

## ESG & Power Equipment & New Energy & Utilities

### 核电行业深度：四代核电加速发展，可控核聚变稳步前行

### Nuclear Power Industry Report: The Development of Fourth-Generation Nuclear Power Accelerates, and Controllable Nuclear Fusion Moves Forward Steadily

杨斌 Bin Yang

bin.yang@htisec.com

热点速评 Flash Analysis

(Please see APPENDIX 1 for English summary)

#### 1、四代核电加速发展，保障能源安全

我国核电站技术路线以压水堆为主。压水堆是世界上在运行的核电站中采用的主要堆型，压水堆全称为“加压水慢化冷却反应堆”。以加压的、未发生沸腾的轻水(即普通水)作为慢化剂和冷却剂的反应堆。根据 IAEA 的数据，全球在运的核电机组中，压水堆占比约为 70%。

“华龙一号”是我国具有完全自主知识产权的三代压水堆，已批量化建造。为了加强预防核电事故，提高核电厂的安全可靠性和经济性，各国在第二代核电技术的基础上提出了新的要求。2021 年 1 月，全球第一台“华龙一号”核电机组——中核集团福建福清核电 5 号机组投入商业运行，后续批量化的机组逐步核准投运。2023 年年末，中广核和中核各有两台“华龙一号”核电机组获得核准。

我国拥有自主创新和研发高温冷气技术的能力，引领第四代核电技术。就安全性和经济性而言，高温气冷堆是我国最接近商业化应用的第四代堆型。2023 年 12 月 6 日，石岛湾高温气冷堆核电站作为全球首个第四代核电站的商业示范工程，成功完成了 168 小时的连续运营测试，并正式开始了商业运营。

#### 2、核聚变是我国“三步走”规划的终极目标

我国磁约束核聚变研究快速发展，阶段性成果显著。2023 年 4 月 12 日，中国科学院等离子体物理研究所的全超导托卡马克核聚变实验装置（EAST）成功实现了 403 秒稳态长脉冲高约束模式等离子体运行，刷新了 2017 年托卡马克装置高约束模式运行 101 秒的世界纪录。

可控核聚变创新联合体成立，推动核聚变产业发展。2023 年 12 月 29 日，25 家央企、科研院所和高校组成了可控核聚变创新联合体，系统布局了重点技术、典型场景、重大工程项目，推进设立可控核聚变专业化公司，为可控核聚变产业发展奠定了坚实基础，有望促进可控核聚变商业化发展。

#### 3、全球可控核聚变研发加速

美国和日本近年来在核聚变研究领域发展较快，全面商业化仍需时间。美国可控核聚变的发展路线主要是激光惯性约束核聚变。2023 年 8 月，美国劳伦斯利弗莫尔国家实验室实验室成功重现“核聚变点火”突破，第二次在可控核聚变实验中实现“净能量增益”，美国将在下一步探索如何实现更大规模的核聚变能量，以及最终如何降低核聚变成本以供商业化。2023 年 11 月，由日本和欧盟共同合作建造运行的超导托卡马克装置——JT-60SA 成功点火，成为实用型核聚变能源漫长发展进程中的一个里程碑。日本电力企业像东京电力未来也将受益于可控核聚变的稳步发展。在全球各国核聚变研究互相竞争、共同发展的背景下，全球核聚变产业链的重点企业有望迎来新的发展机遇。

**投资建议：**关注核电产业链重点企业【中国核电】【中国广核】【东方电气】【上海电气】【东京电力】等。

**风险提示：**1、核聚变项目进展不及预期；2、电力需求不及预期；3、政策推进不及预期。

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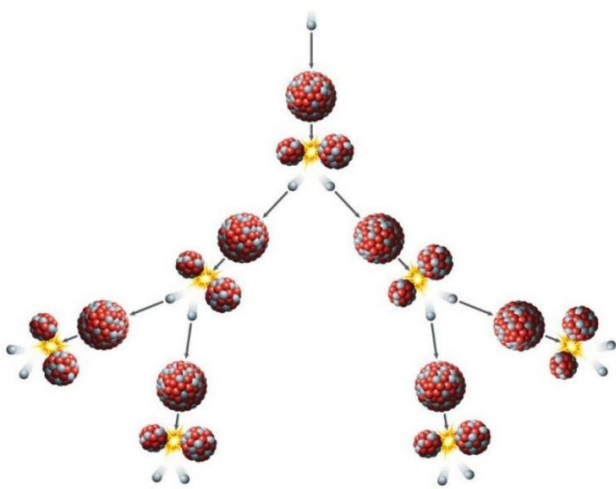
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### （一）四代核电加速发展，保障能源安全

