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国网新源抽水蓄能技术经济研究院
PUMPED-STORAGE TECHNOLOGICAL & ECONOMIC RESEARCH INSTITUTE
STATE GRID XINYUAN COMPANY LTD.

# 科学发展抽水蓄能，助力构建新型电力系统

# Scientific Development of Pumped Storage Contributes to Building New Type Power System


国网新源集团有限公司抽水蓄能技术经济研究院

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# 碳达峰碳中和与新型电力系统

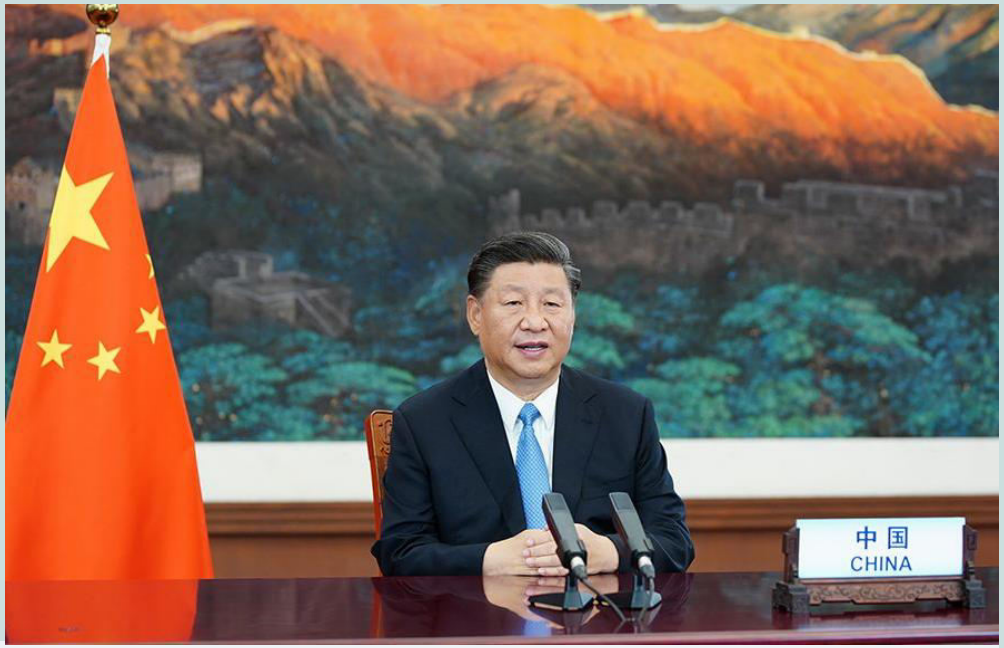
## Carbon peaking, carbon neutrality and new type power systems

➢2020年，习近平总书记在第七十五届联合国大会一般性辩论上提出碳达峰碳中和目标。

➢2021年中央财经委员会第九次会议作出构建新型电力系统重要指示。

➢2022年，党的二十大胜利召开，总书记在工作报告中再次强调，要加快规划建设新型能源体系。

➢在能源转型的大背景下，抽水蓄能迎来了巨大的发展机遇。




➢In 2020, Chinese President Xi Jinping proposed the goal of achieving peak carbon neutrality during the General debate of the seventy-fifth session of the United Nations General Assembly.

➢The ninth meeting of the Financial and Economic Commission of the CPC Central Committee in 2021 made important instructions to build a new power system.

➢In 2022, the 20th National Congress of the Communist Party of China was successfully held. In the government work report, the General Secretary also emphasized the need to expedite the planning and construction of a new energy system.

➢In the context of energy transformation, pumped storage hydropower (PSH) has ushered in a huge development opportunity.

