北方冬季取暖

步入2.0（无燃烧）时代

START OF THE ERA OF HEATING 2.0 (NON-COMBUSTION) IN THE NORTH WINTER

北方冬季地能热泵高效清洁取暖——热冷一体化新兴绿色产业

EFFICIENT AND CLEAN WINTER HEATING BY GROUND-SOURCE ENERGY HEAT PUMP IN NORTHERN CHINA - AN EMERGING GREEN INDUSTRY OF INTEGATED HEATING AND COOLING

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恒有源科技发展集团有限公司
EVER SOURCE SCIENCE &TECHNOLOGY DEVELOPMENT GROUP CO.,LTD.

恒有源科技发展集团有限公司在中国（香港）恒有源发展集团京港两地一体化管理框架下，专注于浅层地能（热）作为替代传统化石能源的北方冬季取暖的科研与推广，特别注重原创技术的产业化发展；公司致力于以燃烧传统化石能源供暖行业深层次的全面升级换代，利用热泵搬运自然界中量大面广、无处不在的低温热能为供暖区域无燃烧、零排放的高效清洁取暖。在新时代，发展北方冬季地能热泵高效清洁取暖——热冷一体化新兴绿色产业。

Under the integrated administrative framework of CHYY(Hong Kong) Development Group, Ever Source Science &Technology Development Group Co., Ltd. focuses on the research and promotion of shallow ground energy (heat) as an alternative to traditional fossil energy in providing heating for northern China in winter, with special emphasis on the industrialization of its original technology. The company is committed to the thorough upgrading of traditional fossil-fueled heating industry, and the provision of clean heating free from combustion and emission by using heat pump technology to upgrade low temperature geothermal energy that is ubiquitous in nature to achieve integrated provision of heating and cooling to North China. In the new era, the development of Efficient and clean winter heating by ground-sourced energy heat pump in Northern China - an emerging green industry of integated heating and cooling.

- **员工行为准则：**
  Staff Code of Conduct :

  安全第一，标准当家
  Safety first, standard speaks

  扎扎实实打基础，反反复复抓落实
  Build a solid foundation, and ensure full implementation

  负责任做每件事，愉快工作每一天
  Be a responsible doer and happy worker

- **我们的追求：**人与自然的和谐共生
  Our Pursue: Harmonious coexistence of human and nature

- **我们的奉献：**让百姓享受高品质的生活
  Our Dedication: For better quality life of all

- **我们的愿景：**因地制宜使用原创的最严格的保持地下水质量的浅层地能（热）采集技术，实现产业化发展，让浅层地能（热）作为冬季取暖的替代能源，进一步完善“温度对口，能源品位相当”的取暖能源的科学、合理利用。
  Our Vision: To achieve industrial development by adapting our original technology to local conditions while stringently maintaining groundwater quality; to ensure shallow-ground geothermal energy as an alternative energy source for winter heating, and to improve the scientific and rational utilization of heating energy that matches the temperature needs with appropriate energy grades.

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总结经验，持续创新，争做供暖 2.0 时代的先锋

——恒有源集团在“北方冬季地能热泵清洁取暖暨热冷一体化新兴产业专家研讨会”上的汇报

作者：徐生恒

2024 年 10 月 9 日，北方冬季地能热泵清洁取暖暨热冷一体化新兴产业专家研讨会在大连召开，与会行业专家进行了充分的讨论交流，对于地能热泵清洁供暖的大力发展形成了共识，中国恒有源发展集团有限公司董事局主席徐生恒先生进行了如下汇报：

一、本次会议为什么选择在大连召开

本次专家研讨会选择在大连召开是经过特别考虑的，一是大连地处东北，是我国北方冬季取暖的典型城市；二是大连小窑湾开发区和记黄埔地能热泵高效清洁取暖项目一次规划、按需投入建设应用，取得了可以简单复制，规模标准化发展的成果。

项目利用热泵因地制宜的高效循环搬运源自于太阳和地心、存储于大地这个天然蓄能器中的量大面广小于 25 度的低温热能（简称：地能），替代传统燃烧化石能源取暖。

按“温度对口、能源品位相当”的科学分类、道德用能标准，将地能作为取暖的替代能源。

浅层地能区别于可直接利用的传统地热能的是，要和热泵结合搬运地能，根据需求获得暖、冷。

大连的应用项目，在理论与实践上都证明了：在北方冬季取暖地区，在最恶劣的气候条件下，地能热泵环境系统可以稳定的以燃煤的成本，无燃烧的环保高效取暖。

和记黄埔项目是恒有源与当地政府在中国节能环保集团支持下签订的《小窑湾国际商务区 900MW 恒有源分布式地能冷热源站供热特许经营协议》范围内的具体项目落实；是包括 216 个能源站、5227 套地能采集井的可以满足区域 1500 万平米建筑物分布式地能热泵环境系统供暖的《大连小窑湾国际商务区 HYY-900MW 分布式地能冷热源站项目区域地能无燃烧为建筑物智慧供暖 (冷) 规划》中一部分；项目的落地有着完整的政府规划

和规范的商业模式，和记黄埔项目三年以来的高效优质供暖保证充分体现了地能清洁供暖的可靠性、不增加政府和用户投资、可以随着项目建设进度分期投入等优势。项目实现了温度对口、能源品位相当的科学合理利用，核心既是符合环保要求的新能源应用，又实现了节能、碳减排，是供暖产业的新质生产力，对于供暖产业发展具有重要意义。

二、恒有源地能热泵清洁供暖的部分案例

（一）HYY 地能热泵环境系统（适用于城镇集中供暖项目）

1. 雄安市民服务中心项目：是雄安新区首批示范项目，确定了新区应用地能供暖（冷）的指导方向，项目最终获得了国家优质工程（鲁班奖）；

2. 国家大剧院景观水池项目：设计要求 3.5 万平方米 50 厘米深度的水面“冬天不结冰、夏天不长藻”，是当时国家大剧院建设过程中的五大技术难题之一，最后是采用了地能换热技术解决了这一难题；

3. 中共中央党校（国家行政学院）港澳培训中心项目：是集教学培训、游泳馆、体育馆等一体的综合性建筑，只用 30 天就快速实现了浅层地热能替代传统化石能源冷热源系统的改造升级；

4. 海淀外国语实验学校项目：以该项目为案例的论文《浅层地能资源利用——单井抽灌技术的实例研究》于 2003 年在墨西哥举行的世界地热资源大会上获得最佳论文奖。论述了浅层地热能在十几万平米建筑上的规模化应用；2023 年在北京举行的世界地热大会的主题论坛邀请我们宣讲了《北京市海淀外国语实验学校京北校区单井循环换热地能采集技术实例研究》论文。该项目 2021 年入选国家节能中心重点节能技术应用典型案例。

（二）HYY 地能热宝系统（适用于农村散户的分间按需取暖）

农村分户煤改电项目：为落实习主席关于农村生活方式革命的讲话精神，恒有源开发了适用于一家一户，按户配设备，分间取暖，用哪间开哪间的地能热宝系统。从 2016 年开始，在多个农村地区配合政府集中煤改电项目进行应用，根据北京市农村农业局对各种采暖形式一个供暖季的数据监测，地能热宝的平均耗电每平方米每个供暖季 30 度，折算供暖季费用每平方米 9.6 元（电价：每天 15 小时每度 0.49 元、9 小时每度 0.1 元），相较于空气源热泵供暖季费用每平方米 18.3 元，蓄能式电暖气供暖季费用每平方米 21.3 元，燃气壁挂炉供暖季费用每平方米 13.8 元，地能供暖产品使用成本最低。在西闸村项目座谈会上，老百姓们情真意切地表示：地能自采暖方式一是安全省心，二是干净省钱，三是有保障、省能源，真正实现了农村生活方式的革命。

三、产品、技术的标准化，推动产业发展

恒有源已经实现三个系统成套产品标准系列：地能热泵环境系统（适合城镇分布式集中供暖）；地能热宝系统（适合农村散户分间取暖）；分布式地能冷热源站（适合规划区域供暖）。系统成套产品由四个循环成套产品组成：循环采集成套产品（一次网）、换热储能成套产品（二次网）、换热提升成套产品（三次网）、循环释放成套产品（四次网）。循环成套产品又分解为模块产品、单件产品、配件等。完全标准化的建设，任何环境系统都可以简单复制，最恶劣气候下都能够保证供暖。可以实现标准系统建设，系统交钥匙工程初始投资在每平方米 300 元以下，冷热源部分在 200 元 / 平方米以内。

结合北方冬季取暖的发展史，热冷一体化的

地能热泵高效清洁取暖，标志着我国进入了北方冬季取暖无燃烧 2.0 时代。

四、企业发展目标

恒有源将进一步总结在各地不同地质进行了二十多年的地能热源的因地制宜的采集方式。在拥有完整的成套系列产品和相关工艺基础上，加强配合地方区域的地能热泵高效清洁取暖规划，设计并提供支持。建立支持北方冬季清洁取暖的维运热泵大数据服务平台，更加简洁的保证客户服务。

我们将依托北京恒有源科技总部，发挥和进一步充分利用中关村高新技术园区的人才优势、技术优势。使恒有源发展集团在 2025 年全面完成转型：在北方冬季供暖地区重点规模标准化的建设地能热泵高效清洁取暖系统。支持地区发展热冷一体化新兴绿色产业。发展区域负责任供暖企业分别作为：HYY 地能热泵环境系统（城镇分布式集中供暖）；HYY 地能热宝系统（农村散户分间取暖）；分布式 HYY 地能冷热源站的发展代理建设商。

恒有源发展集团是地能热泵高效清洁取暖系统成套技术服务商。

五、总结

国家“振兴东北”的战略目标从振兴东北的产业开始，东北的供暖产业是其中重要的一部分。大连是东北发展的一个核心的区域，大连供暖产业的发展至关重要。热泵高效清洁取暖的未来不单是福利，必将成为热冷一体化的新兴产业。这个产业它既联系着千家万户，也是千家万户可以共同参与的事，产业是一个螺旋上升的朝阳产业，在双碳目标下有着特殊的意义。一栋楼的减排量并不大，但若整个区域所有建筑都用这个技术，那碳减排的意义就非常大，正所谓“集腋成裘、聚沙成塔”。在传统供暖方式下，北方供暖能耗占国家总能耗的 10% 左右，现在这项技术可以用传统燃煤的成本，用燃煤 50% 的能耗就解决原有面积的供暖问题，也就是可以降低国家总能耗 3-5% 的同时，还能提高老百姓的生活水平，实现冬暖夏凉、日常有热水。我们对于双碳目标的实现有信心，目前，在北方冬季取暖地区，非常有利于企业发展地能热泵高效清洁取暖和热冷一体化的新兴产业。

注释：供暖 1.0 时代采用燃烧取暖，供暖 2.0 时代采用清洁供热，热泵取暖为清洁供热的方式之一。燃烧取暖利用燃料的化学能，在燃烧过程中，构成燃料的分子发生变化，形成新分子并释放热量。例如，煤在锅炉中燃烧时，煤中的碳与空气中的氧结合形成二氧化碳，同时放出热量。其结果是煤被消耗殆尽，产生了二氧化碳；热泵取暖只有物理变化，不存在化学变化。在热泵取暖过程中，从宏观层面来看，没有物质被消耗或产生，只有热量在传递。比如我们的地能热泵，在冬季采暖时，将浅层地下的低温热能提升品位后输送至室内取暖。仅消耗少量电能，主要作用并非产生热量，而是搬运热量。热泵取暖的另一个重要特点是，热泵取暖系统的最高温度接近供暖温度。燃烧取暖的温度受燃料“燃点”限制，不可能过低，通常是几百度的热源为二十多度的房间供暖，造成能源品味的不匹配。此外，燃烧取暖的能源只能来源于燃料，而热泵取暖的能源范围广泛，包括许多清洁的可再生能源。

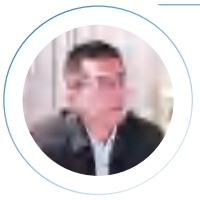
北方冬季地能热泵清洁取暖暨热冷一体化新兴产业专家研讨会上领导和专家发言摘要

张玉清　国家能源局原副局长

浅层地热能清洁取暖，不但要算经济账，还要算生态账。要在国家层面上，做好宏观规划;在管理政策上加以完善，制定地热能利用的管理办法;出台优惠措施，鼓励企业实施地热能取暖。既要加强监管，又要制定地热能清洁取暖项目准入门槛，优化项目审批流程，完善地热能清洁取暖持续发展的考核体系，加速推进热冷一体化新兴产业发展。有助于尽早实现 2030 年前碳达峰、2060 年前碳中和的宏伟目标，是未来能源转型的新方向，是建筑能源低碳高效利用的优化选择，是完成非化石能源利用目标、建设清洁低碳社会、实现能源可持续发展的必然选择。我们相信，一个全新的清洁能源供热时代正在到来。

周　春　清洁供热产业委员会（CHIC）执行主任

截止到 2023 年底，中央财政部共投入 1209 亿元，由财政部牵头，搞了五批 88 个清洁取暖试点项目，带动社会投资已超过 4000 亿，由此也形成了一个新的产业——清洁供热产业，去年的产值达到 9250 亿。我们将供热大概分为两个阶段，第一阶段为从建国以后到 2016 年，为传统供热时代，称为供热 1.0 时代；第二阶段为从 2017 年到目前为止，称为清洁供热 2.0 时代。如今看来整个行业已经是一个新的万亿产业，正在蓬勃发展。

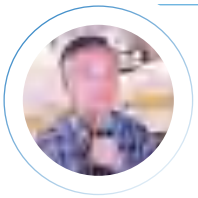


唐铁军 国家发展和改革委员会价格成本和认证中心副主任

结合国家发改委价格成本和认证中心开展的工作，给大家汇报三点认识：第一、要正确认识供热行业市场化改革的方向；第二、充分认识清洁供热的战略意义。随着我国城市化进程的加快，供热面积以每年 10% 的速度在增长。同时为满足人民群众需求，全国大多数城市近期在供热的温度上还要进行上调，将进一步加剧热力资源的紧张状况。从国家层面，通过清洁取暖供热行业的高质量绿色发展，适应结构转型发展新要求，对保障能源安全和促进经济社会发展有重要意义；第三、准确把握地热能在未来供热领域的地位，应看到地能热泵的优势和良好的发展。随着供热计量改革的不断深化，热力商品化属性逐步增加，供热价格逐步市场化，也会为地能热泵技术提供更加灵活的市场空间。冷热一体化的独特优势，在提高效率积极性的同时，冷热联供为降低地区冬夏两季的用电负荷，为保障热力系统安全做出更大贡献。

汪集旸 中国科学院院士

我与恒有源科技发展集团有限公司从北京举办奥运会开始就有接触，这个企业所从事的是个朝阳产业，它的前身是北京四季青公社的一个锅炉厂，以徐生恒为领导的一批专家，把开发重点从开发锅炉转到开发单井抽灌（地能热泵）为主的方向。我当时作为北京市的地热供暖的专家组组长，有幸接触到恒有源科技的同事，当时的转型是非常好的。该公司的项目不仅仅在北京有，还在其他省多点都有分布，据我了解西藏地区也有涉及。大家都知道，地热能是一种不可多得的可再生资源，稳定高效。在大连地区想进一步推动这个事情，我作为一个搞地热方面的专家，是大力支持的。



周宏春 国务院发展研究中心原副巡视员、清洁供热产业委员会（CHIC）主任

供热产业转型提供的是新质生产力。新质生产力是高质量发展中孕育发展起来的，我们清洁供热也产生新质生产力。热泵这项技术就是做了地热能的搬运工，把分散在地下的能源收集、运输、转化，供大家提高居住环境的生活质量水平，这本身就是一个新质生产力。

热是低品位的，天然气、石油是高品位的，用燃气、用二次能源电力来做供热都是在浪费资源，要用低品位的，比如地热能，生物质能源。如何发展清洁供热，要将安全放第一，高效是第二。供热产业转型方向跟能源转型是一致的，国家提出的“清洁低碳安全高效”，但我认为安全是第一位。所以安全、高效、清洁、低碳，地能热泵可以做到，但还有可以再升级的地方。

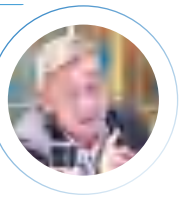
曹莉莉 和记黄埔卧龙北地产（大连）有限公司代表

长江集团和记黄埔地产作为小窑湾最早进驻的房地产开发企业，希望把先进的国际设计理念、领先的技术设备以及高质量的住宅品质带到小窑湾国际商务区。御南湾项目是最早响应国家和政府号召的使用清洁能源的项目，供热面积大概 58000 多平方米。通过与恒有源科技发展集团有限公司强强联合，采用先进的供暖技术和设备，提高了供暖的效率，注重环保和节能，降低了环境污染，实现了供暖服务的可持续性和社会责任。从 2021 年供热以来，已经过三个完整的供暖期，供暖效果远超国家规定温度以及大连当地的供暖标准，做到了供暖之前做好调试，供暖之中及时响应，供暖之后落实回访，业主及物业公司对供热效果表示认可。

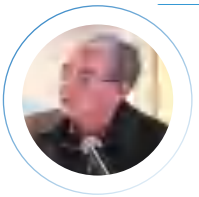
武献华　辽宁省政协副主席

供暖是关系到我们切身利益的问题。特别是在北方，供暖是必不可少的。通过这次会议的企业介绍、用户介绍、院士们讲述中，发现地能热泵取暖的的优点，对未来的发展指出一个方向。在投资运行费用相当的情况下，一是安全性；二是过去的供暖锅炉房只是解决了取暖问题，制冷问题未解决；三是低碳，没有任何的碳排放，具有非常广阔的前景，可以支持东北产业发展。包括出图纸设计、零配件的生产、产业园的建设等。这不仅仅是一项事业，更可以发展成产业，不仅是纯粹的对民生的关爱，也是我们东北发展的一个重要抓手，意义非常大。

熊大新　北京市政协原副主席



恒有源科技应该趁着现在经济改革的潮流，再进一步。不能满足于现在企业的发展，企业要有前途，要好好搞企业运营、企业宣传。做一些脚踏实地的企业运作和宣传工作。



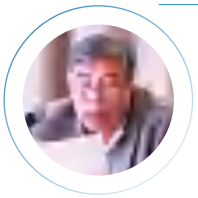
白金荣　北京控股集团有限公司原总经理

要提倡企业家精神，要给企业家容错机制，要给产业推动提供看得见、摸得找的东西。能否在政策要求下把清洁供热纳入建筑设计标准，让用户多几种选择。让在“敲对门、找对人、送好文”的基础上，在借鉴快速发展的例子，在政策要求上，再进一步推广起来，将这种模式作为快速增长的突破口发展起来。

胡昭广 中关村创始人、北京市原副市长

恒有源科技经过 20 多年来的艰苦奋斗，艰难的创业，现在面临需要实现跨越式发展的局面。要发展新质生产力，要高质量发展，要在双碳目标指导下发展冷热一体化产业。这是一个转折点，不能再平铺直叙、按部就班，要突破性发展。传统生产力就是劳动力加上劳动工具发展，新质生产力要比传统生产力层面高。生产要素创新性发展，这是一个产业深度的升级转型。

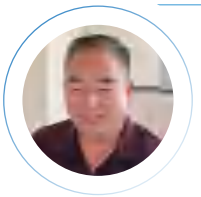
梁耀东 供暖专家



气候变化是当今人类社会面临的最为重大的非传统安全。IPCC 评估报告科学结论已成为 COP28 全球盘点的政治共识。气候变化即是环境问题，也是发展问题，但归根到底是发展问题。习近平主席宣布中国力争 2030 年前实现碳达峰、2060 年前实现碳中和。实现碳达峰碳中和是贯彻新发展理念、构建新发展格局、推动高质量发展的内在要求，顺势而为、乘势而上，以更大力度推动我国新能源高质量发展，应对气候变化是人类共同事业，中国实施积极应对气候变化国家战略。恒有源从创业至今，坚持做浅层地热能开发利用的引领者，建议恒有源地能热泵清洁取暖暨热冷一体化的系统集成技术及产品与服务在我国适宜区域加快应用推广力度与相关政策支持，早利用、早受益，多使用、多受益，为我国建筑绿色低碳供暖作出应有贡献。

杨明忠 中国恒有源发展集团有限公司 CEO

恒有源科技有着 20 多年的地能供暖探索实践，我们完成了多种多应用场景下、商务模式下，地能清洁供暖的供暖（冷）的项目。我们现在有着充分的技术、产品和服务的储备，我们也正在把公司这 20 多年的积累经验向全社会推广，把企业常规的工程发展模式变革为支持区域整体发展的模式。我们会继续加倍的努力推动北方地能热泵清洁取暖，助力我国双碳目标的实现。



张　卫　恒有源科技发展集团有限公司董事长

供暖是关乎民生的大事，也是值得我们全身心投入的事业。从传统供暖 1.0 时代到清洁供暖的 2.0 时代，从单纯的供暖转向热冷一体化，这也是新质生产力的发展。保障供暖是我们从业人员的责任，恒有源科技一直坚持开发利用的浅层地热能，是重要的清洁能源之一，也是完全可以作为传统供暖能源的替代能源。在新时代，我认为浅层地热能的开发和利用，也必将会得到发扬光大。

刘宝红　恒有源科技发展集团有限公司副总裁、热泵产品和成套设备负责人

我们依据低温热源的类型和采暖方式（自采暖或集中采暖），对热泵机组及成套产品进行了分类和集成，采用模块化设计和制造。这种创新模式不仅简化了现场安装流程，确保了系统质量的稳定性和可靠性，还允许系统能够灵活地根据具体工程需求进行调整和扩展，以适应多样化的市场需求。我们的全线产品包括供暖热泵机组、循环换热成套产品以及成套供暖热泵系统，均采用标准化设计和生产制造。这些产品能够全面替代传统的燃烧供暖方式，无论是农村的燃煤炉取暖、办公楼的锅炉供暖，还是区域热电厂的燃烧供暖，都有相应的地能热泵清洁取暖系统产品方案，能够满足不同场景下的取暖需求。

新闻报道

北方取暖步入无燃烧地能热泵高效清洁取暖 2.0 时代

——北方冬季地能热泵清洁取暖暨热冷一体化新兴产业专家研讨会在连召开

10 月 9 日，由中国中小企业协会清洁供热产业委员会、《中国地热能》杂志社、北京工业对外经贸促进会主办的北方冬季地能热泵清洁取暖暨热冷一体化新兴产业专家研讨会在大连召开。

本次会议，与会专家听取了恒有源科技发展集团有限公司（以下简称“恒有源科技”）的汇报，参观位于小窑湾国际商务区大连和记黄埔 (御南湾) 单井循环换热地能清洁供暖项目 , 该项目已成功完成 3 个取暖季的检验。与会专家经实地考察和讨论分析，认为这是北方冬季将从传统燃烧取暖方式的 1.0 时代步入无燃烧地能热泵高效清洁取暖 2.0 时代的重要标志。

恒有源科技多年来始终贯彻学习习总书记关于推进北方地区清洁取暖的重要指示精神，坚持无燃烧清洁取暖，始终追求人与自然和谐共生，让老百姓享受高品质生活。公司针对北方区域特点开发的供暖产品全面周到、功能齐全，既能满足单个农户需求，也能满足区域集中供暖；既能冬季供暖、夏季制冷，也能提供热水等服务，实现了热冷一体化；不仅可以提供单个的供暖产品，也可提供系统的供暖（冷）解决方案。在推动浅层地热能利用的基础上，公司积极开展空气能、氢能等多种清洁能源的耦合利用研究，积极探索组合优化的清洁能源供暖方案。

目前，恒有源科技在北京设立北方冬季地能热泵高效清洁取暖系统运维服务中心，是支持热冷一体化产业发展的 24 小时的服务平台，可以支持区域重点企业在当地发展热冷一体化新兴产业、建设产业园区、提供系统成套技术、相关成套产品和服务培训。恒有源致力于发展区域代理，为区域重点企业提供支持，共同推广区域地热能清洁供暖产业。

北方冬季地能热泵高效清洁取暖是在新质生产力推动下的标准化发展，产业升级换代为无燃烧取暖大数据服务模式，完成企业从工程模式向大数据服务平台的转型。实现双碳目标下的热冷一体化新兴产业、实现市场区域化发展的转型。

反响

1

2024 年 10 月 10 日,《大连日报》做相关报道

04 综合新闻

北方取暖将步入无燃烧2.0时代

北方冬季地能热泵清洁取暖暨热冷一体化新兴产业专家研讨会在连召开

2

2024 年 10 月 10 日，金普新闻做相关报道

3

2024 年 10 月 10 日，清洁供热协会（CHIC）平台做相关报道

4

2024 年 10 月 17 日，CGTN 国际频道做相关报道

China's Dalian introduces geothermal energy for winter heating

22:27, 17-Oct-2024

Translate Share

Geothermal energy, or heat emitting from the earth, is considered by many to be a sustainable and clean source of energy. And as the winter season approaches, homes in the country's northeast are switching from traditional coal-fired heating to geothermal heating.