**核裂变是目前核电站发电运用的主要原理。**核裂变是指由重的原子核（主要是指铀核或钚核）分裂成两个或多个质量较小的原子的一种核反应形式。原子弹或核能发电厂的能量来源就是核裂变。其中铀裂变在核电厂最常见，热中子轰击铀-235原子后会放出2到4个中子，中子再去撞击其它铀-235原子，从而形成链式反应，核电厂利用反应产生的巨大能量来发电。

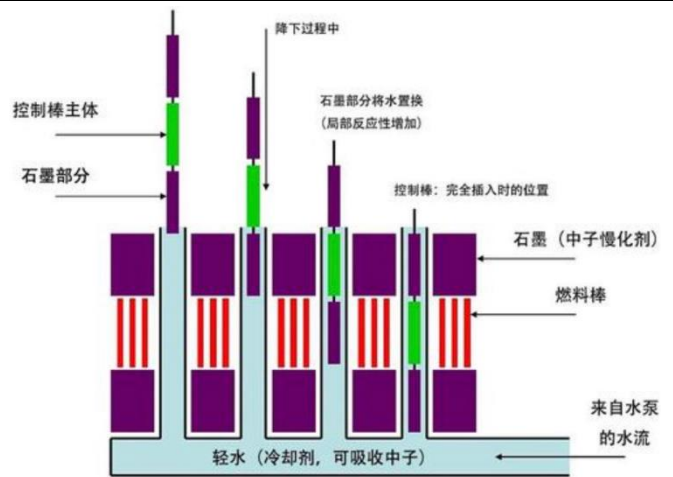
**核裂变反应速率主要由控制棒调节。**控制棒是一种具有中子吸收材料的长棒状结构，在反应堆中呈垂直布置。其主要作用是通过调节中子的流动，影响并调节核反应堆的反应速率。将控制棒垂直插入反应堆中时，可以增加中子的吸收量，阻止中子流动，从而减慢反应堆的反应速率；抽出控制棒时则会加快反应堆的反应速率。通常情况下，核电站会使用多根控制棒进行协同调节，以保证整个反应堆的平衡和稳定。

图 1: 核裂变示意图



资料来源：中国新材料产业技术创新平台，HTI

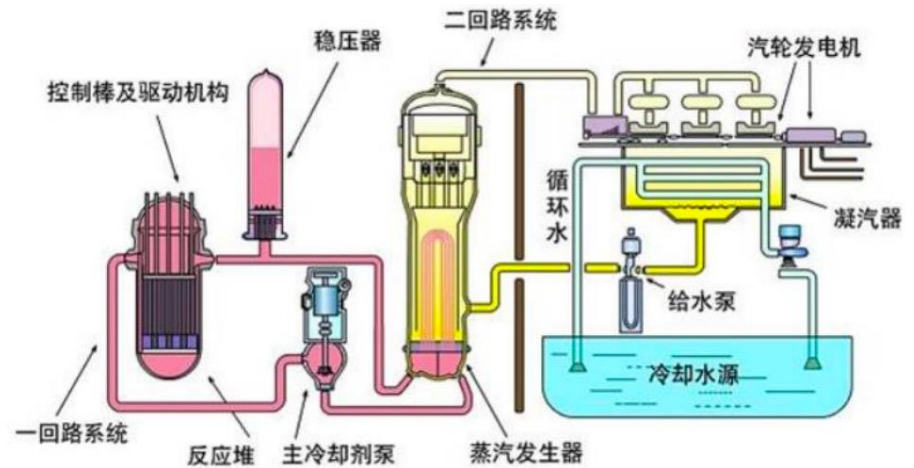
图 2: 控制棒吸收中子示意图



资料来源：中科院高能所，HTI

**我国核电站技术路线以压水堆为主。**压水堆是世界上在运行的核电站中采用的主要堆型，压水堆全称为“加压水慢化冷却反应堆”。以加压的、未发生沸腾的轻水(即普通水)作为慢化剂和冷却剂的反应堆。由燃料组件、慢化剂(兼作冷却剂)、控制棒组件、可燃毒物组件、中子源组件、堆芯吊篮和压力壳等组成。压水堆具备结构紧凑、功率密度高、安全性好的特性，许多国家选择压水堆作为主要技术路径。根据IAEA的数据，全球在运的核电机组中，压水堆占比约为70%。压水堆核电站由核岛和常规岛组成，核岛中的大型设备主要包括蒸发器、稳压器、主泵等，是核电站的核心装置；常规岛主要包括汽轮机组及二回路其他辅助系统，与常规火电厂类似。在核电设备成本中，核岛和常规岛占比约为58%和22%。