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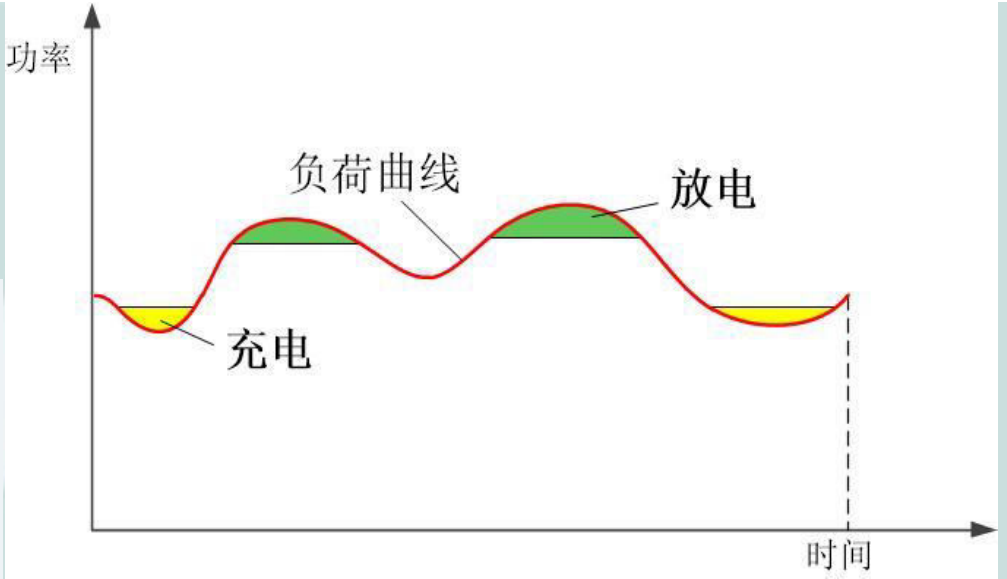
# 抽水蓄能发展现状
## The development status of PSH

➢ 抽水蓄能电站利用水作为介质，在电力负荷低谷时，利用多余电能抽水至上水库转化为势能，电力负荷高峰期，通过放水至下水库发电将储存的势能再转化为电能，从而实现电能的储存和管理。此外，抽水蓄能还具备调峰、调频、调相、事故备用、黑启动等基础功能，是新型电力系统的重要组成部

➢PSH station employs water as a medium. During the low power load period, the PSH station uses excess energy to pump water into the upper reservoir and convert it into potential energy; during the peak power load period, the PSH station converts the stored potential energy into electric energy by releasing water to the lower reservoir to generate electricity, realizing the storage and management of electric energy. In addition, PSH has some basic functions such as peak regulation, frequency regulation, phase regulation, emergency reserve, and black start, so it is an important part of the new type power system.

➢ 近年来，随着我国抽水蓄能电价政策和中长期规划的出台，抽水蓄能进入前所未有的高速发展阶段。截至2023年底8月底，我国已建抽水蓄能装机容量4939万千瓦，约占全球抽水蓄能装机的28.3%，位居世界首位。

➢In recent years, with the introduction of China's PSH price policy and medium - and long-term planning, PSH has entered an unprecedented stage of rapid development. By the end of August 2023, China has constructed a PSH capacity of 49.39 million kW, which comprises approximately 28.3% of the global PSH capacity, ranking first in the world.

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《抽水蓄能中长期发展规划（2021-2035年）》印发实施

2021-09-09 21:28 来源：能源局网站 字号：默认 大 超大 | 打印

为推进抽水蓄能快速发展，适应新型电力系统建设和大规模高比例新能源发展需要，助力实现碳达峰、碳中和目标，近日，国家能源局发布《抽水蓄能中长期发展规划（2021-2035年）》（以下简称《规划》）。《规划》指出，当前我国正处于能源绿色低碳转型发展的关键时期，风电、光伏发电等新能源大规模高比例发展，对调节电源的需求更加迫切，构建以新能源为主体的新型电力系统对抽水蓄能发展提出更高要求。