5

2024 年 10 月 12 日，恒有源科技发展集团有限公司官网、微博、微信公众号平台做相关报道

北方取暖步入无燃烧地能热泵清洁取暖 2.0 时代 | 北方冬季地能热泵清洁取暖暨热冷一体化新兴产业专家研讨会在连召开

北方冬季地能热泵高效清洁取暖系统与其他形式对比表

——HYY 地能热泵环境系统（适合城镇分布式集中供暖）与其它集中供暖、制冷系统方式的对比分析表

序号	取暖、制冷方式	能源形式特点	主要设备	系统初投资直接成本（以 500kW 标准供热量、取暖面积 1 万平米建筑为例核算）			
				一次循环换热系统		二次循环换热系统	
				系统描述	直接成本	系统描述	直接成本
1	地能热泵环境系统高效供暖制冷提供生活热水	以地下水为介质的单井循环换热技术采集可再生浅层地热能高效的为建筑冬季供暖、夏季制冷	单井循环换热地能采集井 地能热泵主机	以地下水为介质的单井循环换热井方式高效环保采能（主要包括 500kW 单井循环换热地能采集井和一次管网）	总投资 90 万（90 元 / ㎡） 其中 采集井：60 万 管网施工：30 万	以环保低冰点（-5°C）介质换、储、运可再生浅层地热能热量（主要包括 100 平米换热器及二次管网）	总投资 20 万（20 元 / ㎡） 其中 换热器：15 万 管网施工：5 万
2	天然气锅炉燃烧供暖 + 冷水机组配合冷却塔制冷	以一次化石能源天然气管网输送到用户锅炉燃烧取暖	天燃气锅炉 冷水机组 冷却塔	天然气市政管网 冷却塔散热系统	总投资 50 万（50 元 / ㎡） 其中 天然气配套费：20 万元 冷却塔：30 万元	燃气调压站及小区二次气网 冷却水循环管线系统	总投资 50 万（30 元 / ㎡） 二次气网：20 万 冷却水系统：30 万元
3	空气源热泵供暖制冷	以室外空气作为低品位取热源电力拖动空气能热泵供暖制冷	空气源热泵	电力增容（主要包括变压器高压引入）	总投资 30 万（30 元 / ㎡）（增加电容 200kW）		
4	电锅炉（蓄热）供暖 + 冷水机组配合冷却塔制冷	用电能直接转化为热能取暖	电锅炉及蓄热设备 冷水机组 冷却塔	电力增容（主要包括变压器高压引入） 冷却塔散热系统	总投资 100 万（100 元 / ㎡） 其中 电力增容费：70 万元 冷却塔：30 万元	低压线缆 冷却水循环管线系统	总投资 50 万（30 元 / ㎡） 低压线缆：20 万 冷却水系统：30 万元
5	中深层地热井供暖 + 热泵机组配合冷却塔制冷	开采高温地热矿产资源供暖	地热井 热泵机组 冷却塔	需在勘探具备地热资源点位钻地热井（2000m 以上），取地热水供暖 冷却塔散热系统	总投资 350 万（350 元 / ㎡） 其中 地热井：300 万 管网施工：20 万 冷却塔：30 万元	需设置二次换热系统（主要包括耐腐蚀换热器及二次管网） 冷却水循环管线系统	总投资 50 万（50 元 / ㎡） 其中 换热器：20 万 冷却水系统：30 万元

备注：①全生命周期年均成本 = 取暖系统初投资 / 主要设备寿命 + 采暖制冷运行成本。

三次循环换热系统		初投资成本合计	系统供暖、制冷运行成本（元 / ㎡）	系统寿命期（年）	全生命周期年均成本（元 / ㎡）	系统安全性	系统操作	备注
系统描述	直接成本							
以环保冷媒为工质提升能源品位达到供暖要求（主要包括 700kW 热泵主机及配套机房循环泵及管路配电系统）	总投资 90 万（90 元 / ㎡） 其中 热泵主机：40 万 配套设备：20 万 配套电气：20 万 施工费用：10 万	总投资 200 万 (200 元 / ㎡)	供暖：28 元 / ㎡ 制冷：16 元 / ㎡ 其中： 供暖电能：24 制冷电能：12 人工：2 维保：2	20	54	无燃烧、无化学和高温高压过程，无安全隐患，无特别消防要求	自动运行简单设置维护简单按需运行	常规小区供电负荷即可
①供暖：燃气锅炉房（主要包括两台 1t 环保燃气锅炉 (一用一备) 及配套机房循环泵及管路配电系统） ②制冷：制冷机房（主要包括 700kW 冷水机组、冷却塔、管路及配套电气）	总投资 120 万（120 元 / ㎡） 其中 锅炉：40 万 冷水机组：30 万 配套设备：15 万 配套电气：15 万 施工费用：20 万	总投资 220 万 (220 元 / ㎡)	供暖：30 元 / ㎡ 制冷：20 元 / ㎡ 其中： 燃气：22 制冷电能：16 人工：供暖 4、制冷 2 维保：供暖 4、制冷 2	15	65	有燃烧和高温高压过程，有安全隐患，需符消防要求的独立建筑作为锅炉房	专业司炉工三班运行	
空气源热泵模块 （主要包括七台空气源热泵模块机及配套机房循环泵及管路配电系统）	总投资 120 万（120 元 / ㎡） 其中 空气源热泵：60 万 配套设备：20 万 配套电气：10 万 施工费用：10 万 消音设施：20 万	总投资 150 万 (150 元 / ㎡)	供暖：40 元 / ㎡ 制冷：22 元 / ㎡ 其中 供暖电能：36 制冷电能：18 人工：2 维保：6	10	77	极寒天气下不能保证需设备份系统 城市密集区存在噪音污染和热岛效应	需频繁除霜运行	
①供暖：电锅炉和蓄热设施（主要包括 1400kW 电锅炉，蓄热设施及配套机房循环泵及管路配电系统） ②制冷：制冷机房（主要包括 700kW 冷水机组、冷却塔、管路及配套电气）	总投资 160 万（160 元 / ㎡） 其中 电锅炉：30 万 冷水机组：30 万 蓄热设施：30 万 配套设备：40 万 施工费用：30 万	总投资 310 万 (310 元 / ㎡)	供暖：60 元 / ㎡ 制冷：20 元 / ㎡ 其中 供暖电能：54 制冷电能：16 人工：供暖 3、制冷 2 维保：供暖 3、制冷 2	15	100	用电量大 运行对电网冲击大	需高压电工专业运行	
①供暖：配备热泵辅助设施梯级利用地热水供暖； ②制冷：热泵主机 + 冷却塔（主要包括冷却塔、管路及配套电气）	总投资 90 万（90 元 / ㎡） 其中 热泵主机：40 万 配套设备：20 万 配套电气：20 万 施工费用：10 万	总投资 490 万 (490 元 / ㎡)	供暖：36 元 / ㎡ 制冷：20 元 / ㎡ 其中 供暖电能：20 地热矿产资源税：10 制冷电能：16 人工：供暖 3、制冷 2 维保：供暖 3、制冷 2	15	89	中深层地热再生周期长有不可持续风险，水质化学含量复杂不能回灌危害较大，如水处理不到位易结垢，换热系统使用寿命短	专业人员运行	

②以上各种形式的四次网（设在建筑内的末端散热系统）按均一致考虑、不影响分析比较，未列入。

北方冬季地能热泵高效清洁取暖系统与其他形式对比表

——HYY 地能热宝系统（适用农村散户分间取暖）与其它分户取暖、制冷系统方式的对比分析表

序号	取暖方式	能源形式特点	系统安全性及需要注意的问题	系统操作和分间控制	系统主要设备	系统描述		两间房（30-50 ㎡） 直接成本
1	电采暖	用电能直接转化为热能取暖	电网需要增容、电网运行效率低；供暖效率最高 100%；	遥控器操作、可分间控制	直热式电采暖器	需电增容； 每间房根据面积匹配功率 1.5kW、2kW、2.5kW 蓄能式电暖器； 功能为供暖；		电增容改造费 0.6 万 户内电改造投资 0.2 万 电暖器 0.5 万元 小计：1.3 万　初投资：260 元 / ㎡
2	天然气壁挂炉	燃烧一次矿物质化石能源天然气制取热水取暖	燃气软管必须定期更换，防止老化造成泄漏；供暖效率 95% 左右；	控制面板操作、不能分间控制	燃气壁挂炉、地板辐射采暖（或散热器）	需建设燃气气源站和入户管道； 每户配置 1 台 20kW 或 36kW 燃气壁挂炉； 功能为供暖；		燃气初装费 1.3 万 燃气壁挂炉及水泵等 0.6 万 地板辐射采暖 0.5 万 小计：2.4 万 初投资：480 元 / ㎡
3	空气能热泵系统	以室外空气作为低品位热（冷）源 冬季取暖 夏季制冷	设备噪音（扰民）；冬季频繁除霜；需配电辅助加热； 供暖效率 200% 左右；	控制面板操作、不能分间控制	空气源热泵供暖机组、地板辐射采暖（或散热器或风机盘管系统）	需电增容； 每户匹配 1 台或 2 台空气能热泵供暖机组； 功能为供暖、可制冷（末端需为风机盘管系统）；		电增容改造费 0.6 万 空气源热泵供暖机组及水泵安装等 1.8 万 地板辐射采暖系统 0.5 万 小计：2.9 万 初投资：580 元 / ㎡
4	地能热宝系统	以地下水为介质的单井循环换热技术或竖孔地埋管换热技术采集可再生浅层地热能冬季取暖 夏季制冷	地热能温度相对恒定，供暖有保证且效率高（供暖效率 350% 及以上）； 无燃烧、零排放，安全性好；	遥控器操作、可分间控制	单井循环换热地能采集井或竖孔地埋管、地能热宝机组	单井循环换热地能热宝系统（按整村 1 万平米应用为例） 功能为供暖、制冷	以地下水为介质的单井循环换热井方式高效环保采能，包括一次循环换热设备及管网。	地能采集井：60 万 管网及施工：30 万 小计：90 万　投资：90 元 / ㎡
							以环保低冰点介质换、储、运可再生浅层地热能，包括二次循环换热设备及管网。	地能热源站（产品）：27 万 管网及施工：35 万 小计：62 万 初投资：62 元 / ㎡
							以环保冷媒为工质提升能源品位达到供暖要求，包括三次循环换热设备。	一拖二地能热宝机组（产品）：0.53 万 安装费用：0.17 万 小计：0.7 万 初投资：140 元 / ㎡
							初投资成本合计：	292 元 / ㎡
						竖孔地埋管换热地能热宝系统 功能为供暖、制冷	以环保低冰点介质换、储、运可再生浅层地热能，包括二次循环换热设备及管网。	竖孔地埋管采集模块：0.12 万 供回水模块 + 定压补水模块：0.03 万 安装费用：0.5 万 小计：0.65 万 初投资：130 元 / ㎡
							以环保冷媒为工质提升能源品位达到供暖要求，包括三次循环换热设备。	地能热宝机组（产品）：0.53 万 安装费用：0.17 万 小计：0.7 万　初投资：140 元 / ㎡
							初投资成本合计：	270 元 / ㎡

备注：

①恒有源原创的“地能热宝”系统是以浅层地热能作为供暖替代能源的节能技术，系统设计符合和继承了中国“省着用”的节俭传统，分间配热宝设备和分间计量，用哪间开哪间；

②取暖系统投资范围包括电力 / 燃气扩容投资、取暖主机设备、末端系统及系统配套管道、电气等，交钥匙工程；

系统初投资直接成本			系统采暖运行成本（元 / ㎡）	系统寿命期（年）	全生命周期年均成本（元 / ㎡）
三间房（50-75 ㎡）	五间房（75-120 ㎡）	八间房（200-300 ㎡）			
直接成本	直接成本	直接成本			
电增容改造费 0.6 万 户内电改造投资 0.2 万 电暖器 0.75 万元 小计：1.55 万　初投资：207 元 / ㎡	电增容改造费 0.6 万 户内电改造投资 0.5 万 电暖器 1.25 万元 小计：2.35 万　初投资：195 元 / ㎡	电增容改造费 1.2 万 户内电改造投资 0.8 万 电暖器 2.5 万元 小计：4.5 万　初投资：150 元 / ㎡	23.3 其中： 电费：21.3 人工：0 维保：2	10	44
燃气初装费 1.3 万 燃气壁挂炉及水泵等 0.6 万 地板辐射采暖 0.75 万 小计：2.65 万 初投资：353 元 / ㎡	燃气初装费 1.3 万 燃气壁挂炉及水泵等 0.6 万 地板辐射采暖 1.2 万 小计：3.1 万 初投资：258 元 / ㎡	燃气初装费 1.3 万 燃气壁挂炉及水泵等 0.6 万 地板辐射采暖 3 万 小计：4.9 万 初投资：163 元 / ㎡	17.8 其中： 燃气费：13.8 人工：0 维保：4	8	57
电增容改造费 0.6 万 空气源热泵供暖机组及水泵安装等 2 万 地板辐射采暖系统 0.75 万 小计：3.35 万 初投资：447 元 / ㎡	电增容改造费 0.6 万 空气源热泵供暖机组及水泵安装等 2.4 万 地板辐射采暖系统 1.2 万 小计：4.2 万 初投资：350 元 / ㎡	电增容改造费 0.6 万 空气源热泵供暖机组及水泵安装等 4 万 地板辐射采暖系统 3 万 小计：7.6 万 初投资：253 元 / ㎡	21.3 其中： 电费：18.3 人工：0 维保：3	10	62
同两间房、初投资 90 元 / ㎡	同两间房、初投资 90 元 / ㎡	同两间房、初投资 90 元 / ㎡	13.1 其中： 电费：9.6 人工：2 维保：1.5	15	32.2
同两间房、初投资 62 元 / ㎡	同两间房、初投资 62 元 / ㎡	同两间房、初投资 62 元 / ㎡			
一拖三地能热宝机组（产品）：0.65 万 安装费用：0.25 万 小计：0.9 万　初投资：120 元 / ㎡	两间房 + 三间房，初投资 130 元 / ㎡	变频多联机产品：3.6 万 安装费：0.8 万 小计：4.4 万　初投资：147 元 / ㎡			
272 元 / ㎡	282 元 / ㎡	299 元 / ㎡			
竖孔地埋管采集模块：0.24 万 供回水模块 + 定压补水模块：0.03 万 安装费用：0.9 万 小计：1.17 万　初投资：156 元 / ㎡	两间房 + 三间房，初投资 143 元 / ㎡	竖孔地埋管采集模块：0.72 万 供回水模块 + 定压补水模块：0.2 万 安装费用：3.5 万 小计：4.42 万　初投资：147 元 / ㎡	11.1 其中： 电费：9.6 人工：0 维保：1.5		29.7
一拖三地能热宝机组（产品）：0.65 万 安装费用：0.25 万 小计：0.9 万　初投资：120 元 / ㎡	两间房 + 三间房，初投资 130 元 / ㎡	变频多联机产品：3.6 万 安装费：0.8 万 小计：4.4 万　初投资：147 元 / ㎡			
276 元 / ㎡	273 元 / ㎡	294 元 / ㎡			

③各取暖方式每个采暖季的电费、天然气费用数据引用北京 2016-2017 煤改电第三方数据；

④各系统寿命期参考北京市农业农村局等部门发布的《北京市农村地区清洁取暖设备更新工作指导意见》。通用报废标准：清洁取暖设备运行使用满 10 年（燃气壁挂炉运行使用满 8 年）且无法正常使用或虽没有达到使用年限但经认定具备报废标准的；

⑤全生命周期年均成本 = 取暖系统初投资 / 主要设备寿命 + 采暖运行成本。

北方冬季地能热泵高效清洁取暖系统与其他形式对比表

——HYY 分布式地能冷热源站（统一规划，按需实施）与区域热电联产供暖能源方式的对比分析表

序号	建设形式	能源形式特点	主要设备	建设方式	初投资（元 /kW）	以 1200 万平米供暖面积为例投资额（万元）	供暖成本（元 / ㎡）	系统安全性	系统节能性	系统操作	备注
1	分布式地能冷热源站	应用 60% 以上免费可生浅层地热能配合热泵高效清洁的为建筑冬季供暖夏季制冷	单井循环换热地能采集井 地能热泵分布式冷热源站	统一规划按需实施 随区域建设进度分步推进	4000	初期：1000（在区域建设前主要为勘察规划费用，其他可随建设进度分期投入） 总投资：24000	20	无燃烧、无化学和高温高压过 程，无安全隐患，无特别消防要求	节能环保、大量应用可再生能源、可增加谷电时段电力消纳	分布式地能冷热源站自动运行简单设置维护简单按需运行	常规小区供电负荷即可
2	区域热电厂	以煤碳（或天然气）一次化石能源燃烧发电并供暖	热电厂发电机组 热力长输管网	集中一次性建设热电厂 先期建设供热主管网	6000 其中： 热电厂 5000 供热管网 1000	初期投资：600000 其中： 100 万 kW 热电厂投资额：50 亿元 供热主管网 10 亿元	30	热电生产直接受化石能源供应影响、长输管线故障隐患点位较多	冬季以热定电运行模式下电厂失去调峰功能，会导致区域弃风弃光新能源的浪费	专业人员运营电厂 热力公司运维热网	

因版面问题，本期杂志不包含英文版表格。需要英文翻译的读者欢迎在我们的公司网页上查询。

Due to layout issues, the English texts that couldn't be included in the above table in this issue. Readers who need the English translations are welcomed to query on our company's webpage.