图 3: 压水堆工作示意图



资料来源: 烟台核电研发中心, HTI

我国以长期稳定的政策支持核电行业发展。2017-2020 年, 相关政策强调安全发展核电, 提高核电运行及在建装机容量; 2021 年, 《“十四五”能源领域科技创新规划》发布, 进一步明确了我国第三代、第四代核电技术的发展方向; 2022-2023 年, 我国发布了一系列能源及电力相关政策, 提出积极建设沿海核电, 加强新一代核电技术的研发及安全标准的制定。

表 1: 核电行业发展政策

发布时间	发布单位	政策名称	主要内容
2017 年	国防科工局	《“十三五”核工业发展规划》	提出要安全高效发展核电, 到 2020 年我国核电运行和在建装机将达到 8800 万千瓦。
2020 年	国家能源局	《2020 年能源工作指导意见》	提出要持续发展非化石能源, 安全发展核电, 稳妥推进项目建设和核能综合利用等。
2021 年	国家能源局、科学技术部	《“十四五”能源领域科技创新规划》	开展三代核电关键技术优化研究, 支撑建立标准化型号和型号谱系; 开展小型模块化反应堆、(超)高温气冷堆、熔盐堆等新一代先进核能系统关键核心技术攻关。
2022 年	国家发改委	《关于完善能源绿色低碳转型体制机制和政策措施的意见》	完善核电、抽水蓄能厂址保护制度, 并在国土空间规划中予以保障, 加快研究和制修订核电等领域技术标准和安全标准。
2023 年	国家能源局	《新型电力系统发展蓝皮书》	核电建设逐步向新一代先进核电技术过渡, 积极建设沿海核电等非化石能源。

资料来源: 中国政府网, HTI

“华龙一号”是我国具有完全自主知识产权的三代压水堆，已批量化建造。为了加强预防核电事故，提高核电站的安全可靠性和经济性，各国在第二代核电技术的基础上提出了新的要求。2013年，中广核和中核就第三代核电技术融合达成一致，双方同意在ACPR1000+和ACP1000基础上，联合开发“华龙一号”核电技术。2020年11月，华龙一号全球首堆——中核集团福清核电5号机组首次并网成功。2021年1月，全球第一台“华龙一号”核电机组——中核集团福建福清核电5号机组投入商业运行，后续批量化的机组逐步核准投运。2023年年末，中广核和中核各有两台“华龙一号”核电机组获得核准。

目前国外第三代反应堆研制及供应国包括美国、法国、俄罗斯、韩国和日本，AP1000(美国)、EPR(法国)、ESBWR(美国-日本)、ABWR(美国-日本)、APWR(日本)，以及ARP1400(韩国)等技术纷纷参与到国际核电市场角逐中。它们在满足用户要求文件(URD、EUR)的基础上，每种堆型采用不同的设计理念，如AP1000采用安全系统“非能动化”和简化系统的设计理念，EPR采用安全系统增加冗余度的设计理念，大多堆型在中国都有建设。

表 2: 核电技术发展过程

技术类别	时间	主要特点
第一代	20世纪50年代至60年代中期	多为早期原型机，使用天然铀燃料和石墨慢化剂，证明了核电技术可行性，具有研究探索的试验原型堆性质。
第二代	20世纪60年代至90年代	较为成熟的商业化反应堆，使用浓缩铀燃料，以水作为冷却剂和慢化剂。主要堆型包括压水堆(PWR)、沸水堆(BWR)、加压重水堆(PHWR)、石墨气冷堆(GCR)等。
第三代	20世纪90年代至今	满足美国“先进轻水堆型用户要求文件”(URD)和“欧洲用户对轻水堆核电站的要求”(EUR)的压水堆型技术核电机组，是具有更高安全性、更高功率的新一代先进核电站。主要堆型包括先进沸水堆(ABWR)、欧洲压水堆(EPR)及华龙一号等。
第四代	21世纪	满足安全、经济、可持续发展、少废物生成、燃料增殖的风险低、防止核扩散等基本要求。主要堆型包括超高温气冷堆、钠冷快堆、钍基熔盐堆等。

资料来源：中国广核招股书, HTI

我国拥有自主创新和研发高温冷气技术的能力，引领第四代核电技术。第四代核电站采用了非能动冷却剂如氦气，以确保在核泄漏等核事故发生时能够自动启动安全系统，从而避免严重后果；第四代核电站采用了更先进的技术和更高效的燃料，以提高核燃料的利用效率并减少资源浪费；第四代核电站能够将核废料的产生量减少到最低。目前，我国正在示范堆建设阶段的核电技术包括六种：（超）高温气冷堆、钠冷快堆、超临界水冷堆、铅冷快堆、气冷快堆、熔盐堆。就安全性和经济性而言，高温气冷堆是我国最接近商业化应用的第四代堆型。2021年，山东荣成石岛湾高温气冷堆核电站示范工程1号反应堆首次并网成功，标志着全球首座具有第四代先进核能系统特征的球床模块式高温气冷堆实现了从“实验室”到“工程应用”的飞跃。2023年12月6日，石岛湾高温气冷堆核电站作为全球首个第四代核电站的商业示范工程，成功完成了168小时的连续运营测试，并正式开始了商业运营。