《规划》提出了坚持生态优先、和谐共存，区域协调、合理布局，成熟先行、超前储备，因地制宜、创新发展的基本原则。在全国范围内普查筛选抽水蓄能资源站点基础上，建立了抽水蓄能中长期发展项目库。对满足规划阶段深度要求、条件成熟、不涉及生态保护红线等环境制约因素的项目，按照应纳尽纳的原则，作为重点实施项目，纳入重点实施项目库，此类项目总装机规模4.21亿千瓦；对满足规划阶段深度要求，但可能涉及生态保护红线等环境制约因素的项目，作为储备项目，纳入储备项目库，这些项目待落实相关条件、做好与生态保护红线等环境制约因素避让和衔接后，可滚动调整进入重点实施项目库，此类项目总装机规模3.05亿千瓦。

《规划》要求加快抽水蓄能电站核准建设，各省（区、市）能源主管部门根据中长期规划，结合本地区实际情况，统筹电力系统需求、新能源发展等，按照能核尽核、能开尽开的原则，在规划重点实施项目库内核准建设抽水蓄能电站。到2025年，抽水蓄能投产总规模较“十三五”翻一番，达到6200万千瓦以上；到2030年，抽水蓄能投产总规模较“十四五”再翻一番，达到1.2亿千瓦左右；到2035年，形成满足新能源高比例大规模发展需求的，技术

# 抽水蓄能在构建新型电力系统中的重要作用

## The important role of PSH in the construction of new power system

➢通过实践和研究总结，我们认为抽水蓄能在构建新型电力系统中，主要发挥促进清洁能源消纳、保障电力安全可靠供应、保障电网安全稳定运行三大重要作用。

➢首先，抽水蓄能能够大幅提升系统新能源消纳能力、降低电力系统碳排放量；

➢其次，抽水蓄能能够改善系统电力电量平衡，为电力供应安全提供保障；

➢再次，抽水蓄能能够有效调节系统的频率和电压，改善无功平衡问题，保障电网的安全稳定运行。

➢Through practical experience and research, we believe that PSH plays a crucial role in the construction of a new type power system from three aspects: promoting the consumption of clean energy, ensuring a secure and reliable electricity supply, and facilitating the safe and stable operation of the grid.

➢Firstly, PSH contributes to improving the system's new energy consumption capacity, reducing carbon emissions of the power system;

➢Secondly, PSH can improve the power balance of the system, so as to provide security for power supply;

➢Thirdly, PSH can effectively adjust the frequency and voltage of the system, improve the reactive power balance, and ensure the safe and stable operation of the power grid.

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# 国网新源集团有限公司简介

## The introduction of State Grid Xinyuan Group Co. Ltd.

➢国网新源集团有限公司是国家电网投资开发运营调节电源的专业化平台，是抽水蓄能行业的主力军、专业的排头兵。截至2023年8月底，国网新源集团管理抽水蓄能电站66座，装机容量达8440万千瓦。

➢State Grid Xinyuan Group Co. Ltd. is a professional platform enterprise under the State Grid Corporation for the development, construction, and operation of regulating power supplies. State Grid Xinyuan Group is the leading force and expert in the PSH industry. By the end of August 2023, State Grid Xinyuan Group managed 66 PSH stations with an installed capacity of 84.4 million kW.

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# 高质量发展抽水蓄能相关经验
## Experience in the high quality development of PSH

➢多年来，集团致力于推进抽水蓄能高质量发展，研究抽水蓄能建设运营的特点规律，在开发建设和运营管理上积累了丰富经验，荣获国家优质工程金奖、建设工程鲁班奖等重要奖项10余项。

➢在工程建设方面，强化智慧化管控、机械化施工、标准化建设，率先完成通用标准体系建设，在国内首次引入并成功应用推广TBM施工技术，开发建设“电站群”智慧管控平台，实现项目间交互协作和交流共享。

➢在生产运营方面，加强专业化、精益化、规范化管理，充分发挥集团化运作的优势。2022年，国网新源集团抽蓄机组综合利用小时数达2800小时，抽水启动34036次，发电启动35263次，启动成功率达到99.9%，为保障电网安全稳定运行作出了巨大贡献。

➢在发展研究方面，积极深化抽水蓄能功能作用研究，助力抽水蓄能在新型电力系统中的科学配置，深入研究抽水蓄能碳减排效益，充分彰显抽水蓄能在能源绿色转型中的作用。

➢Over the years, State Grid Xinyuan Group is dedicated to promoting the high-quality development of PSH. We have conducted research on the characteristics and principles of PSH construction and operation, accumulating a wealth of experience in development, construction, and operational management. As a result, we have honored with more than 10 prestigious awards, including the China National Quality Engineering Gold Award and the China Construction Engineering Luban Award.