中国恒有源发展集团有限公司获「最佳节能减碳行动奖」

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11 月 5 日下午，2024 香港国际金融论坛暨香港国际 ESG 榜单年度评选颁奖典礼在香港隆重举行。全国政协委员、香港大公文汇传媒集团董事长兼大公报社长、香港文汇报社长李大宏，香港特别行政区政府署理财政司司长黄伟纶致辞，国务院国资委研究中心主任衣学东在论坛上发布中英文版《中央企业海外发展报告（2024）》，香港政商界人士、内地及香港上市公司、创投机构负责人、经济学家等逾 300 位嘉宾出席活动。

本届香港国际金融论坛暨香港国际 ESG 榜单年度评选颁奖典礼以“绿色金融助力，共创永续未来”为主题，由香港大公文汇传媒集团主办，

中国检验认证集团、香港大学中国商业学院、北京大学汇丰金融研究院协办，并获得香港特别行政区政府财经事务及库务局、香港特别行政区政府房屋局、香港特别行政区政府民政及青年事务局等机构的大力支持。

自新时代以来，习近平总书记多次指出：绿水青山就是金山银山，新质生产力本身就是绿色生产力。香港特别行政区行政长官李家超在首届香港国际 ESG 榜单年度评选活动致辞中表示，香港特区政府目标争取在 2035 年前碳排放量减半，2050 年前实现碳中和。香港社会绿色发展从此有了明确的目标与方向。

为积极响应中央绿色发展相关政策，2024 年 5 月 26 日 , 国务院国有资产监督管理委员会研究中心和香港大公文汇传媒集团携手合作，共同在引领 ESG 国际话语体系中发挥重要作用。香港国际 ESG 联盟和香港国际 ESG 榜单年度评选系列活动以此为基石，不断进步、成长。

香港国际 ESG 榜单年度评选依托专业 ESG 权威评级数据库，基于公开公正，专业透明的原则，综合专家委员及联合主办机构意见，在 ESG 评分、专家委员会打分、权威数据库综合评估后汇总得分，评选出香港国际 ESG 榜单年度评选最终获奖名单。

中国恒有源发展集团有限公司在本次颁奖典礼汇中获最佳节能减碳行动奖。

∧中国恒有源资深荣誉董事陈蕙姬女士代表公司领奖

∨ 我公司在颁奖现场的展板

企业动态

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2024 年 10 月 15 日，市城市管理委供热办许红局长带队，对恒有源科技发展集团有限公司进行调研。

许局长带队考察了全国工商联办公大楼、海淀外国语实验学校等项目。并在恒有源科技发展集团有限公司进行了交流座谈。对清洁供暖的实施、保障、价格等诸多关心的问题，双方进行了充分的沟通。

2024 年 10 月 20 日，北京市经济和信息化局党组书记、局长姜广智，材料与绿色能源产业处副处长冷少林到恒有源科技发展集团有限公司调研，现场考查了西山赢府国际商务中心地能供暖项目，并与恒有源科技发展集团有限公司就北方冬季地能热泵高效清洁取暖——热冷一体化新兴绿色产业发展进行了座谈交流。

2024 年 10 月 23 日，石榴地产李总、仲总来访。参观了罗家坟、海淀外国语实验学校等项目，并在集团进行了交流。对恒有源科技发展集团有限公司的技术、案例等做了详细了解。并对恒有源科技发展集团有限公司正在运行的运维中心的建设，管理平台 APP 的制作等，进行了充分的沟通。以期进一步深化双方的合作。

2024 年 10 月 25 日，北京市发改委能源处周长宽处长带队对恒有源科技发展集团有限公司项目进行考察、调研。

周处一行考察了海淀外国语实验学校项目、四季青镇政府项目和玉泉慧谷项目。然后在公司进行了座谈、交流。就恒有源地能热泵清洁供暖的技术、方案、项目现状、存在问题及企业需要解决的问题等方面进行了充分的沟通。

2024 年 11 月 8 日，北京大学能源研究院杨雷副院长带队，对恒有源科技发展集团有限公司进行了考察。杨院长一行参观了罗家坟、海淀外国语实验学校、西山赢府商务中心等项目。在公司的座谈会中，双方对清洁取暖技术和取得的成果进行了沟通。一同参加考察的还有能源局原副局长张玉清、国务院发展研究中心原副巡视员 、清洁供热产业委员会（CHIC）主任周宏春、清洁供热产业委员会执行主任周春。

特色运维项目

作者：刘宝红、王学志、李艳超、王东

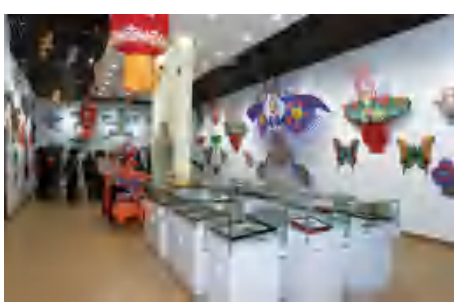
一、恒有源地能热宝系统（农村散户分间取暖）应用典型案例

李家坟村地能热宝取暖系统

李家坟村地处南沙河（即上庄水库下游）北岸，曾获评“北京最美乡村”、“全国文明村镇”、“第二批国家森林乡村名单”、“全国村级议事协商创新实验试点单位”等荣誉称号。村内“曹氏风筝”已经被列为国家级非物质文化遗产，李家坟村被誉为“风筝中起飞的最美乡村”。

全村共有 260 户，村民住宅建筑面积近 4 万平方米。2016 年，该村完成整村取暖设施改造，采用地能热宝取暖系统替换燃煤炉为村民冬季供暖、夏季制冷，日常提供生活热水。地能热宝系统的地能采集孔就近布置于农户建筑屋后的马路地面下，分户采能，各户均为独立取暖系统，每年的取暖费低至燃煤取暖的 30%-90%（煤价 800 元 / 吨），一个采暖季节减排二氧化碳约 1235 吨。

村民对地能热宝取暖系统的反应良好，系统操作简单方便，可以根据需要调节室内温度，且运行成本较低。村民白大爷表示：“现在家里面就他和老伴两人，只开客厅和卧室两台机子就可以了，出门关掉，来了再开，一会就暖和。”地能热宝取暖系统在实际应用中行为节能优势明显，人员在哪间房就开哪间的地能热宝，更加节省费用。



李家坟村曹氏风筝工艺坊

安装在外墙的地能热宝室外机

村委会赠送锦旗

罗家坟村地能热宝取暖系统

罗家坟村位于海淀区北部新区，地处上庄镇中部，是一个环境优美、设施完善的村庄，曾获得“北京郊区文明生态村”、“首都精神文明村”、“北京市农村工作（2017-2021 年）先进集体”等荣誉称号。

全村共 108 户，村民住宅建筑面积近 2.3 万平方米。2015 年，该村曾采用蓄能式电暖器进行“煤改电”试点。经过 2 年的试运行后，村民改用分户采能地能热宝系统冬季供暖、夏季制冷。

地能热宝系统的地能采集孔就近布置于农户建筑附近的空地下，不额外占用庭院面积。地能热宝系统分户采能就近供暖，自己采能自己用，一个采暖季的耗电费用 10-15 元 / 平方米。相较蓄能式电暖器供暖，整村一个采暖季节电 369.8 万 kW•h，折合减少电厂发电用煤 1128 吨、减排二氧化碳约 2786 吨。

村民们对改用后的运行效果和费用表示非常满意，将地能热宝取暖系统誉为“省心、省力、省钱、方便、干净”的五乐清洁自采暖。

罗家坟村安装在外墙的地能热宝室外机

西闸村地能热宝取暖系统

西闸村位于北京市海淀区上庄镇北部，是一个具有丰富历史文化和现代化设施的村庄，曾获得“北京市民主法治示范村”、“海淀区村务公开民主管理示范村”、“国家森林乡村”等荣誉称号。

全村共 220 户，村民住宅建筑面积近 6 万平方米。2016 年用时 27 天，西闸村完成地能热宝取暖系统施工，在海淀区率先完成整村“无煤化”改造。

在改用地能热宝取暖系统进行冬季采暖前，西闸村农户一直采用传统的燃煤采暖，每个供暖季耗煤约 1100 吨。改造后节能效果显著，取暖耗电量约一个采暖季 30 度 / 平方米，采暖成本相当于烧土暖气成本的 50-90%，对于勤俭节约的广大村民来说实惠又高效，非常合适。地能热宝取暖系统被西闸村村民誉为“电高效替煤、省钱；地能暖农户，省心”的清洁自采暖方案。

西闸村安装在外墙的地能热宝室外机

西闸村村委会赠送锦旗

留民营村地能热宝取暖系统

留民营村位于北京市大兴区长子营镇，是一个享誉盛名的生态农业村，先后获得“全球环保五百佳”（被评为国家 3A 级旅游景区）、“北京最美的乡村”、首批“全国农业旅游示范点”、“北京市民俗旅游村”、“首都绿色村庄”、“中国绿色村庄”、“全国创建文明村镇工作先进村镇”等光荣称号。

全村共 246 户，村民住宅建筑面积近 4 万平方米。原有取暖方式主要为沼气燃烧取暖，供暖温度不稳定。

2016 年该村完成整村供暖设施改造，采用分户采能地能热宝系统为村民冬季供暖、夏季制冷，日常提供生活热水，每户为完全独立系统，分户电计量，分房间使用。整村实现冬季全天候稳定取暖，取暖平均耗电量约 30 度 / 平方米，一个采暖季减排二氧化碳约 1235 吨。村民对地能热宝取暖系统的反应良好，表示省钱、环保、又舒服。

采用地能热泵取暖的村文化中心

留民营村安装在外墙的地能热宝室外机

二、恒有源分布式地能冷热源站系统（统一规划总站，按需投入建设分站）应用典型案例

北京市海淀外国语实验学校

1、项目简介

北京市海淀外国语实验学校地处北京市海淀区，是一所全寄宿制学校。学校始建于 1999 年 7 月，在校师生 6000 人左右，占地面积 350 亩，总建筑面积约 10 万平方米。学校供暖制冷系统全部采用恒有源分布式地能冷热源站系统，一期（北校）于 2001 年 9 月起投入运行，二期（南校）于 2008 年投入运行，北校乒羽中心、幼儿园分别于 2011 年和 2012 年投入运行。截至目前项目已规模化运行 23 年。

海淀外国语实验学校

2、恒有源分布式地能冷热源站系统配置

学校的建设周期较长，循序分批建设投入使用，且各个建筑物有不同的使用功能，分为教学、宿舍、办公、体育场馆等。针对这一特点，学校供暖制冷系统从设计上就采用了恒有源分布式地能冷热源站系统，实现了按建筑物冷热需求、分批次建设并投入运行，与集中供暖制冷系统相比，节约了大量集中管网的投资，也便于后期按建筑物需求特点实现精准运行，节省运行费用。

恒有源分布式地能冷热源站系统按照学校的发展规划及实施情况进行布置，系统共设置了 15 个分布式地能冷热源分站，满足了学校全部建筑的供暖、制冷需求。

北京市海淀外国语实验学校恒有源分布式地能冷热源分站分布示意图

分布式冷热源站配置一览表

冷热源分站序号	建筑名称	建筑面积（平方米）	装机数量（台）	装机容量（MW）	满足功能
1	N1（员工楼）	14000	3	1.3	供暖、制冷、供应生活热水
2	N2（男生宿舍）	6296	1	0.55	供暖、制冷、供应生活热水
3	N3（女生宿舍）	6296	1	0.55	供暖、制冷、供应生活热水
4	N4（小学楼）	8879	1	0.55	供暖、制冷

冷热源分站序号	建筑名称	建筑面积（平方米）	装机数量（台）	装机容量（MW）	满足功能
5	N5（中学楼）	8047	1	0.55	供暖、制冷
6	N6（办公楼）	6009	1	0.72	供暖、制冷
7	N7（科技楼）	5248	1	0.4	供暖、制冷
8	N8（游泳馆）	5603	2	0.5	供暖、制冷、供应生活热水、满足泳池加热
9	N9（北校食堂）	4455	1	0.4	供暖、制冷、供应生活热水
10	N10（羽毛球馆）	2420	2	0.39	供暖、制冷、供应生活热水
11	N11（网球馆）	2364	2	0.34	供暖、制冷、供应生活热水
12	S2（南校食堂）	3040	6	0.51	供暖、制冷、供应生活热水
13	S1-S3（男、女生宿舍）	4698	1	0.6	供暖、制冷、供应生活热水
14	S4-S6（教学楼）	14700	3	1.3	供暖、制冷、供应生活热水
15	幼儿园	4818	2	0.55	供暖、制冷、供应生活热水、满足泳池加热
合计		96873	28	9.21	

3、恒有源分布式地能冷热源站系统运行能耗统计

经过多年实际运行数据统计，该项目冷热源系统冬季平均能耗（耗电量）为 34.04kW•h/ ㎡（含 5400 人的生活热水），夏季平均能耗（耗电量）为 19.07kW•h/ ㎡（余热回收免费制热水），全年供热、制冷、提供生活热水及泳池维温总能耗（耗电量）为 53.11kW•h/ ㎡，按学校电价 0.4886 元 /kW•h 计算，全年运行能源费用为 25.9 元 / 平方米（包括了全年 151 天供热、100 天制冷、200 天热水、365 天泳池加热）。单冬季供热一项，较北京市发布执行的北京市非居民供热价格项目 45 元 / 平方米（按建筑面积计算）的收费标准节约 42.4%。

4、恒有源分布式地能冷热源站系统使用效果

学校设有各类普通教室、多媒体教室、钢琴教室、多功能厅等约 400 间，全部配置最新现代化教学设备；学生宿舍按照国际标准布置，每间宿舍配置 6 名学生，上下铺设计，房间内配独立卫生间，24 小时热水供应。根据室外环境温度，各建筑室内温度可以在 18°C -26°C之间随意调节，分别满足冬季和夏季对舒适度的要求。考虑学校特殊的使用环境，系统启用时间通常为环境温度持续高于 26°C（连续 5 天）开始制冷或持续低于 18°C（连续 5 天）开始供暖，直至环境温度处于 18°C -26°C范围。生活热水系统出水温度设置 40-45°C，不间断供水。

截至 2024 年，项目已规模化稳定运行 23 年。多年来，得到了业主单位的一致好评。

用户使用报告

北京市海淀外国语实验学校恒有源地能热泵环境系统

北京市海淀外国语实验学校自 1999 年成立以来，经过 20 余年的发展，海淀本校区已经成为包含教学楼、办公楼、宿舍、球类场馆、游泳馆等近 20 栋建筑共计约 10 万平方米的校区。

校区自 2001 年引入恒有源地能热泵环境系统作为供暖、制冷方式至今，已经建设成为包含 15 个冷热源站的清洁能源供暖冷系统，实现了全校区供暖、制冷、生活热水、泳池加热的全部地能热泵清洁供应，实现了系统的无污染、无排放，美化了校园的环境。

恒有源地能热泵环境系统控制灵活，各建筑室内温度可以在 18℃-26℃之间调节，分别满足冬季和夏季对室内环境舒适度的要求。生活热水系统出水温度设置 40-45℃，24 小时不间断供水。泳池加热设置池水温度 26-28℃。

截止目前，项目已经连续稳定运行 20 余年，保证了校区供暖、制冷的安全稳定的同时，每年的运行费用约 25 元/平方米，与市政供暖系统相比，节约了大量的费用，带来了很好的经济效益。

特此证明。

北京市海淀外国语实验学校

2024 年 8 月

用户使用评价

三、恒有源地能热泵环境系统（分布式城镇集中供暖）应用典型案例

全国工商联办公楼项目

1、项目简介

全国工商联办公楼项目位于北京市西城区，紧邻北二环路，总建筑面积 23188 平方米。项目地下四层地上十层，地下四层至地下二层作为停车场及设备用房，地下一层包括餐厅和泳池；地上一层到三层为门厅及多功能厅，四到十层为办公楼。

全国工商联办公楼

2、恒有源地能热泵环境系统配置

项目采用恒有源地能热泵环境系统，共设置一个冷热源机房，满足建筑的供暖、制冷及提供生活热水的需求。

（1）项目冷热负荷统计

建筑功能	采暖热负荷（kW）	制冷冷负荷（kW）	生活热水量（m^3/h）	生活热水负荷（kW）
办公	1300	1400	低区：1.05 高区：0.46	低区：55 高区：24

（2）冷热源机房主要设备配置

依据项目冷热负荷需求及地能热泵机组的技术参数，机房选用 2 台 YSSR-900B/2 型地能热泵机组满足建筑物供暖、供冷需求，选用 1 台 YSSRW-90B 地能热泵机组满足生活热水负荷需求。

冷热源机房主要设备配置表

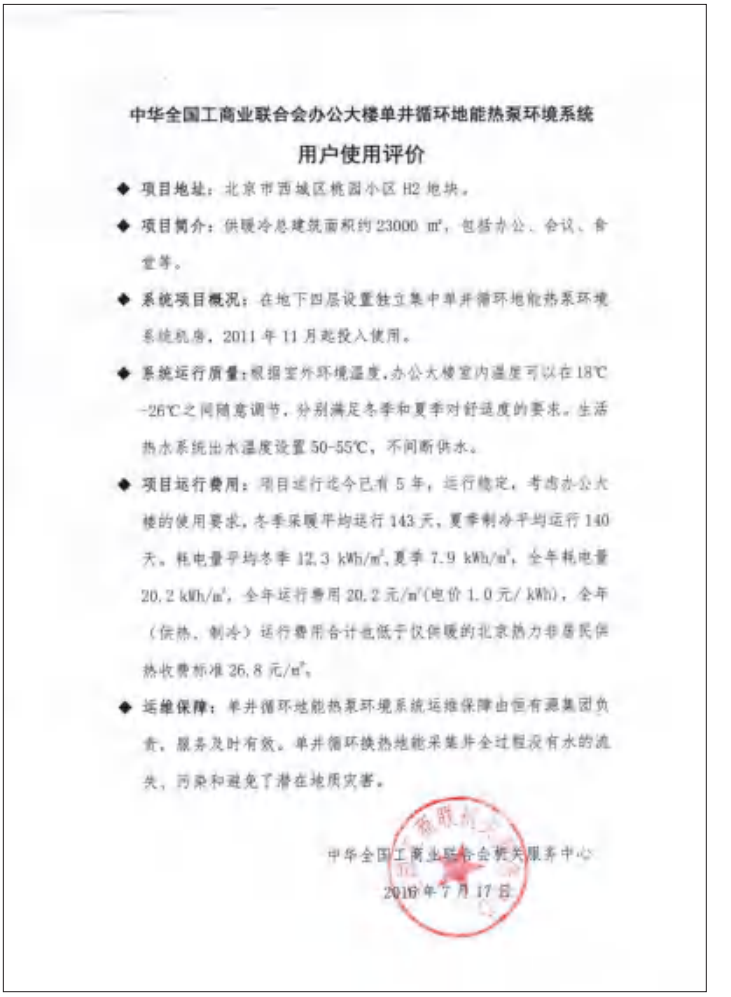
地能热泵主机型号	主机数量（台）	单台制热量 (kW)	单台制冷量 (kW)	总制热量 (kW)	总制冷量 (kW)
YSSR-900B/2	2	945	882	1890	1764
YSSRW-90B	1	101.7	90.1	101.7	90.1

（3）项目地能循环采集系统配置

项目临近北京市地铁二号线，可供设置采集浅层地热能系统的区域有限，设计结合单井循环换热地能采集技术的自身优势，项目采用单井循环换热地能采集井系统作为浅层地热能采集方式，破解了在城市中心建筑物利用浅层地热能采能区域受限的难题。项目共设计 4 套单井循环换热地能采集井，单井循环流量为 100m^3/h。实施时将采集井设置在了距离建筑地下室外墙 2 米的绿化带位置，采用暗井方式，成井后井口与普通市政井盖完全相同，建成后不仅未影响地面的绿化，也没有对建筑地基及地铁系统造成不利影响。

3、系统运行效果

该项目于 2009 年建成并投入使用，截至目前，已经安全稳定运行 15 年，根据多年运行数据统计显示，项目年总耗电量约为 108.98 万 kW•h，折合单平米耗电量为 22kW•h/ 年，节能减排效果显著。



中华全国工商业联合会办公大楼单井循环地能热泵环境系统

用户使用评价

- 项目地址：北京市西城区桃园小区 H2 地块。
- 项目简介：供暖冷总建筑面积约 23000 ㎡，包括办公、会议、食堂等。
- 系统项目概况：在地下四层设置独立集中单井循环地能热泵环境系统机房，2011 年 11 月起投入使用。
- 系统运行质量：根据室外环境温度，办公大楼室内温度可以在 18℃-26℃之间随意调节，分别满足冬季和夏季对舒适度的要求。生活热水系统出水温度设置 50-55℃，不间断供水。
- 项目运行费用：项目运行迄今已有 5 年，运行稳定，考虑办公大楼的使用要求，冬季采暖平均运行 143 天，夏季制冷平均运行 140 天。耗电量平均冬季 12.3 kWh/㎡，夏季 7.9 kWh/㎡，全年耗电量 20.2 kWh/㎡，全年运行费用 20.2 元/㎡(电价 1.0 元/ kWh)，全年（供热、制冷）运行费用合计也低于仅供暖的北京热力非居民供热收费标准 26.8 元/㎡。
- 运维保障：单井循环地能热泵环境系统运维保障由恒有源集团负责，服务及时有效。单井循环换热地能采集井全过程没有水的流失，污染和避免了潜在地质灾害。

中华全国工商业联合会机关服务中心

2015 年 7 月 17 日

全国工商联用户评价

四、地能热泵与深层地热有机结合实现深层地热梯级利用为高层建筑住宅小区分区高效供暖的成功范例

天津老城厢龙亭家园项目

1、引言

地热能作为一种清洁、可再生能源，其开发利用对于缓解能源压力、减少环境污染具有重要意义。天津老城厢龙亭家园项目通过两口地热井配合热泵主机实现 17 万平方米的住宅小区的高效稳定供热，其在深井耦合热泵使系统供热能力的大幅提升、对单口地热井采能梯级的极致利用、随负荷强度地热井与热泵的灵活运行策略、对于百米高层建筑分区安全承压供暖等诸多方向的长期实践，对此类系统的应用有着重要的示范意义。

天津老城厢项目

2、项目概况

天津老城厢承载着深厚的历史文化底蕴，是天津市城市发展的重要见证。独特的地理位置和人文环境使其成为开发新型节能社区的理想之地。在国家和地方节能法规的推动下，该区域开展地下水资源开发利用论证，为地热能项目的落地奠

定基础。

2009 年由天津中新信捷房地产开发有限公司将老城厢 9# 地建设成为龙亭家园宜居社区，项目位于天津市南开区鼓楼、北马路南侧，供暖总建筑面积达 175,963 ㎡。同年，恒有源科技发展集团有限公司完成本项目的深层地热井耦合热泵供暖配套项目投资建设。

截至目前，项目已成功稳定供暖服务 15 年，其运行效果得到居民、社区居委会及南开供热办的高度认可。

3、系统配置

（1）建筑基本信息与供暖分区

项目由 12 栋百米高层建筑组成，其中地上住宅面积 146,263 ㎡（27-30 层），商住两用的 12 号楼面积为 29,700 ㎡（20 层、层高 4.8 米）。