表 3: 第四代核反应堆特征

堆型	功率等级/MWe	冷却剂	燃料循环	中子范围
(超)高温气冷堆	250~300	氦气	开式	热中子
气冷快堆	1200	氦气	闭式	快中子
钠冷快堆	50~150 300~1500 600~1500	钠	闭式	快中子
铅冷快堆	20~180 300~1200 600~1000	铅	闭式	快中子
熔盐堆	1000	氟化物盐	闭式	热/快中子
超临界水冷堆	300~700 1000~1500	水	开式/闭式	热/快中子

资料来源: 中能传媒能源安全新战略研究院, HTI

我国核能坚持“热堆—快堆—聚变堆”三步走战略体系。“三步走”发展战略, 是我国 1983 年在“核能发展技术政策论证会”上首次提出的核能发展总战略, 其核心内容是解决我国核能可持续发展、核燃料长期安全有效供应的问题。热堆是最成熟并具有显著经济性的核能技术, 是近中期核电建设的主力堆型百年尺度能源; 快堆是富有潜力的核能技术, 是中远期建设的主力堆型千年尺度能源; 聚变堆作为颠覆性核能技术, 则是远期建设的主力堆型万年尺度能源。

表 4: 核电发展“三步走”战略

第一步	发展以压水堆为代表的热中子反应堆。主要使用铀资源中储备占比 0.7%的铀 235。
第二步	发展快中子反应堆, 使用铀资源中占比 99.3%的铀 238 和资源总量更多的钍, 将天然铀资源的利用率由热中子堆的 1~2%提高至 60~70%, 降低燃料消耗。
第三步	发展可控聚变堆技术, 与裂变能源相比, 聚变能源产生的放射性废物总量少、且不产生长寿命放射性核素、处置更加容易。

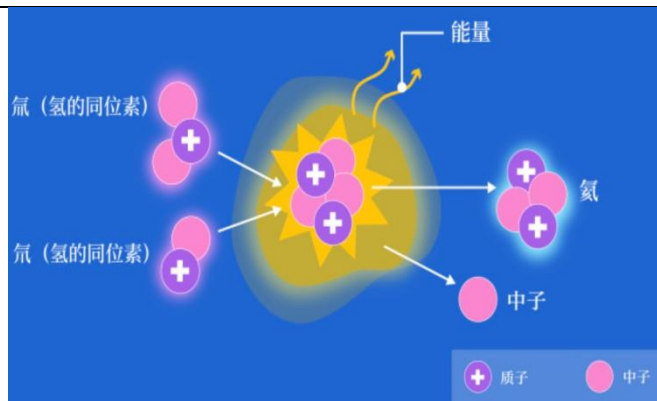
资料来源: 《核能发展技术政策要点》, HTI

## （二）核聚变是我国“三步走”规划的终极目标

核聚变是两个轻原子核结合成一个较重的原子核并释放出巨大能量的过程。核聚变又称核融合，即两个较轻的核结合而形成一个较重的核和一个较轻的核（或粒子）的一种核反应形式。核聚变每公斤燃料可以产生比核裂变（用于核电站）多四倍的能量，比燃烧石油或煤炭多近四百万倍的能量。大多数正在开发的聚变反应堆概念将使用氘和氚的混合物——含有额外中子的氢原子。理论上，只要有几克这些反应物，就可以产生一万亿焦耳的能量，这大约是一个发达国家里一个人 60 年所需的能量。

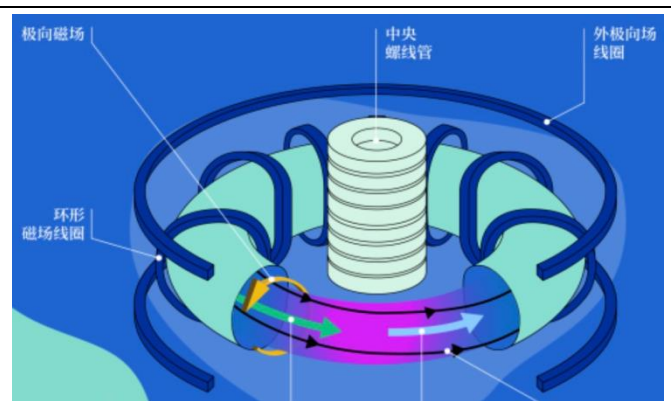
磁约束核聚变是实现可控核聚变的主流方式。目前，可控核聚变主要有三种技术路线，其中以托卡马克为代表的磁约束核聚变是发展的最有希望利用热核聚变发电的技术路线，此外还有重力场约束核聚变、激光惯性约束核聚变。我国磁约束的研究基本基于托卡马克装置，托卡马克是一种环形装置，通过约束电磁波驱动，创造氘、氚实现聚变的环境和超高温，并实现人类对聚变反应的控制。受控热核聚变在常规托卡马克装置上已经实现。但常规托卡马克装置体积庞大、效率低，突破难度大。上世纪末，科学家们把新兴的超导技术用于托卡马克装置，使基础理论研究和系统运行参数得到很大提高。据科学家估计，可控热核聚变的演示性的聚变堆将于 2025 年实现，商用聚变堆将于 2040 年建成。

