbine.



碳捕集、利用与封存技术Carbon Capture Use and Storage

二氧化碳捕集、利用与封存（CCUS）成本与能耗逐步降低，CCUS系统集成与风险管控技术得到突破，建成多个CCUS产业集群。Low-cost CCUS, system integration and risk control, industrial cluster.

谢 谢！

Thank you!

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