每栋建筑依据高度划分为高区（H）、中区（M）、低区（L）三个供暖分区（每区 10 层楼），低区 6065 ㎡，中区 58405 ㎡，高区 41493 ㎡。分区设置供暖系统，保证了用户室内散热设施在安全压力下运行，同时也便于系统控制调节、实现精准供暖，提高能源利用效率。

（2）供暖系统相关设置

本系统冬季供热负荷为 7700kW，采暖系统设计供回水温度为 60°C /50°C。

项目设一座供热机房，安装了 12 台 HD-660B 型热泵、热泵供热能力 7920kW，供热指标约 45W/ ㎡。

项目设两口 2000 米深度地热井，单井出水温度 57°C，出水量 120m³/h，在考虑配合热泵主机梯级充分利用的设置下，通过一级换热器直接供热降温至 42°C后进入二级串联换热器供高中低区热泵低温采能，最终回水温度控制在 7-10°C，单井最大提供热量约 7000kW，完全可以满足系统需求。

（3）主要设备配置详情

①热源配置特点

两口定向地热井（NKR-24A、NAR-24B）位于小区西南角，井口间距 4 米，井底最大位移 433 米。其井深、井底位移、出水温度及出水量等参数均详细测定，且满足设计要求。两口地热井作为项目的核心热源，为整个供热系统提供了稳定、高温的地热水资源，是实现地热能高效利用的基础。

②机房设备综合配置

机房内设备配置齐全，包括 6 台板式换热器、6 台二次循环泵、6 台补水泵、11 台末端循环泵和 12 台热泵。热泵根据末端用热面积合理分布于低、中、高三个区域，循环泵对应配置，各区均配备备用水泵，补水泵、二次循环泵和板换均匀分布。这种配置方式确保了系统在不同工况下的稳定运行，实现了地热能在各个区域的有效传递和利用。

③供电设备配置保障

建设一座 10KV 变电站为项目提供电力支持，其电气一次部分和二次部分的设备配置详细，包括干式变压器、高压开关柜、低压开关柜、直流屏、中央信号控制屏和计量及负控屏等。稳定的供电系统是地热能开发利用设备正常运行的关键保障，确保了整个供热过程的连续性和可靠性。

④设备控制配置智能化

共配置 13 面控制柜，分别用于控制主机、附属设备和地热井（一用一备）。通过智能化的设备控制配置，实现了对整个供热系统的精准调控，可根据实际需求调整设备运行状态，提高系统的自动化程度和运行效率，降低人工干预带来的误

差和能源浪费。

4、系统运行效果

本项目作为恒有源在地能热泵与深层地热结合供热领域的首次尝试，具有创新性和挑战性，运行团队依据热泵和地热井特性探索了节能运行方法并持续优化。

（1）梯级利用策略与原理

①背景与面临问题

在将地能热泵与深层地热结合供热时，项目面临深层地热高温度与低流量以及地热井水矿化度高（矿化度达 3700mg/L 以上）的问题，尽管热负荷匹配，但这些问题制约了能源利用效率的提升，需要创新解决方案实现二者的有效协同。

②具体措施与原理阐释

二次系统的关键作用：深层地热的高品位特性决定其换热后仍有利用价值，增加二次系统是解决问题的关键。该系统可增加流量、降低温差并隔绝腐蚀，使地能热泵与深层地热实现优势互补，提高整体能源利用效率。

逐级换热的高效流程：二次高温水在系统中的换热过程遵循特定顺序，先经过第一台地能热泵机组冷凝器，保持余温在 24℃ -25℃，再依次进入后续机组，直至温度降至 10℃左右。这种逐级换热方式充分利用了地热水的热能，减少了能源浪费。

串联连接与温度精准控制：项目采用高中低分区，地能热泵机组冷凝器串联连接。通过调节深层地热供水量，精准控制各区第一台主机二次水进水温度在 28℃ -29℃之间，同时保证机组间温差在 4℃。这一设计有效解决高温度与低流量问题，确保系统高效稳定运行，实现地热能的梯级利用，提高能源利用效率，为项目的节能环保和稳定供热提供坚实保障。

（2）灵活的供暖策略实施

①供暖前期和后期，采用板换直接换热供暖，利用板换高效换热特性快速响应供暖需求，确保室内温度及时达到舒适标准。

②供暖中期，根据天气变化灵活调整为地能热泵与深层地热组合模式供暖，充分发挥两种能源的优势，实现能源的优化配置，提高能源利用效率。

③极寒天气时，借助变频器增大泵出水量，保证二次水温度满足供暖要求，确保居民在极端气候条件下也能享受温暖舒适的室内环境。

（3）长期运行效果与节能效益评估

系统自 2009 年运行至今，已连续稳定运行 15 年，年总耗电量不高于 430 万 kW•h，单平方米耗电量不高于 25kW•h。这些数据充分证明了项目在长期运行过程中的稳定性和节能性，在满足居民采暖需求的同时，显著降低能源消耗，减少碳排放，体现出地热水梯级利用热泵供暖在节能环保和低运行成本方面的巨大优势，为地热能开发利用行业的可持续发展提供有力的实践支持。

（4）历年运行能耗数据分析

通过对历年运行能耗数据的深入分析，可以清晰洞察项目在不同年份的能耗变化趋势，为进一步优化系统运行、制定更精准的节能策略提供科学依据，有助于推动地热能开发利用技术的持续改进和发展。

综上所述，天津老城厢项目在地热能开发利用方面取得了显著成果，其成功经验包括科学合理安全的系统配置、创新的梯级利用策略、灵活的供暖模式以及卓越的节能效益等，为地热能开发利用行业提供了全面、可借鉴的范例，对推动行业技术进步和可持续发展具有重要意义。

历年运行能耗数据分析表（参考计算面积 172977 m^2）

年份	供暖能耗（万 kW·h）	平均能耗（kW·h/m^2）
2009 - 2010	402	23.24
2010 - 2011	360	20.81
2011 - 2012	372	21.50
2012 - 2013	430	24.86
2013 - 2014	401	23.18
2014 - 2015	364	21.04
2015 - 2016	371	21.45
2016 - 2017	340	19.65
2017 - 2018	381	22.02
2018 - 2019	372	21.50
2019 - 2020	372	21.50
2020 - 2021	415	23.99
2021 - 2022	379	21.91
2022 - 2023	395	22.83

氢能热泵供暖的探索

作者：刘宝红

1、氢能供暖的应用现状

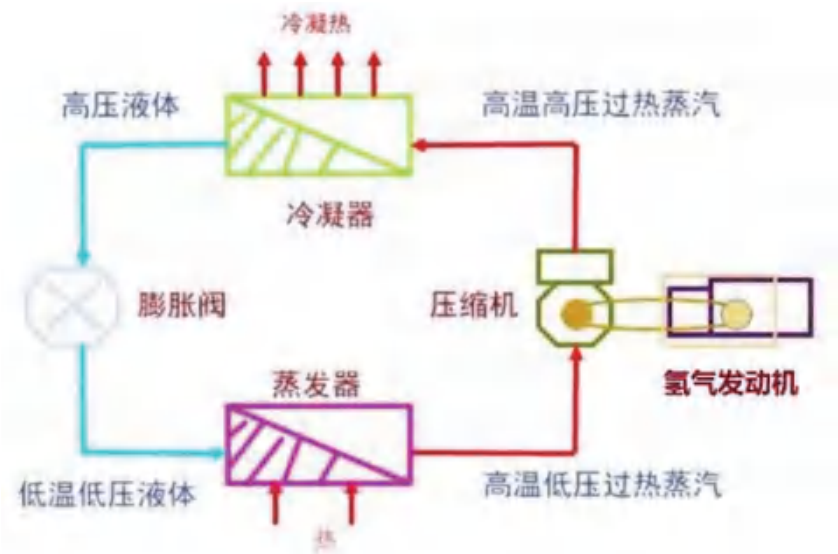
氢能作为一种清洁能源，目前在多个领域展现出巨大的潜力。在交通领域，氢燃料电池汽车已经从实验室走向市场，一些国家和地区已经开始推广氢能汽车的使用。然而，在供暖领域，氢能的应用还处于起步阶段。尽管如此，氢能供暖因其零碳排放的特点，正逐渐受到重视。

2、氢能热泵供暖的技术路线

2.1 氢气发动机驱动的压缩式热泵（简称氢气热泵机组）

氢气发动机驱动的压缩式热泵以氢气发动机取代电动机，驱动热泵机组压缩机工作实现制热（冷），最大优势在于供暖期可回收氢气发动机余热，提升制热能力。氢气在气缸内燃烧推动活塞做功从而产生动能，原理与普通天然气发动机类似，增加氢气喷射系统，按照吸气—压缩—膨胀（做功）—排气 4 个冲程来完成化学能向机械能的转化。

氢气可燃性好，燃烧速度快，燃烧产物无污染，非常适合作为动力能源。因此，对氢气发动机的研究一直是新能源发动机领域内的研究热点。但氢气热值与汽油热值相等的情况下，体积是汽油的 3000 倍，所以氢气的存储一直是

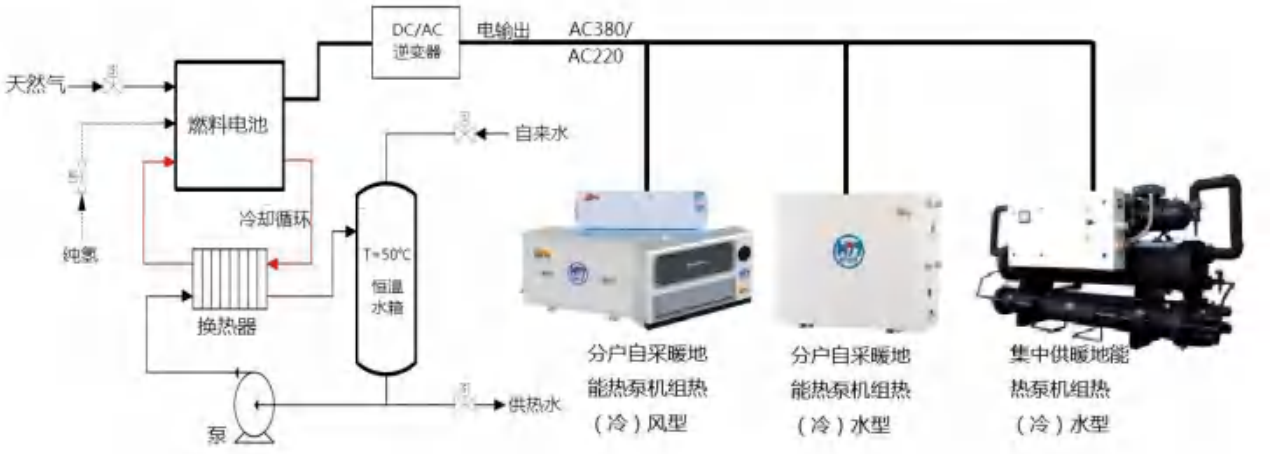


氢气热泵机组原理图

研究难点。同时，氢气发动机本身也存在限制，氢气发动机与传统的汽油动发动机相似，都属于点燃式发动机，可以通过对汽油机和柴油机进行改装实现。目前可分为采用化油器、进气喷射的预混式和缸内直喷式。预混式是通过喷射预先混合后的气体进入气缸点火，空气和氢气的混合在外部完成，该方式的输出功率低，容易发生回火和早燃现象。而缸内直喷式将氢气直接喷入气缸，不会产生回火，在低压喷入时也会容易早燃。氢气发动机是氢能应用的一个重要方向，技术难度比传统燃油机大，尤其是在早燃、爆燃和回火等方面需要克服技术难点，目前还处于研发阶段。

2.2 氢燃料电池供电 + 热泵机组耦合系统

通过氢燃料电池将氢气转化为电能，供给热泵主机（如地源热泵主机、空气源热泵主机）使用。氢燃料电池在发电过程中产生的废热可以通过热泵技术进行回收，进一步供应给供暖（冷）系统使用，提高能源利用效率。可以简单地将氢燃料电池可以理解为“化学能发电机”！氢燃料电池是一种能量转化装置，它能够将氢燃料通过化学反应转化为电能，类似于电化学发电装置。其发出来的电能经控制器、逆变器等多组电器部件后，可直接驱动电机，为热泵主机提供电能。由于分解后的氢气需要经过质子交换膜来不断地产生电能，氢离子和电子到达阴极板之后并不会凭空消

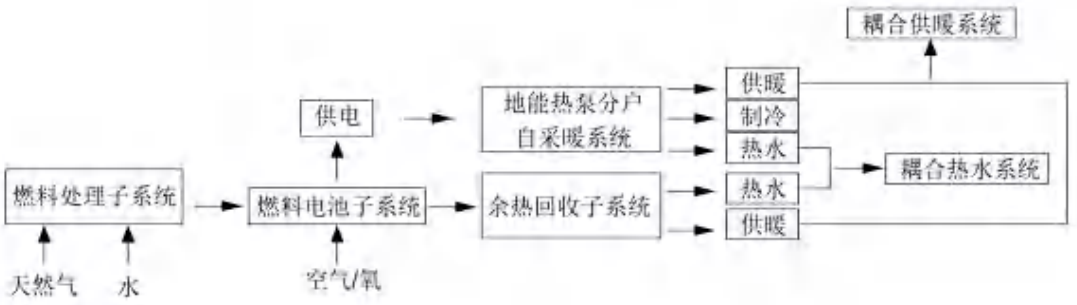


氢燃料电池供电 + 热泵机组耦合系统示意图

失，而是与氧原子重新结合为水，几乎是零排放，零污染。

2.2.1 家用氢燃料电池 + 分户自采暖耦合系统

家用氢燃料电池 + 分户自采暖系统耦合的三联供系统由六部分组成：燃料处理子系统、燃料电池系统、电力电子子系统（供电）、余热回收子系统、耦合热水系统、耦合供暖（冷）系统。首先，燃料处理子系统将燃气重整为氢气，输送至燃料电池系统进行发电；其次，电力电子子系统将燃料电池产生的直流电转化为交流电，供地能热泵分户自采暖系统使用或并入电网；然后，余热回收子系统将燃料电池发电产生的余热回收、储存，用于供暖、供热水；最后，根据冬季、夏季建筑物的冷热需求组成耦合的热水系统、耦合供暖（冷）系统。



耦合分户供暖系统示意图

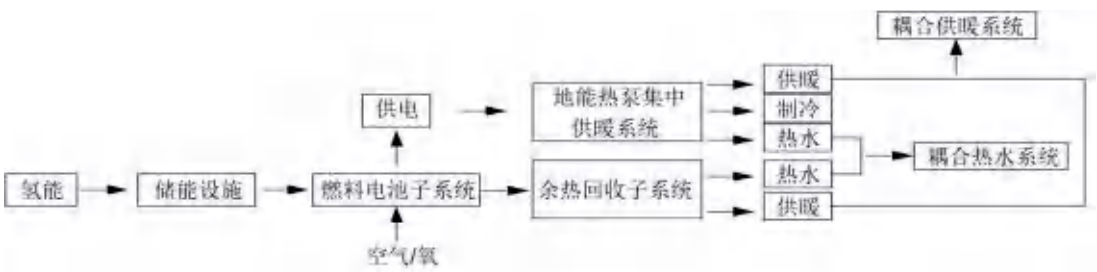
系统特点：每户是独立的能源利用系统，不依赖电网运行，减少了能源输送投资和运行成本；运行灵活，环保无有害物质排放。

发展前景：可以分布式实现单户自发自用、发用结合，清洁无污染，是最理想的用户端用能方式。

2.2.2 氢燃料电池发电站与地能热泵集中供暖耦合系统

氢能能量密度高，较传统储能方式，能够实现储能容量数量级的提升。通过废弃的风力发电、光伏发电等可再生能源可低成本制取氢气，完成电–氢–电循环的转化，可实现可再生电力更加可控、稳定、安全的供应。国内氢能燃料电池发电站应用技术较为成熟，已成功的应用交通、应急电源等场景。利用氢能燃料电池发电站与地能热泵集中供暖系统的耦合系统能为大面积建筑或建筑群供暖、制冷、提供热水。

系统特点：一栋建筑或是多个建筑群是独立的能源利用系统，不依赖电网运行，环保无有害



耦合集中供暖系统示意图

物质排放；氢能装置设备置于建筑公共地带，结合国内发展技术，具体实施安全性能更易满足。

发展前景：可以分布式实现区域建筑自发自用、发用结合，清洁无污染，是新型分布式综合能源利用方式。

2.3 两种技术路线的比较

热泵技术已较为成熟，两种氢能热泵供暖的技术路线可行性主要取决于氢气发动机和氢燃料电池的发展。其中氢气发动机、氢燃料电池的技术方案特点如下表。

氢气发动机、氢燃料电池的技术方案特点表

	氢气发动机	氢燃料电池
氢气	纯度要求低	纯度要求极高 （杂质对质子交换膜有损害）
成本	可利用现有汽油发动机零部件， 成本约为氢燃料电池 1/10	包括质子交换膜、贵金属催化剂等部件， 成本高
效率	与普通汽油发动机相似，为 40-60%	为 60-80%
污染排放	$2H_2+O_2=2H_2O$ $H_2+O_2+N_2 \rightarrowtail H_2O+NO_x$ NO_x 为主，可后处理	$2H_2+O_2=2H_2O$ 零排
噪音	固有振动噪音	无噪音
辅助系统	储氢供氢系统	储氢供氢系统、电池、电机
使用寿命	可靠（车用型约 50 万公里）	约 5000 小时、寿命敏感

3、未来展望

氢能是一种几乎零碳排放的能源，氢能热泵供暖能显著降低供暖行业的碳排放，在供暖领域具有巨大的潜力。氢气发动机驱动的压缩式热泵或氢燃料电池供电 + 热泵机组耦合系统有助于推动清洁供暖技术的创新和多样化。

目前，氢能热泵供暖的利用还存在很多挑战，包括氢能的成本、存储、运输、加注、安全性等方面，还需有氢气发动机的技术成熟和氢燃料电池成本降低。相信随着技术的成熟和规模化应用，会让氢能热泵供暖的应用实现进一步跨越。

名词解释

作者：李大秋

北方冬季取暖 2.0（无燃烧）时代

我们将供热大概分为两个阶段，第一阶段为从建国以后到 2016 年，为传统供热时代，称为供热 1.0 时代；第二阶段为从 2017 年到目前为止，称为清洁供热 2.0 时代。

北方冬季取暖 2.0（无燃烧）时代：地能热泵环境系统清洁取暖实现了热冷一体化的产业发展是落实北方地区冬季清洁取暖关于能源生产和消费革命，农村生活方式革命的要求。实现了在北方冬季最恶劣的气候条件下，利用供暖热泵循环搬运所取得的冰冻三尺以下的低温地热能（低于 25 度），替代了燃烧传统能源取暖。保证了在使用安全的同时，直接成本和传统燃煤相当；在标准化的简单操作下，达到国家要求的最基本的环境温度且可按需调节。

在双碳目标和新质生产力的推动下，迎接北方冬季取暖 2.0 时代（无燃烧）的到来，让传统的燃烧取暖、制冷（空调）二个产业融合升级而成热冷一体化的新兴产业。相同的取暖面积与传统燃烧化石能源方式相比，降低了 50% 左右的能源消耗。且清洁取暖区域无燃烧、零排放。

新时期，就近因地制宜的采集取得随处都有的低温地热能，通过供暖热泵循环搬运至人身体适宜的 22 度左右的环境温度；冬暖夏凉、日常有生活热水，稳定提高了人们的生活品质。是“温度对口、能源品位相当”的科学用能。

适用于农村散户的地能热泵环境系统清洁取暖的地能热宝系统，每户独立计量，各自因地制宜的取得低温热能，分间按需取暖和调节温度（16-26 度），用哪开哪，不开系统也不会冻坏；住户安全、省心、省钱又干净。

低温地热能是一个量大面广的地能热源，地球表面就是天然的太阳能板，大地就是蓄能器，在地心和太阳的作用下，地下一定的深度就有一定的温度。我国北方的窑洞冬暖夏凉，就是我们先贤对低温地热能的直接利用。今天供暖热泵技术成熟，低温的地能热源虽不似传统地热能的直接利用，而是利用供暖热泵机组循环搬运浅层（不深于 200 米）低温地热能；保证人们希望的 22 度左右的环境温度，是“温度对口、能源品位相当”的科学使用可再生能源取暖在新时期应用科学的又一成功实践；地能热泵高效清洁取暖，让低于 25 度的低温地热能成为北方冬季取暖的可再生替代能源。

2 地能热泵高效清洁取暖

地能热泵是一种利用浅层地热能为建筑物进行高效的供暖或制冷的系统。

在北方冬季最恶劣的气候条件下，利用符合国家标准的建筑物配电容量，以一份电能驱动供暖热泵机组，搬运得到相当于三份以上的电直接加热的取暖热量。供暖热泵机组循环搬运，因地制宜地采集地能热源中的（大地冰冻三尺以下的土壤沙石中）天然储存、自然平衡的低温热能。达到温度对口、能源品位相当的为人与动植物取暖，提供保证适合生存、生长的环境温度。在双碳目标下，仅以燃煤的成本和 50% 燃烧取暖的能耗，保证原 100% 的取暖面积达到国家标准温度。在我国大力推进绿色低碳和高质量发展，加快培育新质生产力的时代背景下，实现了一个系统融合了冬季取暖、夏季制冷两个功能，完成了深层次的产业升级换代：北方冬季地能热泵高效清洁取暖——热冷一体化新兴绿色产业，并在降低能耗的前提下，提高了百姓的生活品质。

3 单井循环换热地能热泵环境系统

中国北京创新的单井循环换热地能采集技术是北京中关村的原创技术。它以地下水为介质，根据地质情况因地制宜地调整地能采集量，通过系统封闭加压实现 100% 同井回灌，在不污染不消耗地下水的前提下，使用地下水作为介质循环采集储存于地下岩土体中的浅层低温热能，温度相对恒定不受天气影响，可保证在最恶劣的气候条件下北方广大群众的温暖过冬。单井循环换热地能热泵环境系统也是一种高效的土壤源热泵系统。