图 4: 核聚变示意图



资料来源: IAEA, HTI

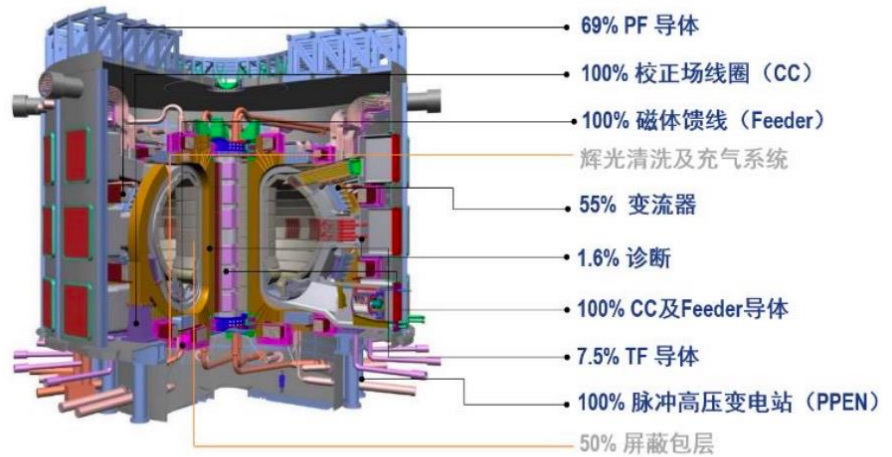
图 5: 托卡马克装置示意图



资料来源: IAEA, HTI

我国在 ITER 项目中发挥关键作用，助力磁约束聚变研究。随着全球各国对可控核聚变研究的深入，1985 年美国、前苏联、欧盟、日本共同启动“国际热核聚变实验堆 (ITER) 计划”。ITER 是全球规模最大、影响最深远的国际科研合作项目之一。ITER 装置是一个能产生大规模核聚变反应的超导托卡马克，俗称“人造太阳”。2006 年 5 月，经国务院批准，中国 ITER 谈判联合小组代表我国政府与欧盟、印度、日本、韩国、俄罗斯和美国共同草签了 ITER 计划协定。中国承担了 18 个部件研制项目的制造任务，涵盖了 ITER 装置重要关键部件。目前，我国按时、高标准、高质量交付了 ITER 计划有关任务，关键部件研制项目完成质量与进度均走在 ITER 参建各方前列。