➢In terms of engineering construction, we have strengthened intelligent management and control, mechanized construction, and standardized construction. We have taken the lead in completing the construction of universal standard system. We have introduced and successfully applied Tunnel Boring Machine (TBM) construction technology for the first time in China. And we have built a smart management and control platform for the "power station group", so as to achieve interaction, cooperation and sharing among projects.

➢In terms of production and operation, we have strengthened professional, lean and standardized management, and have given full play to the advantages of group operation. In 2022, the comprehensive utilization hours of PSH stations of State Grid Xinyuan Group have reached 2,800 hours, the number of pumping starts have reached 34,036 times, the number of power generation starts have reached 35,263 times, and the start-up success rate have reached 99.9%, which has made great contributions to ensuring the safe and stable operation of the power grid.

➢In terms of development research, we actively seek to deepen our understanding of the functional role of pumped hydro storage, promoting its scientific allocation in emerging power systems. We have conduct thorough research on the benefits of pumped hydro storage in reducing carbon emissions and have demonstrated its pivotal role in driving green energy transformation.

# 抽水蓄能工作未来展望
## Future work prospects of PSH

➢面向未来，国网新源集团愿意与世界同行一道，抓住机遇，共同推动抽水蓄能行业科学有序高质量发展。
➢一是紧密围绕能源绿色转型，大力开发抽水蓄能，丰富电网灵活性调节资源，助力新型电力系统构建。
➢二是深入研究新型电力系统发展路径，根据电网实际需求，科学拟定抽水蓄能开发建设布局时序。
➢三是积极推进先进施工技术推广应用，降低工程建设成本，提高抽水蓄能开发经济性。
➢四是加强科技创新，推动抽水蓄能技术进步，开展变速机组示范工程应用，加强超高水头、大容量、三机式抽蓄机组等新技术研究，更好地服务电网灵活调节需求。
➢五是积极为建立适应新型电力系统的政策体系和市场机制建言献策，为抽水蓄能行业持续健康发展营造有利条件。

➢Looking towards the future, State Grid Xinyuan Group is willing to collaborating with peers worldwide to seize the opportunity and promote the scientific, systematic and high-quality development of the pumped storage industry.

➢Firstly, we will prioritize the green transformation of energy, vigorously develop PSH and enrich power grid flexibility and regulation resources to support the construction of new power systems.

➢Secondly, we will further study the development path of new power systems and scientifically formulate the timing layout of PSH construction according to the actual needs of the power grid.

➢Thirdly, we will actively promote the application of mechanized construction technology, aiming to reduce costs of mature technologies, and enhance the economic viability of PSH development.

➢Fourthly, We will strengthen scientific and technological innovation, promote the advancement of PSH, and carry out demonstration projects for variable speed units. We will strengthen research on new technologies such as high-head, large-capacity, and three stage PSH station to better serve the flexible regulation needs of the power grid.

➢Fifthly, we will provide recommendations for establishing a policy system and market mechanisms that are aligned with the new power system. This will create favorable conditions for the sustainable and healthy development of the PSH industry.

➢各位嘉宾，国网新源集团愿与各国同行进一步加强沟通交流，深化务实合作，积极分享抽水蓄能建设和管理经验，共同为推动双碳目标下水电可持续发展与智慧能源转型作出积极贡献。谢谢！

➢Distinguished guests, State Grid Xinyuan Group is eager to enhance communication and collaboration with counterparts from other countries, deepen practical cooperation, actively share experience in pumped storage construction and management, and collectively promote the sustainable development of hydropower and smart energy transformation under the carbon peak and carbon neutrality targets. Thank you!