4 碳排放及碳中和

碳排放

碳排放是指人类经济社会活动中，由于化石燃料燃烧、工业生产过程、农业活动、土地利用变化及废弃物处理等活动所产生的二氧化碳等温室气体排放。这些温室气体排放量的增加是全球气候变化的主要原因之一。在学术研究中，碳排放量通常以“二氧化碳排放当量”为单位进行计算，以全面反映不同温室气体对全球气候变暖的潜在影响。

碳中和

碳中和，也称“净零排放”，是指通过一系列措施，使得人类经济社会活动所产生的二氧化碳等温室气体排放量与通过自然过程或人工技术所移除的温室气体量达到平衡，从而实现温室气体净增量为零的状态。

庆祝《中国地热能》杂志创刊十周年

十年磨一剑，成果铸未来。此时此刻，我们欢聚一堂，热烈庆祝《中国地热能》杂志创刊十周年。

艰辛走过的 10 年，是清洁能源领域迅速发展的十年，也是我们杂志与读者共同成长的十年。

从创刊之初的探索，到如今的稳健前行，每一步都凝聚着我们的心血与汗水，更离不开上级领导的全力支持和广大读者的热情鼓励和积极建议。

努力跋涉的十年来，杂志始终致力于推动地热能的研究、开发和应用，紧跟国内外地热能的最新动态，深入报道地热能供暖（制冷）以及地热能源等领域的最新科技成果、技术进步和成功案例。从全球地热能资源的分布与勘探，到地热能发电技术的创新与突破，再到地热能在公共设施，居民生活中的广泛应用，我们全面展示了地热能作为清洁能源的潜能和优势，在为清洁人类生存环境和持续发展鼓与呼。

杂志自创刊以来，为国内外读者提供了大量的科技前沿成果，以及在这个领域公共设施的更新改造和惠民实例。

展望未来，我们将继续秉承办刊宗旨，为政府制定能源政策提供参考建议，为地能开发企业提供宣传平台，为设计者、大众提供交流空间。推广浅层地热能利用经验，展示应用实例。为社会生态环境保护和持续发展，为创造更多社会福祉贡献我们的智慧和力量。

本刊编辑部

SUMMARY OF EXPERIENCE, CONTINUOUS INNOVATION, AND STRIVING TO BE THE PIONEER IN THE HEATING 2.0 ERA

—— Report by Ever Source Science & Technology Development Group Co.,Ltd at the "Expert Seminar on Ground-Source Heat Pump Clean Heating and Heat-Cooling Integration New Industry in Northern Winter"

Author: Xu Shengheng

On October 9, 2024, the "Expert Seminar on Ground-Source Heat Pump Clean Heating and Heat-Cooling Integration New Industry in Northern Winter" was held in Dalian. During this seminar, industry experts gathered to engage in in-depth discussions and reached a consensus on the strong promotion of ground-source heat pump clean heating. Mr. Xu Shengheng, Chairman of CHYY Development Group Limited, delivered the following report:

I. Rationale for Selecting Dalian as the Venue for This Conference

The choice of Dalian as the venue for this expert seminar was made with careful consideration. Dalian, located in northeastern China, serves as a model city for winter heating in the northern regions. Furthermore, the high-efficiency clean heating project involving ground-source heat pumps in the Hutchison Whampoa project within the Xiaoyao Bay Development Zone in Dalian was planned, constructed, and implemented with a demand-driven approach. The outcomes of this project are highly replicable and offer potential for standardized, large-scale development.

The project utilizes heat pumps to efficiently and cyclically extract low-temperature thermal energy, known as "ground energy," which is naturally stored in the earth below 25°C. This ground energy, sourced from the sun and the Earth's core, serves as an alternative to traditional fossil fuel combustion for heating purposes. Ground energy, as an alternative source, is harnessed according to the scientific principles of "matching temperature and equivalent energy grade," ensuring that the temperature and energy requirements for heating are met sustainably.

Unlike traditional geothermal energy, ground energy is not directly utilized; instead, heat pumps transport this energy to provide heating and cooling as needed. The Dalian project has demonstrated, both theoretically and practically, that in the

harsh winter conditions of northern China, the ground-source heat pump system can efficiently and stably provide heating without the need for combustion, thus offering a more environmentally friendly and efficient solution compared to coal combustion.

The Hutchison Whampoa project is a concrete implementation of the "Franchise Agreement for the Heating of the HYY-900MW Distributed Ground-Source Heat and Cold Source Stations in the Xiaoyao Bay International Business District." This agreement was signed between HYY and the local government with the support of the China Energy Conservation and Environmental Protection Group. The project is part of the "Regional Ground-Source Non-Combustion Intelligent Heating (Cooling) Plan for the HYY-900MW Distributed Ground-Source Heat and Cold Source Stations in the Xiaoyao Bay International Business District, Dalian." It is designed to meet the heating needs of 15 million square meters of buildings in the region through 216 energy stations and 5,227 sets of ground energy extraction wells. The implementation of the project is based on a comprehensive government plan and a standardized business model.

The successful operation of the Hutchison Whampoa project over the past three years demonstrates the reliability of ground-source clean heating. The project has not increased the financial burden on the government or users and can be phased in gradually as the construction progresses. This system exemplifies the scientific and rational use of energy matching, aligning with environmental protection goals and achieving energy conservation and carbon emission reduction. It represents a new, high-quality force in the heating industry and plays a critical role in advancing the development of sustainable heating technologies.

II. Illustrative Cases of HYY Ground-Source Heat Pump Clean Heating

1.HYY Ground-Source Heat Pump Environmental System (Applicable to Urban Centralized Heating Projects)

① **Xiong'an Citizen Service Center Project:** As one of the first demonstration projects in the Xiong'an New Area, this initiative has set a leading example for the application of ground-source heating (and cooling) technologies in the region. The project was recognized with the prestigious National Quality Project (Luban Award), underscoring its excellence in construction and energy-efficient design.

② **National Grand Theater Landscape Pool Project:** This project faced the challenge of ensuring that a 35,000-square-meter water surface with a depth of 50 centimeters remained unfrozen in winter and free from algae growth in summer. This was one of the five major technical challenges during the construction of the National Grand Theater. Ground-source heat exchange technology was successfully implemented to overcome this obstacle, providing a sustainable solution to maintain the water's temperature and quality year-round.

③ **Hong Kong and Macau Training Center of the Central Party School (National Academy of Governance) Project:** This comprehensive facility, which includes teaching and training spaces, swimming pools, and gymnasiums, underwent a transformation in its energy system. The traditional fossil energy-based cold and heat source system was swiftly replaced by a shallow geothermal energy system, which was completed in just 30 days, showcasing

the efficiency and feasibility of geothermal technology for rapid upgrades.

④ **Haidian Foreign Language Experimental School Project:** The paper "Utilization of Shallow Geothermal Energy-Case Study of Single-Well Pumping and Injection Technology," which focused on this project, won the Best Paper Award at the World Geothermal Resources Conference in Mexico in 2003. This paper highlighted the large-scale use of shallow geothermal energy in buildings over 100,000 square meters. In 2023, the project was featured at the main forum of the World Geothermal Congress in Beijing, where the paper "Case Study of Single-Well Circulation Heat Exchange Ground Energy Collection Technology in the Jingbei Campus of Haidian Foreign Language Experimental School" was presented. The project was also recognized by the National Energy Conservation Center in 2021 as a typical example of key energy-saving technologies, further emphasizing its impact and relevance in the field of geothermal energy utilization.

2.HYY Ground-Source Heat Treasure System (Applicable to Decentralized Heating in Rural Households)

Rural Household Coal-to-Electricity Conversion Project: In response to President Xi's call for a revolution in rural lifestyles, HYY has developed the ground-source heat treasure system, specifically designed for individual rural households. This system is customized to each household's requirements, enabling room-by-room heating that can be activated as needed. Since 2016, it has been deployed in numerous rural areas as part of the government's centralized coal-to-electricity conversion initiatives.

According to data from the Beijing Municipal Bureau of Rural Affairs, which monitored various heating systems during a heating season, the ground-source heat treasure system has proven to be highly efficient. Its average power consumption is 30 kW·h per square meter per heating season, translating to a heating season cost of 9.6 yuan per square meter (calculated at an electricity rate of 0.49 yuan per kW·h for 15 hours of daily use and 0.1 yuan per kW·h for 9 hours of off-peak use).

In comparison, the costs of alternative heating systems during the same period were as follows: air-source heat pumps at 18.3 yuan per square meter, energy storage electric heaters at 21.3 yuan per square meter, and gas wall-mounted boilers at 13.8 yuan per square meter. The ground-source heat treasure system has the lowest operational cost among these options, demonstrating its efficiency and affordability.

At a symposium in Xizha Village, Haidian, Beijing, local residents praised the ground-source self-heating system for its safety, cleanliness, cost-effectiveness, reliability, and energy efficiency. The system has truly transformed the rural heating landscape, offering a sustainable and economically viable alternative to traditional coal-based heating methods.

III. Standardization of Products and Technologies to Propel Industrial Development

HYY has successfully developed three standardized product series:

1.Ground-Source Heat Pump Environmental System: Designed for urban distributed centralized heating.

2.Ground-Source Heat Treasure System: Tailored for decentralized heating in rural households.

3.Distributed Ground-Source Heat and Cold Source Station: Suitable for heating in planned areas.

These product systems include a complete set of four circulating components:

1.Circulating Collection Complete Set (Primary Network)

2.Heat Exchange and Energy Storage Complete Set (Secondary Network)

3.Heat Exchange and Upgrading Complete Set (Tertiary Network)

4.Circulating Release Complete Set (Quaternary Network)

The circulating products are further broken down into modular units, single-piece products, and accessories. This modular, fully standardized construction allows for easy replication and guarantees reliable heating even under extreme climatic conditions.

The system's turnkey projects are designed to be cost-effective, with the initial investment for system construction being less than 300 yuan per square meter. Specifically, the cold and heat source portion costs less than 200 yuan per square meter.

This advancement in high-efficiency clean heating, through the integration of ground-source heat pumps with heat-cooling capabilities, marks China's entry into the Non-Combustion 2.0 Era of winter heating in northern regions. This innovative approach reflects a significant step forward in sustainable, non-combustion heating solutions, aligning with the country's energy-saving and environmental goals.

IV. Enterprise Development Objectives

HYY is committed to advancing the integration of ground energy collection methods adapted to various geological conditions developed over the past two decades. By leveraging its complete suite of series products and associated processes, the company aims to strengthen collaborations with local regions for planning and implementing high-efficiency clean heating systems based on ground-source heat pumps. This initiative will include offering design support and establishing a comprehensive maintenance and operation platform powered by heat pump big data, enhancing customer service and ensuring efficient heating solutions for northern regions during the winter.

In 2025, HYY plans to complete its transformation by focusing on large-scale, standardized construction of high-efficiency clean heating systems using ground-source heat pumps for winter heating in northern regions. The company intends to foster the development of new industries in heat-cooling integration and will support regional heating enterprises to serve as development and construction agents for:

1.HYY Ground-Source Heat Pump Environmental Systems: For urban distributed centralized heating.

2.HYY Ground-Source Heat Treasure Systems: For decentralized heating in rural households.

3.Distributed HYY Ground-Source Heat and Cold Source Stations: For planned area heating.

HYY will continue to be a comprehensive technical service provider, ensuring the widespread adoption and successful implementation of these systems, promoting clean, efficient, and sustainable heating solutions across northern China.

V. Conclusion

The strategic goal of "revitalizing the northeast" begins with the revitalization of industries, and the heating sector plays a crucial role in this transformation. Dalian, as a key region in the northeast, stands at the forefront of this evolution. The future of high-efficiency clean heating using heat pumps is poised to not only offer significant benefits but also usher in the new heat-cooling integration industry. This emerging industry holds immense potential, benefiting thousands of households and contributing to broader economic and environmental progress.

This industry is particularly significant in the context of China's dual-carbon goals, as it directly addresses the pressing need to reduce carbon emissions. While the reduction from a single building may seem small, the collective impact of implementing this technology across entire regions could lead to substantial reductions in carbon emissions. As the saying goes, "Many a little makes a mickle." In northern regions, traditional heating accounts for approximately 10% of the nation's total energy consumption. High-efficiency heat pump technology can reduce energy consumption by 50% compared to traditional coal heating, which translates to a potential reduction of 3-5% in the country's overall energy consumption. This shift not only supports energy conservation but also improves the quality of life for residents by providing warm winters, cool summers, and consistent hot water.

The development of high-efficiency clean heating using ground-source heat pumps and the integration of heat-cooling systems is a promising path forward for enterprises in northern winter heating areas. It holds great promise for achieving the dual-carbon goal while simultaneously improving living conditions and fostering sustainable development. The widespread adoption of this technology can have far-reaching positive effects, making it a pivotal part of the region's future growth.

Note:
The heating 1.0 era entailed combustion heating, and the heating 2.0 era embraces clean heating. Heat pump heating is one of the modalities of clean heating. Combustion heating exploits the chemical energy of fuel. During the combustion process, the molecules constituting the fuel undergo transformation, giving rise to new molecules and liberating heat. For instance, when coal is combusted in a boiler, the carbon in the coal combines with the oxygen in the air to form carbon dioxide and release heat concomitantly. As a result, the coal is depleted, and carbon dioxide is generated.
Heat pump heating solely involves physical alterations and no chemical changes. During the heat pump heating process, from a macroscopic perspective, no substances are consumed or produced, and only heat is transferred. For example, in our ground-source heat pump, during winter heating, the low-temperature heat energy in the shallow underground is upgraded and conveyed indoors for heating. Only a trifling amount of electricity is consumed, and its principal function is not to generate heat but to transport heat. Another salient feature of heat pump heating is that the maximum temperature of the heat pump heating system approximates the heating temperature. The temperature of combustion heating is circumscribed by the "ignition point" of the fuel and cannot be overly low. Ordinarily, a heat source of several hundred degrees Celsius is employed to heat a room of over 20 degrees Celsius, culminating in a waste of energy grade. Additionally, the energy source of combustion heating can only emanate from fuel, whereas the energy source of heat pump heating is extensive, encompassing numerous clean and renewable energy sources.

SEMINAR ON GROUND-SOURCE HEAT PUMP CLEAN HEATING AND HEATING-COOLING INTEGRATION IN WINTER ABSTRACTS OF SPEECHES BY LEADERS AND EXPERTS

Zhang Yuqing

Former Deputy Director of the National Energy Administration

Clean heating with shallow geothermal energy requires not only economic considerations but also ecological ones. At the national level, it is essential to conduct comprehensive macro-planning, improve management policies, and formulate specific measures for the utilization of geothermal energy. Introducing preferential policies to encourage enterprises to implement geothermal heating projects is crucial. Strengthening supervision, setting access thresholds for geothermal clean heating projects, optimizing the project approval process, and improving the assessment system for the sustainable development of geothermal clean heating will accelerate the growth of the emerging heat-cooling integration industry.

This approach will contribute to the ambitious goals of reaching carbon peak by 2030 and carbon neutrality by 2060, marking a new direction for future energy transformation. It represents an optimal choice for the low-carbon and efficient utilization of building energy and is an inevitable step toward fulfilling non-fossil energy utilization targets. This strategy will help build a clean and low-carbon society and promote sustainable energy development. We firmly believe that a new era of clean energy heating is on the horizon.

Zhou Chun

Executive Director of the Clean Heating Industry Committee (CHIC)

By the end of 2023, the central Ministry of Finance had invested a total of 120.9 billion yuan. Led by the Ministry of Finance, five batches of 88 clean heating pilot projects have been carried out, driving social investment of over 400 billion yuan. This has given rise to a new industry-the clean heating industry-with an output value of 925 billion yuan last year.

We divide the heating industry into two stages. The first stage, from the founding of the People's Republic of China to 2016, is the traditional heating era, known as the Heating 1.0 era. The second stage, from 2017 to the present, is called the Clean Heating 2.0 era. It is clear now that the entire industry has blossomed into a new trillion-yuan industry, experiencing rapid growth and expansion.

Tang Tiejun

Deputy Director of the Price Cost and Certification Center of the National Development and Reform Commission

Based on the work carried out by the Price Cost and Certification Center of the National Development and Reform Commission, I would like to share three key points of understanding:

First, we should correctly understand the direction of market-oriented reform in the heating industry.

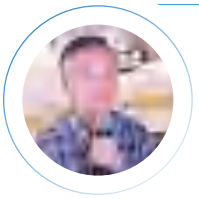
Second, it is essential to fully recognize the strategic significance of clean heating. With the acceleration of China's urbanization process, the heating area is growing at an annual rate of 10%. At the same time, to meet the needs of the people, many cities across the country have recently required an increase in the heating temperature, which will further exacerbate the shortage of heating resources. At the national level, through the high-quality and green development of the clean heating industry, adapting to the new requirements of structural transformation and development, it is of great significance for ensuring energy security and promoting economic

and social development.

Third, we must accurately grasp the position of geothermal energy in the future heating field and recognize the advantages and promising development prospects of ground-source heat pumps. With the continuous deepening of heating metering reform, the commoditization attribute of heat is gradually increasing, and the heating price is gradually becoming market-oriented. This will provide more flexible market space for ground-source heat pump technology. The unique advantage of heat-cooling integration, while improving efficiency and enthusiasm, will also contribute to reducing electricity load in winter and summer, ensuring greater reliability and safety of the heating system.

Academician of the Chinese Academy of Sciences **Wang Jiyang**

I have been in contact with HYY. since the Beijing Olympics. The enterprise engaged by this company is a sunrise enterprise. Its predecessor was a boiler factory of the Beijing SiJiqing Commune. A group of experts led by Xu Shengheng shifted the development focus from boiler development to the development of single-well pumping and injection (ground-source heat pump). At that time, as the leader of the geothermal heating expert group in Beijing, I was fortunate to have contact with colleagues from HYY. The transformation at that time was very good. The company's projects are not only located in Beijing but also distributed in multiple locations in other provinces. As far as I know, they are also involved in the Tibet region. As we all know, geothermal energy is a rare and renewable resource, which is stable and efficient. As an expert in the field of geothermal energy, I strongly support further promoting this matter in the Dalian area.



Zhou Hongchun

Former Deputy Inspector of the Development Research Center of the State Council and Director of the Clean Heating Industry Committee (CHIC)

The transformation of the heating industry provides new-quality productive forces. New-quality productive forces emerge in the process of high-quality development, and our clean heating technology contributes to this transformation. Heat pump technology, which serves as a transporter of geothermal energy, collects, transports, and converts the energy dispersed underground to improve the living quality of people's environments. This process itself constitutes a new-quality productive force.

Heat, as a low-grade energy source, should be utilized more efficiently. In contrast, natural gas and oil are high-grade energy sources, and using gas or secondary energy electricity for heating represents a waste of resources. To promote clean heating, we must prioritize the use of low-grade energy sources, such as geothermal and biomass energy.

The transformation direction of the heating industry aligns with the broader energy transformation goals. The national policy emphasizes a "clean, low-carbon, safe, and efficient" energy future. However, safety should be our first priority, followed by efficiency. Ground-source heat pumps can achieve safety, high efficiency, cleanliness, and low carbon emissions, but there is still potential for further upgrades and improvements in this technology.

Cao Lili

Representative of Hutchison Whampoa Wolong North Real Estate (Dalian) Co., Ltd.

As the earliest real estate development enterprise to enter Xiaoyao Bay, Hutchison Whampoa Real Estate of the Yangtze River Group aims to bring advanced international design concepts, leading technical equipment, and high-quality residential qualities to the Xiaoyao Bay International Business District. The Yunan Bay project is the first to respond to the government's call for the use of clean energy, with a heating area of approximately 58,000 square meters. Through a strong partnership with HYY, advanced heating technologies and equipment

have been adopted, significantly improving heating efficiency. The project emphasizes environmental protection and energy conservation, reducing environmental pollution, and fulfilling the sustainability and social responsibility goals of the heating service.

Since the heating system began operations in 2021, the performance over three full heating seasons has far exceeded national and local heating standards in Dalian. The system's commissioning was thoroughly completed before heating season, responses during the heating season were timely, and follow-up visits were conducted after the season. Both the property owners and the property management company have expressed high satisfaction with the heating effects.

Wu Xianhua

Vice Chairman of the Liaoning Provincial Committee of the Chinese People's Political Consultative Conference

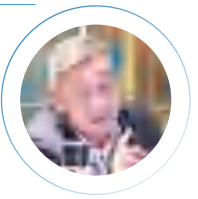
Heating is a critical issue that directly affects the well-being of the people, particularly in northern regions where it is essential. Through the enterprise presentations, user testimonials, and contributions from academicians at this conference, the advantages of ground-source heat pump heating have become clear, highlighting the direction for future development. Under the condition of equivalent investment and operating costs, this technology offers several key benefits:

First, it provides high safety; second, it addresses not only heating but also cooling, which traditional heating systems, such as boiler rooms, fail to solve; third, it is low-carbon with no carbon pollution, making it a sustainable solution with broad prospects. The development of ground-source heat pump technology has the potential to support the industrial growth of the northeast, including areas such as design, spare parts production, and the construction of industrial parks.

This is not just a solution for improving people's livelihoods but also a significant opportunity for the development of the region. It represents both a cause and a vital component for the revitalization of the northeast, with immense importance for both local development and the national push for clean energy.

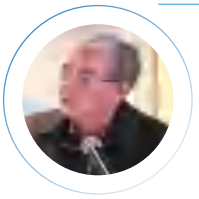
Xiong Daxin

Former Vice Chairman of the Beijing Municipal Committee of the Chinese People's Political Consultative Conference



HYY should leverage the current economic reform trends to drive further progress. The company should not rest on its current achievements but aim for a more promising future. It is crucial for the enterprise to focus on improving its operations and enhancing its visibility. Strategic and down-to-earth efforts in both enterprise operations and publicity are essential to ensure sustainable growth and to build a strong reputation in the industry.