图 6: 中国在 ITER 中的制造任务

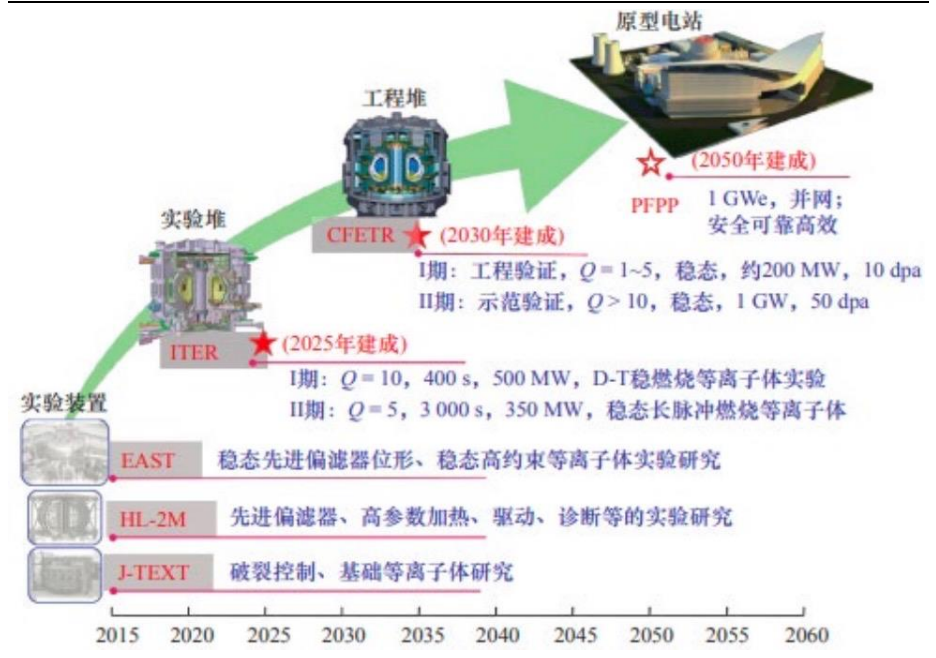


资料来源: 中科院等离子体物理研究所, HTI

**我国磁约束核聚变研究快速发展, 阶段性成果显著。**目前, 华中科技大学的 J-TEXT 装置, 核工业西南物理研究院的 HL-2M 装置和中国科学院等离子体物理研究所的 EAST (“东方超环”) 装置是我国现役的主要磁约束聚变研究装置。EAST 是我国自行设计研制的世界上第一个“全超导非圆截面托卡马克”核聚变实验装置, 位形与 ITER 相似且更加灵活。2023 年 4 月 12 日, 正在运行的世界首个全超导托卡马克核聚变实验装置 (EAST) 成功实现了 403 秒稳态长脉冲高约束模式等离子体运行, 刷新了 2017 年托卡马克装置高约束模式运行 101 秒的世界纪录。

我国在吸收 ITER 技术和管理的技術基础上, 自主设计研发中国聚变工程试验堆 (CFETR)。CFETR 于 2017 年正式启动, 是中国自主开发和设计的下一代聚变装置, 旨在弥补 ITER 和未来聚变堆之间的差距, 已进行了数轮总体工程设计。根据《可控核聚变科学技术前沿问题和进展》, 我国磁约束聚变能的开发分为 3 个阶段: 第一阶段, 力争在 2025 年推动中国聚变工程试验堆立项并开始装置建设; 第二阶段, 到 2035 年建成中国聚变工程试验堆, 调试运行并开展稳态、高效、安全聚变堆科学研究; 第三阶段, 到 2050 年开始建设商业聚变示范电站, 探索聚变商用电站的工程、安全、经济性。

图 7：中国磁约束核聚变发展路径



资料来源：《可控核聚变科学技术前沿问题和进展》，HTI

**可控核聚变创新联合体成立，推动核聚变产业发展。**2023年以来，国务院国资委启动了实施未来产业启航行动，明确可控核聚变领域为未来能源的唯一方向。2023年12月29日，以“核力启航聚变未来”为主题的可控核聚变未来产业推进会在成都召开。25家央企、科研院所和高校组成了可控核聚变创新联合体，正式揭牌中国聚变能原有限公司(筹)。中核集团主动担当作为，牵头组织中央企业共同承担，系统布局了重点技术、典型场景、重大工程项目，推进设立可控核聚变专业化公司，为可控核聚变产业发展奠定了坚实基础。本次可控核聚变创新联合体的成员包括中国一重、东方电气、佳电股份、中国西电、长江电力等，多家重点央企联合，有望促进可控核聚变商业化发展。

### (三) 全球可控核聚变研发加速

**美国和日本近年来在核聚变研究领域发展较快，全面商业化仍需时间。**美国可控核聚变的发展路线主要是激光惯性约束核聚变。2022年12月，美国能源部下屬的劳伦斯利弗莫尔国家实验室国家点火装置(NIF)实现了“核聚变点火”，而在2023年8月，该实验室成功重现“核聚变点火”突破，第二次在可控核聚变实验中实现“净能量增益”，美国将在下一步探索如何实现更大规模的核聚变能量，以及最终如何降低核聚变成本以供商业化。日本一直致力于磁约束核聚变的技术研究，2023年11月，由日本和欧盟共同合作建造运行的超导托卡马克装置——JT-60SA成功点火，成为实用型核聚变能源漫长发展进程中的一个里程碑；日本产官学合作组织也将于2024年3月成立，力争实现核聚变发电实用化，在日本主导核聚变的大多数企业都会加入新组织，开发动向将更加活跃，日本电力企业像东京电力未来也将受益于可控核聚变的稳步发展。在全球各国核聚变研究互相竞争、共同发展的背景下，全球核聚变产业链的重点企业有望迎来新的发展机遇。

**投资建议：**建议关注核电产业链重点企业：【中国核电】、【中国广核】、【东方电气】、【上海电气】、【东京电力】等。

**风险提示：**1、核聚变项目进展不及预期；2、电力需求不及预期；3、政策推进不及预期。

## APPENDIX 1

### Summary

#### 1. The fourth generation of nuclear power accelerated development to ensure energy security

**The technical route for nuclear power plants in China is mainly pressurized water reactors.** Pressurized water reactor is the main type of reactor used in operating nuclear power plants in the world. According to IAEA data, pressurized water reactors account for approximately 70% of the nuclear power units in operation worldwide. A pressurized water reactor nuclear power plant consists of a nuclear island and a conventional island. The large equipment in the nuclear island mainly includes evaporators, voltage regulators, main pumps, etc., which are the core devices of the nuclear power plant; the conventional island mainly includes steam turbine units and other auxiliary systems of the secondary circuit, similar to conventional thermal power plants. In the cost of nuclear power equipment, nuclear islands and conventional islands account for approximately 58% and 22%.