Bai Jinrong



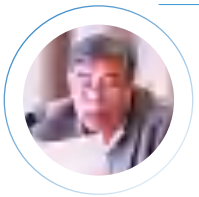
Former General Manager of Beijing Enterprises Group Co., Ltd.

We should foster an entrepreneurial spirit and create a fault-tolerant mechanism for entrepreneurs. It's essential to provide concrete support to advance the industry. One approach could be incorporating clean heating into building design standards within policy frameworks, offering users more choices. By strategically engaging with the right stakeholders, presenting the appropriate documents, and learning from rapidly developing cases, we can drive forward the model of clean heating. This will serve as a breakthrough for rapid industry growth under the guidance of effective policy requirements.

Hu Zhaoguang

Founder of Zhongguancun and Former Vice Mayor of Beijing

After more than 20 years of hard work and entrepreneurship, HYY now finds itself at a critical juncture that demands leapfrog development. It must focus on cultivating new-quality productive forces, pursuing high-quality development, and advancing the heat-cooling integration industry in line with the dual-carbon goals. This moment marks a turning point. The company cannot afford to continue along a mediocre or routine path but must strive for breakthrough development. Traditional productive forces are created by combining labor with labor tools, whereas new-quality productive forces represent a higher level of development. The innovative transformation of production factors is a profound upgrade, leading to a complete industry overhaul.



Liang Yaodong Heating Expert

Climate change is the most significant non-traditional security issue facing human society today. The scientific conclusions of the IPCC assessment reports have become the political consensus of the global stocktake at COP28. Climate change is both an environmental and development issue, but ultimately, it is a development issue. President Xi Jinping announced that China is striving to achieve carbon peak by 2030 and carbon neutrality by 2060. Achieving carbon peak and carbon neutrality is an inherent requirement for implementing the new development concept, building a new development pattern, and promoting high-quality development. We should seize this opportunity and accelerate the high-quality development of new energy in China.

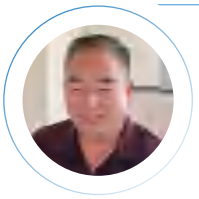
Responding to climate change is a common cause for all mankind. China is actively implementing a national strategy to address climate change. Since its inception, HYY has been committed to leading the development and utilization of shallow geothermal energy. It is recommended that HYY's system integration technology, products, and services for ground-source heat pump clean heating and heat-cooling integration be accelerated in suitable regions across China, with the support of relevant policies. The earlier these technologies are utilized, the greater the benefits. This approach will contribute significantly to the green and low-carbon heating of buildings in China.

Yang Mingzhong

CEO of CHYY Development Group Limited.

HYY has more than 20 years of exploration and practice in ground-source heating. Over these years, we have successfully completed ground-source clean heating (cooling) projects across various application scenarios and business models. As a result, we now possess sufficient reserves of technology, products, and services. We are committed to promoting the valuable experience accumulated over the past two decades and sharing it with society. Our goal is to transform the company's conventional engineering development model into one that supports the comprehensive development of the region.

We will continue to intensify our efforts to promote ground-source heat pump clean heating in northern China and make significant contributions toward realizing China's dual-carbon goals.



Zhang Wei

Chairman of Ever Source Science & Technology Development Group Co., Ltd.

Heating is a critical issue that directly impacts people's livelihoods, and it is a cause that demands our full dedication. We have witnessed the evolution from the traditional Heating 1.0 era to the Clean Heating 2.0 era, and now, with the advent of heat-cooling integration, we are advancing toward the development of new-quality productive forces. Ensuring reliable heating is a responsibility that we, as industry practitioners, must embrace with great care.

HYY has always remained committed to the development and utilization of shallow geothermal energy, which is one of the most important clean energy sources capable of fully replacing traditional heating methods. As we enter this new era, I firmly believe that the development and use of shallow geothermal energy will continue to grow and play a vital role in shaping a sustainable and energy-efficient future.

Liu Baohong

Vice President of Ever Source Science & Technology Development Group Co., Ltd.
Person in Charge of Heat Pump Products and Complete Equipment

We have classified and integrated heat pump units and complete products based on the type of low-temperature heat source and heating methods (self-heating or central heating), adopting a modular design and manufacturing approach. This innovative model not only simplifies the on-site installation process, ensuring the stability and reliability of system quality, but also allows for flexible adjustments and expansion based on specific engineering requirements to meet diverse market demands.

Our full range of products, including heating heat pump units, circulating heat exchange complete products, and complete heating heat pump systems, are all designed and manufactured in accordance with standardized procedures. These products are capable of completely replacing traditional combustion heating methods. Whether it's coal-fired stove heating in rural areas, boiler heating in office buildings, or combustion heating in regional thermal power plants, we offer corresponding ground-source heat pump clean heating system product solutions tailored to meet the heating needs of various scenarios.

News Report

Northern Heating Enters the 2.0 Era of Non-combustion Ground-Source Heat Pump Clean and Efficient Heating

——The Seminar on Ground-Source Heat Pump Clean Heating and Heat-Cooling Integration in the North China was held in Dalian.

On October 9th, the Seminar on Ground-Source Heat Pump Clean Heating and Heat-Cooling Integration in the North China, organized by the Clean Heating Industry Committee of the China Association of Small and Medium Enterprises, China Geothermal Energy magazine, and the Beijing Industrial Foreign Economic and Trade Promotion Association, was held in Dalian.

During the conference, experts attended a presentation by Ever Source Science & Technology Development Group Co., Ltd. (hereinafter referred to as "HYY") and visited the single-well circulating heat exchange ground-source clean heating project at Hutchison Whampoa's Yunan Bay in the Xiaoyao Bay International Business District, Dalian. This project has successfully completed three heating seasons. After on-site inspection and in-depth analysis, the experts agreed that this marked a significant milestone: the northern winter is entering the 2.0 era of non-combustion ground-source heat pump clean and efficient heating, transitioning from the traditional combustion-based heating 1.0 era.

HYY has consistently followed General Secretary Xi Jinping's important directives on advancing clean heating in the northern regions. The company has steadfastly committed to non-combustion clean heating and seeks to foster harmonious coexistence of humans and nature, improving the quality of life for people. The company's heating solutions, tailored to the specific needs of northern regions, are comprehensive and versatile. They cater to both individual households and regional central heating systems, providing winter heating, summer cooling, and hot water services through heat-cooling integration. In addition to individual heating products, HYY also offers complete system solutions for heating and cooling.

Building on the utilization of shallow geothermal energy, the company is actively researching the coupling use of other clean energy sources, such as air energy and hydrogen energy, to develop optimized heating solutions.

HYY has established the North Winter Ground-Source Heat Pump Clean and Efficient Heating System Operation and Maintenance Service Center in Beijing. This 24-hour service platform is dedicated to supporting the development of the heat-cooling integration industry. It helps regional key enterprises advance the emerging heat-cooling integration industry locally by constructing industrial parks and providing technologies, products, and service training. HYY is committed to fostering regional agents and supporting key enterprises in promoting the geothermal clean heating industry.

The development of ground-source heat pump clean and efficient heating in northern winters is a standardized process driven by new-quality productive forces. The industrial upgrade and transformation is supported by a non-combustion heating big data service model, shifting the company from an engineering model to a big data service platform. This contributes to the growth of the heat-cooling integration industry under China's dual-carbon goals and facilitates the regional development of the market.

Reactions

1

On October 10, 2024, Dalian Daily made relevant reports.

04 综合新闻

北方取暖将步入无燃烧2.0时代

北方冬季地能热泵清洁取暖暨热冷一体化新兴产业专家研讨会在连召开

2

On October 10, 2024, Jinpu News made relevant reports.

3

On October 10, 2024, the platform of the Clean Heating Industry Committee (CHIC) made relevant reports.

4

On October 17, 2024, the CGTN International Channel made relevant reports.

China's Dalian introduces geothermal energy for winter heating

22:27, 17 Oct 2024

Translate Share

Geothermal energy, or heat emitting from the earth, is considered by many to be a sustainable and clean source of energy. And as the winter season approaches, homes in the country's northeast are switching from traditional coal-fired heating to geothermal heating.

5

On October 12, 2024, the official website, Weibo, and WeChat official account platforms of Ever Source Science & Technology Development Group Co., Ltd. made relevant reports.

北方取暖步入无燃烧地能热泵清洁取暖 2.0 时代 | 北方冬季地能热泵清洁取暖暨热冷一体化新兴产业专家研讨会在连召开

CHYY DEVELOPMENT GROUP LIMITED WINS THE BEST ENERGY SAVING AND CARBON REDUCTION ACTION AWARD

Author: He Tianyue

On the afternoon of November 5th, the 2024 Hong Kong International Financial Forum and the Hong Kong International ESG List Annual Selection and Award Ceremony were grandly held in Hong Kong. Li Dahong, a member of the National Committee of the Chinese People's Political Consultative Conference (CPPCC), Chairman of the Hong Kong Takungpao Wen Wei Po Media Group, and President of Ta Kung Pao and Wen Wei Po, along with Paul Wong, Acting Financial Secretary of the Hong Kong Special Administrative Region Government, delivered speeches at the event. Yi Xuedong, Director of the Research Center of the State-owned Assets Supervision and Administration Commission of the State Council, released the "Report on the Overseas Development of Central Enterprises (2024)" in both Chinese and English at the forum. More than 300 distinguished guests, including political and business leaders from Hong Kong, executives from mainland and Hong Kong listed companies, venture capital institutions, and economists, attended the ceremony.

This year's Hong Kong International Financial Forum and the Hong Kong International ESG List Annual Selection and Award Ceremony, themed "Green Finance Empowerment, Co-creating a Sustainable

Future," was hosted by the Hong Kong Takungpao Wen Wei Po Media Group. It was co-organized by the China Certification and Inspection Group, the Chinese Business School of the University of Hong Kong, and the HSBC Financial Research Institute of Peking University. The event also received strong support from institutions such as the Financial Services and the Treasury Bureau, the Housing Bureau, and the Home Affairs and Youth Affairs Bureau of the Hong Kong Special Administrative Region Government.

Since the new era, President Xi Jinping has emphasized that "lucid waters and lush mountains are invaluable assets," and that new-quality productive forces themselves represent green productive forces. In his speech at the inaugural Hong Kong International ESG List Annual Selection event, Hong Kong Special Administrative Region Chief Executive Li Jiachao highlighted that the Hong Kong SAR Government aims to halve carbon emissions by 2035 and achieve carbon neutrality by 2050. This clear goal has set the direction for Hong Kong's green development.

In response to the central government's policies on green development, the Research Center of the State-owned Assets Supervision and Administration Commission of the State Council, along with the Hong Kong Takungpao Wen Wei Po Media Group, partnered on May 26th, 2024, to take an active role in shaping the international discourse on ESG. Building on this partnership, the Hong Kong International ESG Alliance and the Hong Kong International ESG List Annual Selection activities have continued to grow and make significant strides.

The Hong Kong International ESG List Annual Selection is based on a professional ESG authoritative rating database. The selection process follows principles of openness, fairness, professionalism, and transparency, synthesizing the opinions of expert committees and co-organizing institutions. After summarizing scores from ESG ratings, expert evaluations, and comprehensive assessments from the authoritative database, the final list of winners of the Hong Kong International ESG List Annual Selection is determined.

CHYY Development Group Limited won the "Best Energy Saving and Carbon Reduction Action Award" at this award ceremony.

Ms. Katherine Chan, senior honorary director of CHYY, accepted the award on behalf of the company

Our company's display board at the award ceremony

COMPANY NEWS

Author: He Tianyue

On October 15, 2024, Director Xu Hong of the Heating Office of the Municipal Urban Management Committee led a team to conduct a research visit to Ever Source Science &Technology Development Group Co., Ltd. (hereinafter referred to as "HYY").

Director Xu and the team visited several projects, including the All-China Federation of Industry and Commerce Office Building and Haidian Foreign Language Experimental School. They also held an exchange and discussion session at HYY. During the meeting, both sides had in-depth communication on various concerns, including the implementation, assurance, and pricing of clean heating.

On October 20, 2024, Jiang Guangzhi, Party Secretary and Director of the Beijing Municipal Bureau of Economy and Information Technology, and Leng Shaolin, Deputy Director of the Materials and Green Energy Industry Division, visited HYY for a research visit. They conducted an on-site inspection of the Xishan Yingfu International Business Center geothermal heating project and held a discussion with HYY regarding the development of the emerging industry of integrated geothermal heat pump clean heating and cooling for winter in northern China.

On October 23, 2024, Mr. Li and Mr. Zhong from Shiliu Group visited HYY. They toured projects such as Luojiafen and Haidian Foreign Language Experimental School and held discussions at the group headquarters. During the visit, they gained a detailed understanding of HYY's technologies, case studies, and other aspects. They also had in-depth discussions about the construction of the

group's ongoing operations and maintenance center, as well as the development of its management platform app, with the aim of further deepening cooperation between the two parties.

On October 25, 2024, Zhou Changkuan, Director of the Energy Division of Beijing Municipal Development and Reform Commission, led a team to visit and research HYY projects. The team toured the Haidian Foreign Language Experimental School project, the Sijiqing Town Government project, and the Yuquan Huigu project. They then held a discussion at the company headquarters with HYY. During the meeting, the two sides had in-depth communication on various aspects, including HYY's ground-source heat pump clean heating technology, solutions, project status, existing challenges, and issues the company needs to address.

On November 8, 2024, Vice Dean Yang Lei of the Energy Research Institute of Peking University led a team to visit HYY. Vice Dean Yang and his team toured several projects, including Luojiafen, Haidian Foreign Language Experimental School, and Xishan Yingfu Business Center. During the meeting at the company, both sides exchanged ideas on clean heating technologies and the achievements made. Also present at the visit were Zhang Yuqing, Former Deputy Director of the Energy Bureau, Zhou Hongchun, former Deputy Inspector of the State Council Development Research Center and Director of the Clean Heating Industry Committee (CHIC), and Zhou Chun, Executive Director of the Clean Heating Industry Committee.

PROMOTING FEATURED OPERATION AND MAINTENANCE PROJECTS

Author: Liu Baohong, Wang Xuezhi, Li Yanchao, Wang Dong

I.Typical Application Cases of the HYY Ground Source Heat Pump System (Heating in separate rooms for rural scattered households)

Ground Source Heat Pump Heating System in Lijiafen Village

Lijiafen Village, located on the north bank of the Nansha River (downstream of the Shangzhuang Reservoir), has earned several prestigious accolades, including "The Most Beautiful Village in Beijing," "National Civilized Village," "National Forest Village (Second Batch)," and "National Pilot Unit for Innovative Consultative Democracy at the Village Level." The village is also home to "Cao's Kite," a national intangible cultural heritage, earning it the title "The Most Beautiful Village Rising with Kites."

The village is made up of 260 households, with a total residential building area of nearly 40,000 square meters. In 2016, Lijiafen completed a significant upgrade to its heating infrastructure, replacing coal-fired stoves with a ground-source heat pump system. This system provides not only winter heating and summer cooling but also daily domestic hot water. The energy collection wells for the heat pump system are strategically placed near the road behind the villagers' homes for decentralized energy gathering, with each household having its own independent heating system. As a result, annual heating costs are reduced to 30%–90% of traditional coal heating (with coal priced at 800 yuan/ton), and approximately 1,235 tons of carbon dioxide are saved each heating season.

The response from villagers has been

overwhelmingly positive. The system is easy to use, with indoor temperatures adjustable to individual needs, and its operating costs are low. Grandpa Bai, a villager, shared, "Now it's just my wife and me at home. We only need to turn on two units-one in the living room and one in the bedroom. We turn them off when we go out and turn them back on when we return, and the house warms up quickly." The ground-source heat pump system has proven to be energy-efficient in practice, with villagers able to save further by only operating the pumps in rooms where people are present.

Lijiafen village Cao's Kite craft workshop

Earth Energy Rebao outdoor unit installed on the exterior wall

The village committee presents a banner

Ground Source Heat Pump Heating System in Luojiafen Village

Luojiafen Village is located in the northern new area of Haidian District, in the heart of Shangzhuang Town. Known for its beautiful environment and comprehensive facilities, the village has earned several prestigious honors, including "Civilized Ecological Village in the Suburbs of Beijing," "Capital Spiritual Civilization Village," and "Advanced Collective of Rural Work in Beijing (2017–2021)."

The village is home to 108 households, with a total residential building area of nearly 23,000 square meters. In 2015, the village launched a "coal-to-electricity" pilot project using energy storage electric heaters. After two years of trial operation, the village transitioned to a decentralized energy collection ground-source heat pump system, which now provides heating in winter and cooling in summer.

The energy collection wells for the ground-source heat pump system are placed near open areas behind the farmers' buildings, ensuring that no additional courtyard space is needed. The system collects energy locally, with each household using the energy it generates. The cost of power consumption during the heating season is just 10–15 yuan per square meter. Compared to the previous energy storage electric heaters, the entire village saves 3.698 million kWh of electricity each heating season. This is equivalent to reducing coal consumption by 1,128 tons at power plants and cutting approximately 2,786 tons of carbon dioxide emissions.

The villagers have expressed high satisfaction with the system's performance and costs. They affectionately call the ground-source heat pump system the "Five Merits" clean self-heating system, as it is "worry-free, labor-saving, cost-effective, convenient, and clean."

Earth Energy Rebao outdoor unit installed on the exterior wall

Ground Source Heat Pump Heating System in Xizha Village

Xizha Village is located in the northern part of Shangzhuang Town, Haidian District, Beijing. It is a village with rich historical culture and modern facilities and has won numerous honors, including "Beijing Democratic and Law-based Demonstration Village," "Haidian District Model Village for Open and Democratic Village Affairs Management," and "National Forest Village."

The village has 220 households, and the building area of the villagers' residences is nearly 60,000 square meters. In 2016, the ground source heat pump heating system in Xizha Village was completed in just 27 days, making it the first village in Haidian District to undergo a "coal-free" renovation.

Before the installation of the ground-source heat pump system, the villagers used traditional coal-fired heating, consuming approximately 1,100 tons of coal each heating season. The renovation has brought impressive energy-saving results. The heating power consumption is about 30 degrees/square meter in a heating season, and the cost of heating is now 50%-90% lower than the cost of burning traditional coal. This makes the system both affordable and efficient, making it an ideal solution for the village's frugal residents. The villagers in Xizha praise the ground source heat pump heating system as a clean, self-sustaining heating solution that "efficiently replaces coal with electricity, saves money, and provides worry-free warmth through ground energy."

Earth Energy Rebao outdoor unit installed on the exterior wall

The village committee presents a banner

Ground Source Heat Pump Heating System in Liuminying Village

Liuminying Village is located in Zhangziying Town, Daxing District, Beijing. Known as a model for ecological agriculture, the village has earned numerous honors, including "Global 500 Environmental Excellence," designation as a national 3A-level tourist scenic area, "The Most Beautiful Village in Beijing," the first batch of "National Agricultural Tourism Demonstration Sites," "Beijing Folk Tourism Village," "Capital Green Village," "China Green Village," and "National Advanced Village in the Work of Creating Civilized Villages and Towns."

The village has 246 households, and the total building area of the villagers' residences is nearly 40,000 square meters. Previously, the village relied on biogas combustion heating, but this method often resulted in unstable heating temperatures.

In 2016, the village underwent a comprehensive renovation of its heating infrastructure and adopted a decentralized energy collection ground-source heat pump system. This system now provides year-round heating in winter, cooling in summer, and daily domestic hot water for the residents. Each household operates an independent system with separate electricity metering and room-by-room control. The village has achieved stable, all-weather heating in winter, with an average heating power consumption of about 30 degrees per square meter. In one heating season, the system has helped reduce approximately 1,235 tons of carbon dioxide emissions. The villagers have responded positively to the ground-source heat pump system, praising it for being cost-effective, environmentally friendly, and comfortable.

Village cultural center heated by ground energy heat pump

Earth Energy Rebao outdoor unit installed on the exterior wall

II. Typical Application Cases of the HYY Ground Source Distributed Environmental System(Unify the planning of the main station and invest in the construction of branch stations according to demand)

Beijing Haidian Foreign Language Experimental School

1. Project Introduction

Beijing Haidian Foreign Language Experimental School is located in Haidian District, Beijing. It is a full-boarding school. Founded in July 1999, the school has about 6,000 teaching and administrative staff and covers an area of 350 mu with a total construction area of about 100,000 square meters. The school's heating and cooling systems all adopt the HYY ground source distributed cold and heat source environmental system. The first phase (North Campus) was put into operation in September 2001, the second phase (South Campus) was put into operation in 2008, and the table tennis and badminton center and kindergarten on the North Campus were put into operation in 2011 and 2012 respectively. At present, the project has been operating on a large scale for 23 years.

Beijing Haidian Foreign Language Experimental School

2. Configuration of the HYY Ground Source Distributed Cold and Heat Source Environmental System

Beijing Haidian Foreign Language Experimental School, located in Haidian District, Beijing, is a full-boarding institution established in July 1999. The school employs approximately 6,000 teaching and administrative staff and spans an area of 350 mu, with a total construction area of about 100,000 square meters.

The school's heating and cooling systems utilize the HYY ground-source distributed cold and heat source environmental system. This advanced system was implemented in phases: the first phase (North Campus) began operation in September 2001, followed by the second phase (South Campus) in 2008. Additionally, the table tennis and badminton center and kindergarten on the North Campus were completed and operational in 2011 and 2012, respectively.

Currently, the system has been operating successfully on a large scale for 23 years, providing consistent and efficient temperature control for the entire campus.

The construction of the school was carried out over a long period and in multiple phases, with buildings being completed and

Distribution diagram of single–well circulating heat exchange ground energy heat pump system in Beijing Haidian Foreign Language Experimental School

Distributed hot and cold source station configuration table

Cold and heat source station serial number	Building name	Building area (m^2)	Installed capacity (units)	Installed capacity (MW)	Satisfy function
1	N1 (Staff building)	14000	3	1.3	Heating, cooling, domestic hot water supply
2	N2 (Boys' dormitory)	6296	1	0.55	Heating, cooling, domestic hot water supply
3	N3 (Girls' dormitory)	6296	1	0.55	Heating, cooling, domestic hot water supply
4	N4 (Primary school building)	8879	1	0.55	Heating and cooling
5	N5 (Secondary school building)	8047	1	0.55	Heating and cooling
6	N6 (Office building)	6009	1	0.72	Heating and cooling
7	N7 (Science and technology building)	5248	1	0.4	Heating and cooling
8	N8 (natatorium)	5603	2	0.5	Heating, cooling, supply of domestic hot water, meet the pool heating
9	N9 (North school canteen)	4455	1	0.4	Heating, cooling, domestic hot water supply
10	N10 (Badminton hall)	2420	2	0.39	Heating, cooling, domestic hot water supply
11	N11 (Tennis arena)	2364	2	0.34	Heating, cooling, domestic hot water supply
12	S2 (South school canteen)	3040	6	0.51	Heating, cooling, domestic hot water supply
13	S1-S3 (Male and female dormitories)	4698	1	0.6	Heating, cooling, domestic hot water supply
14	S4-S6 (Teaching building)	14700	3	1.3	Heating, cooling, domestic hot water supply
15	kindergarten	4818	2	0.55	Heating, cooling, supply of domestic hot water, meet the pool heating
Total		96873	28	9.21	

put into use in batches. Each building serves a different purpose, including classrooms, dormitories, offices, and sports facilities. In response to these varying needs, the school's heating and cooling system was designed from the outset to use the HYY ground-source distributed cold and heat source environmental system. This system allows for phased construction and operation based on the specific heating and cooling demands of each building.

Compared to a traditional centralized heating and cooling system, the ground-source system significantly reduces the need for a large centralized pipe network, saving on substantial initial investment. Additionally, it provides the flexibility to adjust operations precisely according to the building's needs, thereby reducing ongoing operating costs.

The HYY system is implemented according to the school's development plan and is equipped with 15 distributed cold and heat source stations, ensuring that all buildings on campus receive efficient and tailored heating and cooling.

3.Statistics of the Operating Energy Consumption of the HYY Ground Source Distributed Cold and Heat Source Environmental System

After years of reliable operation, the project has demonstrated stable performance. Based on collected data, the average power consumption is 34.04 kW•h/m^2 in winter (including domestic hot water for 5,400 people), 19.07 kW•h/m^2 in summer (with hot water produced free of charge through waste heat recovery), and a total of 53.11 kW•h/m^2 for heating, cooling, hot water supply, and swimming pool temperature maintenance throughout the year. At the actual electricity rate of 0.4886 yuan/kW•h for the school, the annual operating cost is 25.9 yuan/m^2, covering 151 days of heating, 100 days of cooling, 200 days of hot water supply, and year-round swimming pool heating. Compared to the standard heating price of 45 yuan/m^2 (construction area) for non-residential heating in Beijing, this system achieves a 42.4% reduction in heating costs.

4.Application Effect of the HYY Ground Source Distributed Cold and Heat Source Environmental System

The school features approximately 400 various classrooms, including ordinary classrooms, multimedia classrooms, piano classrooms, and multi-functional halls, all equipped with the latest modern teaching tools. The student dormitories are designed according to international standards, with 6 students per room. The beds are arranged in upper and lower bunks, and each room is equipped with an independent bathroom and a 24-hour hot water supply. To ensure comfort, the indoor temperature of each building can be freely adjusted between 18℃ and 26℃ ,based on the outdoor temperature, to meet the requirements for winter and summer.

Given the special use environment of the school, the system is activated when the ambient temperature remains above 26℃ for 5 consecutive days (for cooling) or below 18℃ for 5 consecutive days (for heating), maintaining the indoor temperature within the optimal range of 18 ℃ to 26 ℃ . The domestic hot water system provides uninterrupted hot water with an outlet temperature set between 40℃ and 45℃ .

As of 2024, the project has been running smoothly on a large scale for 23 years and has received consistent praise from the owner for its stable performance.

用户使用报告

北京市海淀外国语实验学校恒有源地能热泵环境系统

北京市海淀外国语实验学校自 1999 年成立以来，经过 20 余年的发展，海淀本校区已经成为包含教学楼、办公楼、宿舍、球类场馆、游泳馆等近 20 栋建筑共计约 10 万平方米的校区。

校区自 2001 年引入恒有源地能热泵环境系统作为供暖、制冷方式至今，已经建设成为包含 15 个冷热源站的清洁能源供暖冷系统，实现了全校区供暖、制冷、生活热水、泳池加热的全部地能热泵清洁供应，实现了系统的无污染、无排放，美化了校园的环境。

恒有源地能热泵环境系统控制灵活，各建筑室内温度可以在 18℃-26℃之间调节，分别满足冬季和夏季对室内环境舒适度的要求。生活热水系统出水温度设置 40-45℃，24 小时不间断供水。泳池加热设置池水温度 26-28℃。

截止目前，项目已经连续稳定运行 20 余年，保证了校区供暖、制冷的安全稳定的同时，每年的运行费用约 25 元/平方米，与市政供暖系统相比，节约了大量的费用，带来了很好的经济效益。

特此证明。

北京市海淀外国语实验学校

2024 年 8 月

User evaluation

III.Typical cases of the application of HYY ground-source heat pump environmental systems (distributed central heating in towns).

Project of the All-China Federation of Industry and Commerce

1. Project Introduction

The office building project of the All-China Federation of Industry and Commerce is located in Xicheng District, Beijing, adjacent to the North Second Ring Road. The total construction area of the project is approximately 23,188m^2. The building consists of four underground floors and ten above-ground floors. The four underground floors, extending to the second level, are designated for parking and equipment rooms. The first underground floor also houses a restaurant and a swimming pool. The ten above-ground floors comprise the lobby and multi-functional hall on the first to third floors, while the fourth to tenth floors are designated for office spaces.

2.Configuration of the HYY Ground Source Distributed Cold and Heat Source Environmental System

The project utilizes the HYY ground source distributed environmental system, which is equipped with a dedicated ground source distributed cold and heat source machine room. This system is designed to meet the building's heating, cooling, and domestic hot water supply requirements efficiently.

National Federation of Industry and Commerce office building

(1) Statistics of the Cooling and Heating Loads of the Project

Building Function	Heating Load (kW)	Cooling Load (kW)	Domestic Hot Water Flow (m^3/h)	Domestic Hot Water Load (kW)
Office	1300	1400	Low Zone: 1.05High Zone: 0.46	Low Zone: 55High Zone: 24

(2) Main Equipment Configuration of the Cold and Heat Source Machine Room

Based on the project's cooling load and the technical parameters of the units, the machine room is equipped with 2 YSSR-900B/2 ground source heat pump units to fulfill the heating and cooling requirements of the building. Additionally, 1 YSSRW-90B ground source heat pump unit is selected to meet the domestic hot water load demand.

Cold and Heat Source Machine Room Main Equipment Configuration Table

Host Model	HostQuantity	Single Unit Heating Capacity(kW)	Single Unit Cooling Capacity(kW)	Total Heating Capacity(kW)	Total Cooling Capacity(kW)
YSSR - 900B/2	2	945	882	1890	1764
YSSRW - 90B	1	101.7	90.1	101.7	90.1

(3) Ground Energy Collection System Configuration of the Project

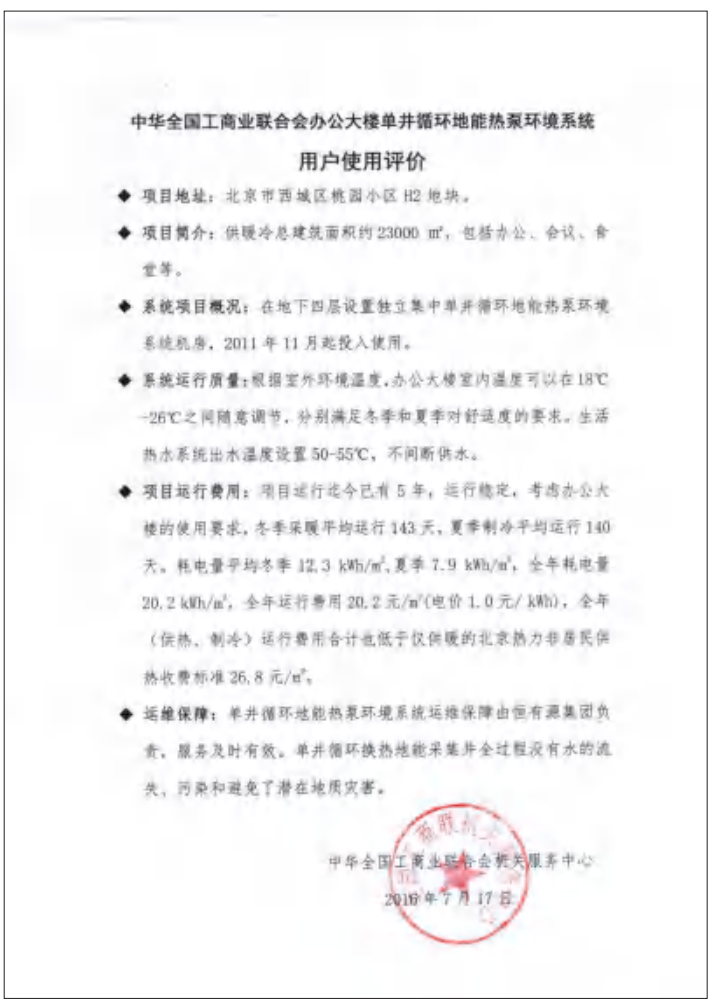
The project is located adjacent to Beijing Metro Line 2, where the available area for setting up a shallow geothermal energy collection system is limited. To address this challenge, the design integrates the advantages of the single-well circulating heat exchange ground energy collection technology. The project employs a single-well circulating heat exchange ground energy collection well system, effectively overcoming the constraints of limited ground energy collection space in urban central buildings.

The design incorporates 4 sets of single-well circulating heat exchange ground energy collection wells, with each well featuring a circulating flow rate of 100m^3/h. During implementation, the collection wells are placed in the green belt 2 meters away

from the building's basement, designed as concealed wells. Upon completion, the wellheads are indistinguishable from ordinary municipal well covers. This approach not only preserves the green space above but also ensures no negative impact on the building's foundation or the nearby subway system.

3.System Operation Effect

The project was completed and put into use in 2009. It has now been operating safely and stably for 15 years. According to the operational data accumulated over these years, the annual total power consumption of the project is approximately 1.0898 million kW•h, which translates to a power consumption of 22 kW•h per square meter. This demonstrates significant energy savings and emission reduction effects.



中华全国工商业联合会办公大楼单井循环地能热泵环境系统

用户使用评价

- 项目地址：北京市西城区桃园小区 H2 地块。
- 项目简介：供暖冷总建筑面积约 23000 ㎡，包括办公、会议、食堂等。
- 系统项目概况：在地下四层设置独立集中单井循环地能热泵环境系统机房，2011 年 11 月起投入使用。
- 系统运行质量：根据室外环境温度，办公大楼室内温度可以在 18℃-26℃之间随意调节，分别满足冬季和夏季对舒适度的要求。生活热水系统出水温度设置 50-55℃，不间断供水。
- 项目运行费用：项目运行迄今已有 5 年，运行稳定，考虑办公大楼的使用要求，冬季采暖平均运行 143 天，夏季制冷平均运行 140 天。耗电量平均冬季 12.3 kWh/㎡，夏季 7.9 kWh/㎡，全年耗电量 20.2 kWh/㎡，全年运行费用 20.2 元/㎡（电价 1.0 元/ kWh），全年（供热、制冷）运行费用合计也低于仅供暖的北京热力非居民供热收费标准 26.8 元/㎡。
- 运维保障：单井循环地能热泵环境系统运维保障由恒有源集团负责，服务及时有效。单井循环换热地能采集井全过程没有水的流失，污染和避免了潜在地质灾害。

中华全国工商业联合会机关服务中心

2019 年 7 月 17 日

User evaluation

IV.A successful example of seamlessly integrating ground-source heat pumps with deep geothermal energy to achieve the cascade utilization of deep geothermal resources, delivering efficient, zoned heating for high-rise residential communities.

Tianjin Old City Project

1. Introduction

As a clean and renewable energy source, geothermal energy development and utilization play a vital role in alleviating energy pressures and reducing environmental pollution. The Tianjin Old City Longtingjiayuan Project demonstrates this by achieving efficient and stable heating for a 170,000-square-meter residential community through the integration of two geothermal wells and heat pump hosts. Its long-term application showcases several innovations, including the significant enhancement of heating capacity through deep well-coupled heat pumps, the optimized cascade utilization of energy from a single geothermal well, flexible operational strategies for geothermal wells and heat pumps based on load intensity, and the safe, pressure-bearing heating of high-rise buildings zoned by height. These advancements provide a valuable model for the broader adoption of such systems.

Tianjin Old City Project

2. Project Overview

The old city area of Tianjin holds profound historical and cultural significance, serving as an important witness to the city's urban development. Its distinctive geographical location and cultural environment make it an ideal setting for establishing new energy-efficient communities. Under the impetus of national and local energy-saving regulations, this area has become a demonstration zone for groundwater resource development and utilization, paving the way for geothermal energy projects.

In 2009, Tianjin Zhongxin Xinjie Real Estate Development Co., Ltd. transformed Plot No.9 in the old city area into the Longtingjiayuan livable community. Located south of the Drum Tower and North Street in Nankai District, Tianjin, the community spans a total heating area of 175,963 square meters. That same year, the supporting deep geothermal well-coupled heat pump heating system, funded and implemented by Ever Source Science and Technology Development Group Co., Ltd., was completed.

To date, the project has successfully delivered stable heating services for 15 years, earning widespread recognition from residents, community neighborhood committees, and the Nankai Heating Office for its reliable performance.

3. System Configuration

(1) Basic Information of Buildings and Heating Zones

The project encompasses 12 high-rise buildings, each approximately 100 meters tall. Among these, the above-ground residential area spans 146,263 square meters, comprising buildings with 27 to 30 floors. Additionally, Building No. 12, a mixed-use structure for commercial and residential purposes, covers 29,700 square meters, with 20 floors and a floor height of 4.8 meters.

To optimize heating efficiency and safety, each building is divided into three heating zones based on height: the high zone (H), the middle zone (M), and the low zone (L), each consisting of 10 floors. The low zone encompasses an area of 60,650 square meters, the middle zone 58,405 square meters, and the high zone 41,493 square meters. By segmenting the heating system into these zones, the indoor heat dissipation facilities operate under safe pressure, ensuring system reliability. This zoned approach also facilitates precise system control and adjustment, achieving targeted heating and enhancing energy utilization efficiency.

(2) Relevant Settings of the Heating System

The heating load of the system during winter is 7,700 kW, with the heating system's designed supply and return water temperatures set at 60 °C and 50 °C, respectively.

A dedicated heating machine room houses 12 HD-660B heat pumps, providing a total heating capacity of 7,920 kW. The heating index for the system is approximately 45 W per square meter, ensuring efficient performance.

The project utilizes two geothermal wells, each with a depth of 2,000 meters. The water outlet temperature from a single well is 57 °C, with a flow rate of 120 cubic meters per hour. To maximize efficiency, the system employs a cascading energy

utilization strategy. Initially, the geothermal water is directly heated and cooled to 42 °C through a primary heat exchanger. Subsequently, it enters a secondary series-connected heat exchanger, which supports low-temperature energy collection for heat pumps across the high, middle, and low zones. The return water temperature is carefully controlled between 7 °C and 10 °C. This approach enables a single well to provide up to 7,000 kW of heat, fully meeting the system's requirements.

(3) Details of the Main Equipment Configuration

① Characteristics of Heat Source Configuration

The project features two directional geothermal wells (NKR-24A and NAR-24B) located in the southwest corner of the community. These wells have a wellhead spacing of 4 meters and a maximum bottom hole displacement of 433 meters. Parameters such as well depth, bottom hole displacement, water outlet temperature, and water output have been meticulously measured and meet the design specifications. Serving as the core heat sources for the system, these geothermal wells provide stable, high-temperature geothermal water, forming the foundation for the efficient utilization of geothermal energy across the heating system.

② Comprehensive Equipment Configuration in the Machine Room

The machine room is fully equipped with 6 plate heat exchangers, 6 secondary circulation pumps, 6 make-up pumps, 11 terminal circulation pumps, and 12 heat pumps. The heat pumps are strategically distributed across the low, middle, and high zones based on the terminal heating demand, with corresponding circulation pumps configured for each zone. Standby pumps are available in each zone to ensure reliability. Additionally, the make-up pumps, secondary circulation pumps, and plate heat exchangers are evenly distributed. This comprehensive setup ensures the stable operation of the system under varying conditions, enabling efficient energy transfer and utilization across all areas.

③ Power Supply Equipment Configuration Guarantee

A 10 KV substation has been established to provide robust power support for the project. The primary and secondary electrical components are equipped with dry-type transformers, high-voltage switch cabinets, low-voltage switch cabinets, DC panels, central signal control panels, metering panels, and load control panels. This stable power supply system is critical for maintaining the reliable operation of the geothermal energy equipment, ensuring the continuity and dependability of the entire heating process.

④ Intelligent Equipment Control Configuration

A total of 13 control cabinets have been installed to manage the main units, auxiliary equipment, and geothermal wells (one active and one standby). The intelligent control configuration allows for precise regulation of the heating system, enabling real-time adjustments based on operational needs. This enhances the automation and efficiency of the system, while minimizing errors and energy waste associated with manual intervention.

4. System Operation Effect

This project, as HYY's pioneering endeavor in integrating ground-source heat pumps with deep geothermal energy for heating, represents a bold and innovative undertaking. The operation team has developed and refined energy-saving strategies tailored to the unique characteristics of heat pumps and geothermal wells, continuously optimizing them for enhanced efficiency.

(1) Cascade Utilization Strategy and Principle

① Background and Challenges

When combining ground-source heat pumps with deep geothermal energy for heating, the project faced challenges such as the high temperature and low flow rate of deep geothermal energy and the high mineralization degree of geothermal well water (with mineralization values exceeding 3,700 mg/L). While the heat load was matched, these issues hindered improvements in energy utilization efficiency, necessitating innovative solutions to achieve effective synergy between the two systems.

② Specific Measures and Principles

Key Role of the Secondary System:
The high-grade characteristics of deep geothermal energy mean that it retains significant utilization value even after initial heat exchange. Introducing a secondary system addresses this issue by increasing flow rate, reducing temperature difference, and isolating corrosion. This setup allows the ground-source heat pumps and deep geothermal energy to complement each other, enhancing overall energy utilization efficiency.

Efficient Step-by-Step Heat Exchange Process:
The secondary high-temperature water undergoes a sequential heat exchange process. Initially, it passes through the condenser of the first ground-source heat pump unit, reducing its temperature to 24 °C–25 °C. It then enters subsequent units, step by step, until its temperature drops to around 10 °C. This cascading heat exchange process maximizes the utilization of geothermal water's thermal energy, minimizing energy waste.

Series Connection and Precise Temperature Control:
The project employs high, middle, and low partitions, with the condensers of the ground-source heat pump units connected in series. By precisely controlling the water supply volume of the deep geothermal energy, the inlet temperature of the secondary water for the first main unit in each zone is maintained at 28 °C–29 °C, ensuring a temperature difference of 4 °C between units. This design effectively addresses the challenges of high temperature and low flow rate, ensuring the system's efficient and stable operation. It achieves the cascade utilization of geothermal energy, boosts energy efficiency, and provides robust support for the project's energy conservation, environmental protection, and stable heating objectives.

(2) Implementation of Flexible Heating Strategies

① Early and Late Heating Stages

Plate heat exchangers are employed for direct heat exchange heating during the early and late stages of the heating season. Leveraging their high-efficiency heat exchange capabilities, these systems quickly respond to heating demands,

ensuring that indoor temperatures promptly reach comfortable standards.

② Mid-Heating Stage

During the middle of the heating season, the system dynamically adjusts to a heating mode that combines ground-source heat pumps and deep geothermal energy based on weather variations. This approach optimally allocates energy, fully harnesses the advantages of both energy sources, and enhances overall energy utilization efficiency.

③ Extreme Cold Weather

In cases of extremely cold weather, frequency converters are used to increase the water output of the pumps. This ensures that the temperature of the secondary water meets the heating requirements, maintaining a warm and comfortable indoor environment for residents even under harsh climatic conditions.

(3) Evaluation of Long-Term Operation Effect and Energy-Saving Benefits

Since the system began operation in 2009, it has consistently operated stably for 15 years. The annual total power consumption has not exceeded 4.3 million kW·h, with the power consumption per square meter staying below 25 kWh. These figures demonstrate the system's stability and energy-saving performance over its long-term operation. Not only does the system meet the heating needs of residents, but it also significantly reduces energy consumption and carbon emissions. This highlights the substantial benefits of utilizing geothermal water in a cascading heat pump system for energy conservation, environmental protection, and low operational costs, while providing strong practical support for the sustainable development of the geothermal energy industry.

(4) Analysis of Historical Operating Energy Consumption Data

Through in-depth analysis of the historical operating energy consumption data, the trends in energy consumption over the years can be clearly identified. This provides a solid scientific foundation for further optimizing system operations and formulating more precise energy-saving strategies. The insights gained also contribute to the ongoing improvement and development of geothermal energy technologies.

In conclusion, the Tianjin Old City project has achieved significant success in the development and utilization of geothermal energy. Its key achievements include a scientifically designed, safe system configuration, innovative cascade utilization strategies, adaptable heating modes, and exceptional energy-saving performance. These successes offer a comprehensive, practical model for the geothermal energy sector and play a crucial role in advancing technological progress and ensuring the sustainable development of the industry.