**"Hualong One" is China's third-generation pressurized water reactor with completely independent intellectual property rights and has been built in batches.** In order to strengthen the prevention of nuclear power accidents and improve the safety, reliability and economy of nuclear power plants, countries have put forward new requirements based on second-generation nuclear power technology. In January 2021, the world's first "Hualong One" nuclear power unit, China National Nuclear Corporation's Fujian Fuqing Nuclear Power Unit No. 5, was put into commercial operation, and subsequent batch units have gradually been approved for operation. At the end of 2023, China General Nuclear Power Corporation and China National Nuclear Corporation each had two "Hualong One" nuclear power units approved.

**China has the ability to independently innovate and develop high-temperature air-conditioning technology, leading the fourth-generation nuclear power technology.** In terms of safety and economy, high-temperature gas-cooled reactors are the fourth-generation reactor type closest to commercial application in China. On December 6, 2023, the Shidao Bay High Temperature Gas-cooled Reactor Nuclear Power Plant, as the world's first commercial demonstration project of the fourth-generation nuclear power plant, successfully completed a 168-hour continuous operation test and officially started commercial operation.

#### 2. Nuclear fusion is the ultimate goal of China's "three-step" plan

**Magnetic confinement nuclear fusion is the mainstream way to achieve controllable nuclear fusion.** China's research on magnetic confinement is basically based on tokamak devices. Tokamak is a ring-shaped device that is driven by constrained electromagnetic waves to create an environment and ultra-high temperature for deuterium and tritium to achieve fusion, and to achieve human control of fusion reactions.

**China's magnetic confinement nuclear fusion research is developing rapidly, with remarkable staged results.** On April 12, 2023, the fully superconducting Tokamak fusion experimental device (EAST) of the Institute of Plasma Physics, Chinese Academy of Sciences, successfully achieved 403 seconds of steady-state long-pulse high-confinement mode plasma operation, breaking the world record of 101 seconds of high-confinement mode operation of a Tokamak device in 2017.

**The Controllable Nuclear Fusion Innovation Consortium was established to promote the development of the nuclear fusion industry.** On December 29, 2023, 25 central enterprises, scientific research institutes and universities formed a controllable nuclear fusion innovation consortium, systematically laid out key technologies, typical scenarios, and major engineering projects, and promoted the establishment of a specialized company for controllable nuclear fusion. The development of the controllable nuclear fusion industry has laid a solid foundation and is expected to promote the commercial development of controllable nuclear fusion.

Risks: 1, fusion projects development lags behind expectation; 2, power demand is less than expected; 3, the policy to promote weaker than expected.

## 附录 APPENDIX

### 重要信息披露

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**优于大市**，未来 12-18 个月内预期相对基准指数涨幅在 10%以上，基准定义如下

**中性**，未来 12-18 个月内预期相对基准指数变化不大，基准定义如下。根据 FINRA/NYSE 的评级分布规则，我们会将中性评级划入持有这一类别。

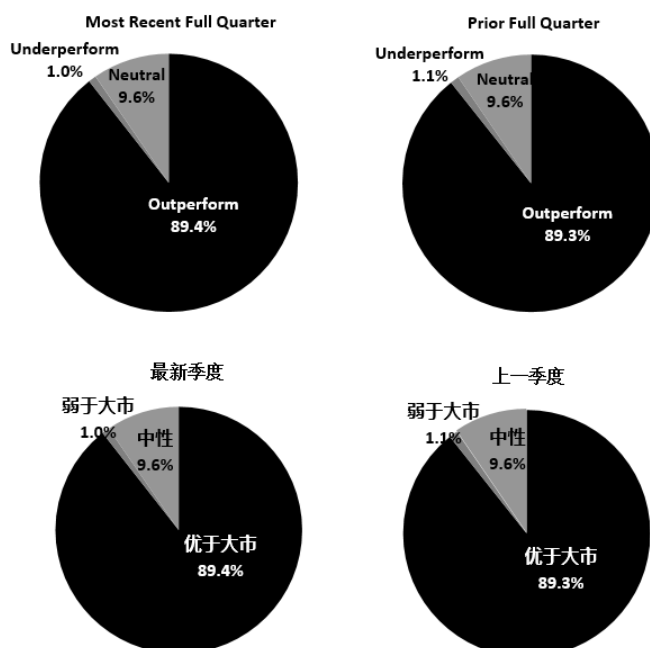
**弱于大市**，未来 12-18 个月内预期相对基准指数跌幅在 10%以上，基准定义如下

各地股票基准指数：日本 - TOPIX, 韩国 - KOSPI, 台湾 - TAIEX, 印度 - Nifty100, 美国 - SP500; 其他所有中国概念股 - MSCI China.

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### 评级分布 Rating Distribution



considerations.

### Analyst Stock Ratings

**Outperform:** The stock's total return over the next 12-18 months is expected to exceed the return of its relevant broad market benchmark, as indicated below.

**Neutral:** The stock's total return over the next 12-18 months is expected to be in line with the return of its relevant broad market benchmark, as indicated below. For purposes only of FINRA/NYSE ratings distribution rules, our Neutral rating falls into a hold rating category.

**Underperform:** The stock's total return over the next 12-18 months is expected to be below the return of its relevant broad market benchmark, as indicated below.

**Benchmarks for each stock's listed region are as follows: Japan – TOPIX, Korea – KOSPI, Taiwan – TAIEX, India – Nifty100, US – SP500; for all other China-concept stocks – MSCI China.**

### 截至 2023 年 12 月 31 日海通国际股票研究评级分布

	优于大市	中性 (持有)	弱于大市
海通国际股票研究覆盖率	89.4%	9.6%	1.0%
投资银行客户*	3.9%	5.1%	5.6%

\*在每个评级类别里投资银行客户所占的百分比。

上述分布中的买入，中性和卖出分别对应我们当前优于大市，中性和落后大市评级。

只有根据 FINRA/NYSE 的评级分布规则，我们才将中性评级划入持有这一类别。请注意在上表中不包含非评级的股票。

### 此前的评级系统定义（直至 2020 年 6 月 30 日）：

买入，未来 12-18 个月内预期相对基准指数涨幅在 10%以上，基准定义如下

中性，未来 12-18 个月内预期相对基准指数变化不大，基准定义如下。根据 FINRA/NYSE 的评级分布规则，我们会将中性评级划入持有这一类别。

卖出，未来 12-18 个月内预期相对基准指数跌幅在 10%以上，基准定义如下

各地股票基准指数：日本 – TOPIX, 韩国 – KOSPI, 台湾 – TAIEX, 印度 – Nifty100; 其他所有中国概念股 – MSCI China.

### Haitong International Equity Research Ratings Distribution, as of December 31, 2023

	Outperform	Neutral (hold)	Underperform
HTI Equity Research Coverage	89.4%	9.6%	1.0%
IB clients*	3.9%	5.1%	5.6%

\*Percentage of investment banking clients in each rating category.

BUY, Neutral, and SELL in the above distribution correspond to our current ratings of Outperform, Neutral, and Underperform.

For purposes only of FINRA/NYSE ratings distribution rules, our Neutral rating falls into a hold rating category. Please note that stocks with an NR designation are not included in the table above.

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**NEUTRAL:** The stock's total return over the next 12-18 months is expected to be in line with the return of its relevant broad market benchmark, as indicated below. For purposes only of FINRA/NYSE ratings distribution rules, our Neutral rating falls into a hold rating category.

**SELL:** The stock's total return over the next 12-18 months is expected to be below the return of its relevant broad market benchmark, as indicated below.

**Benchmarks for each stock's listed region are as follows: Japan – TOPIX, Korea – KOSPI, Taiwan – TAIEX, India – Nifty100; for all other China-concept stocks – MSCI China.**

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研究机构名称: Haitong Securities India Private Limited

SEBI 研究分析师注册号: INH000002590

地址: 1203A, Floor 12A, Tower 2A, One World Center

841 Senapati Bapat Marg, Elphinstone Road, Mumbai 400 013, India

CIN U74140MH2011FTC224070

电话: +91 22 43156800 传真: +91 22 24216327

合规和申诉办公室联系人: Prasanna Chandwaskar; 电话: +91 22 43156803; 电子邮箱: [prasanna.chandwaskar@htisec.com](mailto:prasanna.chandwaskar@htisec.com)

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Name of the entity: Haitong Securities India Private Limited

SEBI Research Analyst Registration Number: INH000002590

Address : 1203A, Floor 12A, Tower 2A, One World Center

841 Senapati Bapat Marg, Elphinstone Road, Mumbai 400 013, India

CIN U74140MH2011FTC224070

Ph: +91 22 43156800 Fax:+91 22 24216327

Details of the Compliance Officer and Grievance Officer : Prasanna Chandwaskar : Ph: +91 22 43156803; Email id: prasanna.chandwaskar@htisec.com

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