Historical Operating Energy Consumption Data Analysis Table (Reference Calculation Area 172977 m^2)

Year	Heating Energy Consumption (10,000 kW•h)	Average Energy Consumption (kW•h/m^2)
2009 - 2010	402	23.24
2010 - 2011	360	20.81
2011 - 2012	372	21.50
2012 - 2013	430	24.86
2013 - 2014	401	23.18
2014 - 2015	364	21.04
2015 - 2016	371	21.45
2016 - 2017	340	19.65
2017 - 2018	381	22.02
2018 - 2019	372	21.50
2019 - 2020	372	21.50
2020 - 2021	415	23.99
2021 - 2022	379	21.91
2022 - 2023	395	22.83

EXPLORATION OF HYDROGEN ENERGY HEAT PUMP HEATING

Author: Liu Baohong

1. Application Status of Hydrogen Energy Heating

Hydrogen energy, as a clean energy source, currently holds significant potential across various sectors. In the transportation industry, hydrogen fuel cell vehicles have transitioned from laboratory research to market-ready products, with several countries and regions already beginning to promote their use. However, in the heating sector, the application of hydrogen energy remains in its early stages. Despite this, hydrogen energy heating is gaining increasing attention due to its zero-carbon emission characteristics, which align with global sustainability goals.

2. Technical Routes of Hydrogen Energy Heat Pump Heating

2.1 Compression Heat Pump Driven by Hydrogen Engine (Abbreviated as Hydrogen Heat Pump Unit)

The hydrogen engine-driven compression heat pump replaces the electric motor with a hydrogen engine, which drives the compressor of the heat pump unit to provide heating (and cooling). One

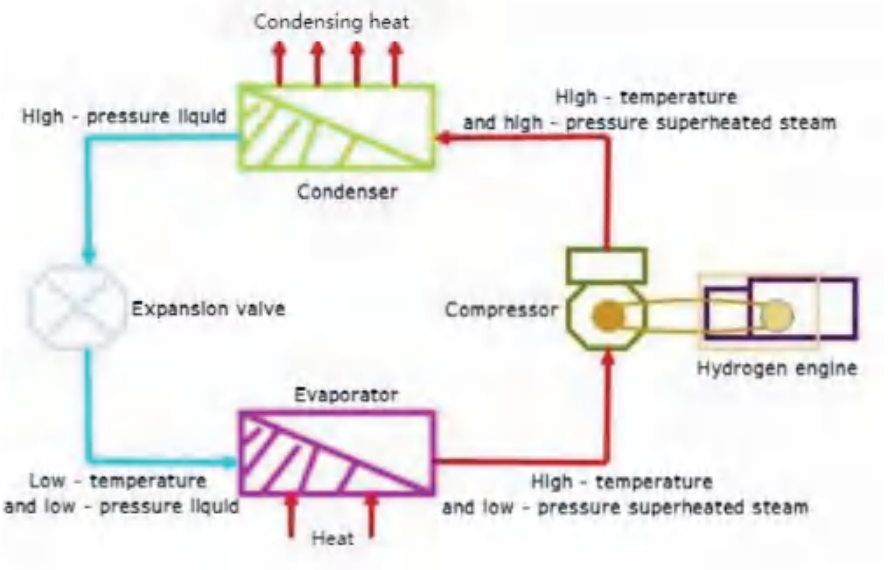


Diagram of Hydrogen Heat Pump Unit Principle

of the main advantages of this system is that the waste heat generated by the hydrogen engine can be recovered during the heating period, enhancing the heating capacity. In the process, hydrogen combusts in the engine's cylinder, pushing the piston to perform work and generate kinetic energy. The principle is similar to that of a conventional natural gas engine. A hydrogen injection system is incorporated, and the conversion of chemical energy into mechanical energy occurs through four stages: suction, compression, expansion (work), and exhaust.

Hydrogen exhibits excellent flammability, a fast combustion speed, and pollution-free combustion products, making it an ideal power source. As a result, research into hydrogen engines has become a key focus in the field of new energy engines. However, while hydrogen's calorific value is comparable to that of gasoline, its volume is 3000 times larger, which presents significant challenges in storage. Additionally, the hydrogen engine itself has its limitations. Similar to traditional gasoline engines, hydrogen engines are spark-ignition engines, and they can be realized by modifying existing gasoline and diesel engines. Currently, hydrogen engines are typically classified into premixed types, which use carburetors and intake injection, and direct injection types.

In the premixed type, hydrogen gas is injected into the cylinder after being mixed with air externally. This method results in low output power and is prone to backfire and pre-ignition. The direct injection type, where hydrogen is injected directly into the cylinder, avoids backfire but is still vulnerable to pre-ignition when injected at low pressure. Hydrogen engines represent an important application for hydrogen energy, but the technical challenges, particularly concerning pre-ignition, deflagration, and backfire, are greater than those of traditional fuel engines. At present, hydrogen engine technology remains in the research and development phase.

2.2 Coupling System of Hydrogen Fuel Cell Power Supply + Heat Pump Unit

Hydrogen can be converted into electricity through a hydrogen fuel cell, which is then supplied to the heat pump unit (such as a ground-source or air-source heat pump). The waste heat generated during the power generation process of the hydrogen fuel cell can be recovered using heat pump technology and further supplied to the heating (or cooling) system, improving overall energy utilization efficiency. A hydrogen fuel cell can be simply understood as a "chemical energy generator." It is an energy conversion device that transforms hydrogen fuel into electricity via a chemical reaction, similar to an electrochemical power generation device. The electricity generated can directly power the motor through various electrical components, such as controllers and inverters, to supply energy to the heat pump unit. As the hydrogen is decomposed, it passes through the proton exchange membrane to generate electricity. The hydrogen ions and electrons do not simply disappear after reaching the cathode plate; instead, they recombine with oxygen atoms to form water, resulting in almost zero emissions and no pollution.

2.2.1 Household Hydrogen Fuel Cell + Decentralized Self-heating Coupling System

The triple-supply coupling system of the household hydrogen fuel cell + decentralized

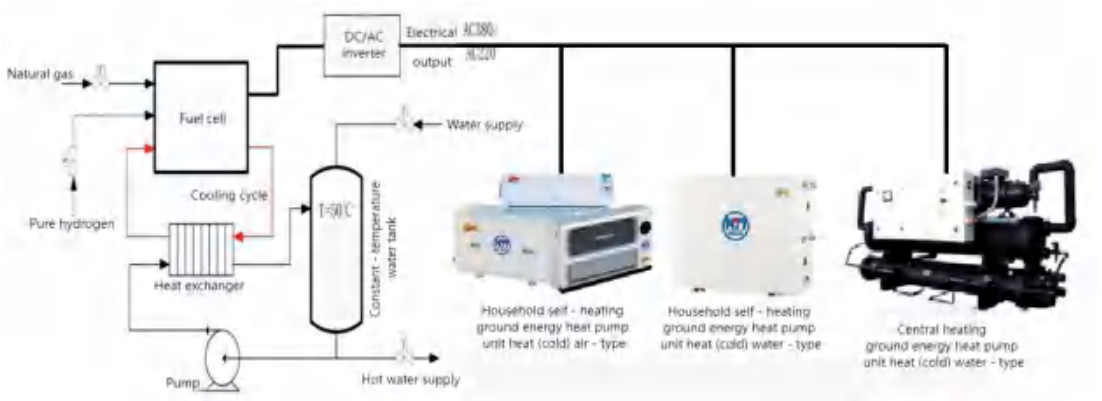


Diagram of the Coupling System of Hydrogen Fuel Cell Power Supply + Heat Pump Unit

self-heating system consists of six key components: the fuel processing subsystem, fuel cell system, power electronics subsystem (power supply), waste heat recovery subsystem, coupling hot water system, and coupling heating (cooling) system.

First, the fuel processing subsystem reformulates the fuel gas into hydrogen and transports it to the fuel cell system for power generation. Next, the power electronics subsystem converts the direct current (DC) generated by the fuel cell into alternating current (AC), which is then used to power the ground-source heat pump decentralized self-heating system or integrated into the power grid.

The waste heat recovery subsystem captures and stores the waste heat generated during the fuel cell's power generation process for later use in heating and hot water supply. Finally, depending on the heating and cooling requirements of the building in both winter and summer, the coupling hot water system and coupling heating (cooling) system are activated to provide the necessary services.

System Characteristics:
Each household operates as an independent energy utilization system, not reliant on the power grid for operation. This reduces the

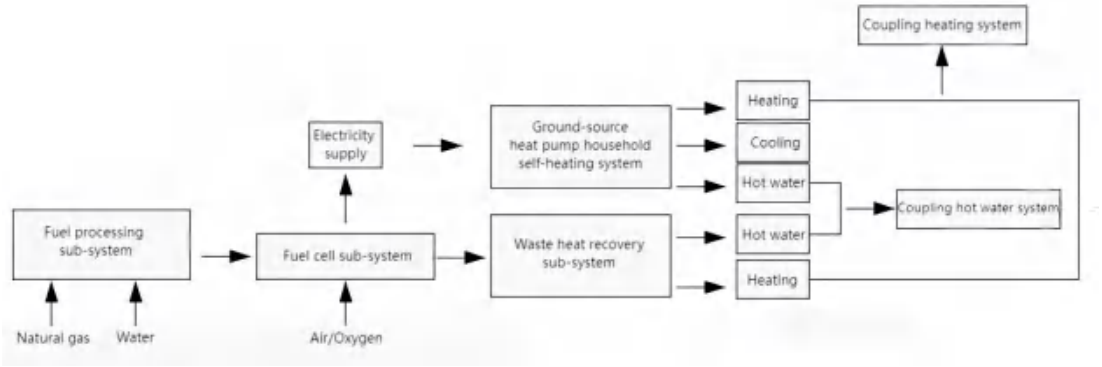


Diagram of the Decentralized Coupling Heating System

need for extensive energy transmission infrastructure, thereby lowering both investment and operational costs. The system offers flexible operation and is environmentally friendly, with zero harmful substance emissions.

Development Prospects:
The system can be distributed for single-house self-generation and self-use, allowing for combined generation and consumption. It is clean, pollution-free, and represents the most ideal method of energy utilization at the user level.

2.2.2 Hydrogen Fuel Cell Power Station and Ground-Source Heat Pump Central Heating Coupling System

Hydrogen energy boasts a high energy density, enabling it to achieve a significant increase in energy storage capacity compared to traditional energy storage methods. By utilizing renewable energy sources such as excess wind and solar power, hydrogen can be produced at a low cost. This allows for the conversion of electricity into hydrogen and back into electricity, creating a more controllable, stable, and secure supply of renewable energy.

The application of domestic hydrogen energy fuel cell power stations is already well-developed and has been successfully implemented in transportation, emergency power supply, and other areas. When coupled with ground-source heat pump central heating systems, hydrogen fuel cell power stations can provide heating, cooling, and hot water for large buildings or entire building complexes.

System Characteristics:
Each building or group of buildings functions as an independent energy utilization system, operating without reliance on the power grid. This system is environmentally friendly, with zero harmful emissions. The hydrogen energy equipment is installed in the public areas of the building, and with the integration of domestic development technologies, it is easier to meet specific safety and performance requirements.

Development Prospects:
The system can be deployed in a distributed manner to achieve self-generation and self-use at the regional building level. This approach allows for combined generation and use, ensuring a clean and pollution-free energy supply. It represents a new type of distributed, comprehensive energy utilization model.

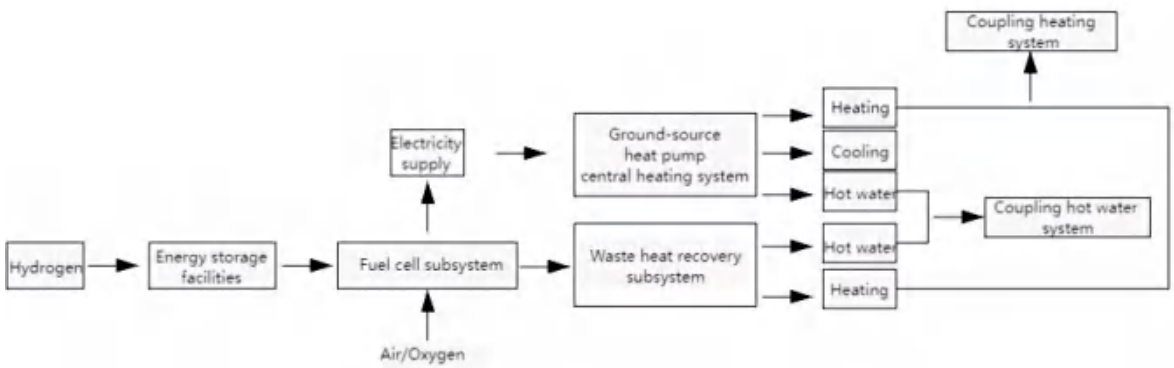


Diagram of the Centralized Coupling Heating System

2.3 Comparison of the Two Technical Routes

Heat pump technology is well-established, and the feasibility of using hydrogen energy for heat pump heating primarily depends on the advancement of hydrogen engines and hydrogen fuel cells. The characteristics of the two key technical routes the hydrogen engine and the hydrogen fuel cell are outlined in the table below.

The technical scheme characteristics of the hydrogen engine and the hydrogen fuel cell

Comparison Items	Hydrogen Engine	Hydrogen Fuel Cell
Hydrogen Purity Requirement	Low	Extremely high (impurities are harmful to the proton exchange membrane)
Cost	Can utilize existing gasoline engine components, about 1/10 of the cost of a hydrogen fuel cell	Includes proton exchange membrane, precious metal catalysts, and other components, with high cost
Efficiency	Similar to that of an ordinary gasoline engine, 40 - 60%	60 - 80%
Pollution Emission	$2H_2 + O_2 = 2H_2O$ $H_2 + O_2 + N_2 \rightarrow H_2O + NO_x$ (mainly NO_x, can be post-treated)	$2H_2 + O_2 = 2H_2O$ (zero emission)
Noise	Inherent vibration noise	No noise
Auxiliary System	Hydrogen storage and supply system	Hydrogen storage and supply system, battery, motor
Service Life	Reliable (about 500,000 kilometers for vehicle use)	About 5000 hours, sensitive to service life

3. Future Outlook

Hydrogen energy is a nearly zero-emission energy source, offering great potential for reducing carbon emissions in the heating industry. Hydrogen energy heat pump heating can significantly lower carbon emissions in this sector. The compression heat pump driven by a hydrogen engine or the coupling system of a hydrogen fuel cell power supply with a heat pump unit can drive the innovation and diversification of clean heating technologies.

However, several challenges remain in the practical use of hydrogen energy for heat pump heating, including the cost, storage, transportation, refueling, and safety concerns associated with hydrogen. Additionally, the technical maturity of hydrogen engines and the need for cost reductions in hydrogen fuel cells remain critical obstacles. Despite these challenges, with advancements in technology and large-scale applications, hydrogen energy heat pump heating is expected to achieve significant breakthroughs in the near future.

GLOSSARY OF TERMS

Author: Li Daqiu

The Era of Heating 2.0 (Non-combustion) in the North Winter

Heating can be roughly divided into two stages. The first stage, from the founding of the People's Republic of China to 2016, is the traditional heating era, also known as Heating 1.0. The second stage, from 2017 to the present, is known as the Clean Heating 2.0 era.

The Clean Heating 2.0 Era (Non-combustion) for Northern Winters:

The Clean Heating 2.0 era ushers in a new way of heating that addresses both the energy production-consumption revolution and the rural lifestyle revolution. Ground-source heat pump systems, which provide both heating and cooling, offer a solution to the northern regions' winter heating needs. These systems utilize low-temperature geothermal energy (below 25°C) obtained from deep underground, a resource that is harnessed even in the harshest winter climates. Unlike traditional combustion-based heating, the ground-source heat pump system circulates heat and provides a safe, cost-effective alternative to coal heating. The system operates with low direct costs, making it comparable to traditional coal combustion, while also offering the flexibility to adjust to varying needs.

Driven by the dual-carbon goals and the rise of new-quality productive forces, the Heating 2.0 era is marked by the integration and upgrading of the traditional industries of combustion heating and refrigeration (air conditioning). This emerging industry, which combines heating and cooling, reduces energy consumption by about 50% compared to traditional fossil fuel-burning methods, and most importantly, it is free of combustion and emissions, making it a clean and sustainable alternative.

Localized, Renewable Heating for Rural Areas:

In the new era, low-temperature geothermal energy, which is widely available and distributed, is collected and utilized based on local conditions. This energy is circulated through the heating pump system to achieve an optimal environmental temperature of about 22°C, providing warmth in winter, coolness in summer, and daily hot water. This system steadily improves people's quality of life and represents a scientific use of energy that matches temperature and energy grade.

The ground-source heat pump environmental system, known as the

ground-source heat treasure system, is ideal for rural households. It features independent metering for each household, ensuring that every home receives low-temperature heat energy based on local conditions. Temperature adjustments can be made within the range of 16–26°C, depending on the needs of each room. Only the rooms in use need to be heated, optimizing energy consumption. The system is safe and robust, as it will not freeze even if not in use, providing worry-free, cost-saving, and clean energy to residents.

The Renewable Energy Solution: Low-Temperature Geothermal Heat:

Low-temperature geothermal energy is abundant and widely distributed, with the earth's surface acting as a natural solar panel and a storage device for geothermal heat. The temperature below the surface, influenced by both the earth's core and the sun, remains relatively constant and can be accessed through shallow geothermal layers (not deeper than 200 meters).

Historically, northern China's cave dwellings took advantage of this natural phenomenon, staying warm in winter and cool in summer by using the earth's low-temperature geothermal energy. Today, thanks to advancements in heat pump technology, this low-temperature geothermal energy is no longer used directly but is instead transported via the heat pump system to maintain an optimal temperature of around 22°C for residents. This process represents the modern, scientific application of renewable energy for heating, ensuring that geothermal energy is a sustainable and effective alternative for heating northern winters.

Efficient and Clean Heating by Ground-Source Heat Pump

2

The ground-source heat pump is a system that efficiently utilizes shallow geothermal energy for both heating and cooling buildings.

In the harsh northern winter conditions, the ground-source heat pump system leverages the power distribution capacity of buildings, meeting national energy standards. By using just one unit of electrical energy to drive the heat pump unit, it can deliver heating equivalent to more than three units of direct electrical heating. The system collects and circulates naturally stored, low-temperature geothermal energy found in the soil, sand, and gravel up to three feet beneath the frozen ground, depending

on local conditions. This energy is then transferred and enhanced to the appropriate temperature, creating a comfortable environment suitable for human, animal, and plant life.

Aligned with the dual-carbon goals, the system achieves significant energy efficiency. It uses only the cost of coal combustion and approximately 50% of the energy consumption required for traditional combustion-based heating, while ensuring that the original heating area meets national temperature standards. As China accelerates its push for green, low-carbon development and the cultivation of new-quality productive forces, the ground-source heat pump system plays a key role in this transition. By integrating both heating and cooling functions, it not only contributes to energy conservation but also improves the quality of life for residents, making it an essential part of the emerging heat-cooling integration industry.

3

Single-Well Circulating Heat Exchange Ground-Source Heat Pump Environmental System

The single-well circulating heat exchange ground-source energy collection technology, innovated in Beijing, China, is a cutting-edge solution developed in Beijing's Zhongguancun. This original technology uses groundwater as the medium for heat exchange. It adjusts the ground-source energy collection based on local geological conditions and achieves 100% reinjection into the same well through a closed pressurization system.

By utilizing groundwater as the medium, the system circulates and collects shallow, low-temperature geothermal energy stored in underground rock and soil layers without polluting or depleting the groundwater. The temperature of the collected geothermal energy remains relatively constant, unaffected by weather fluctuations, ensuring stable heating during the coldest winter months, even under harsh northern climate conditions.

The single-well circulating heat exchange system is an efficient and environmentally friendly ground-source heat pump system, providing a reliable, sustainable solution for heating in regions with extreme winter temperatures.

Carbon Emission and Carbon Neutrality

Carbon Emission

Carbon emissions refer to the release of greenhouse gases, primarily carbon dioxide, produced through human activities such as the combustion of fossil fuels, industrial production, agricultural practices, land use changes, and waste disposal. The increase in these emissions is a major contributor to global climate change. In academic research and environmental analysis, carbon emissions are often measured in "carbon dioxide equivalent" (CO_2e) to capture the combined impact of various greenhouse gases on global warming, accounting for their differing global warming potentials.

Carbon Neutrality

Carbon neutrality, also known as "net zero emissions," refers to the state in which the amount of greenhouse gases emitted into the atmosphere is balanced by the amount of greenhouse gases removed or offset through natural processes or technological means. In this state, the net increase in greenhouse gas concentrations is effectively zero, contributing to the reduction of the overall impact on global climate change.

CELEBRATING THE 10TH ANNIVERSARY OF CHINA GEOTHERMAL ENERGY MAGAZINE

It takes a decade to sharpen a sword, and achievements pave the way for the future. Today, we come together to warmly celebrate the 10th anniversary of China Geothermal Energy magazine.

These ten years have been a period of rapid development in the clean energy sector, as well as a time when our magazine has evolved alongside its readership.

From the initial stages of exploration to the steady progress we see today, every step reflects our dedicated efforts and hard work, and is inextricably linked to the unwavering support of our leaders and the enthusiastic encouragement and constructive feedback from our readers.

Over the past decade, the magazine has been steadfast in its mission to promote the research, development, and application of geothermal energy. We have closely followed the latest trends in the geothermal sector, both domestically and internationally, offering in-depth coverage of cutting-edge scientific advancements, technological progress, and successful case studies in the fields of geothermal heating and cooling. From global geothermal resource distribution and exploration to innovations in geothermal power generation, and the widespread application of geothermal energy in public infrastructure and everyday life, we have showcased the potential and advantages of geothermal energy as a clean, sustainable energy source. Our goal has always been to advocate for a cleaner living environment and to support sustainable development for humanity.

Since its inception, the magazine has provided readers, both at home and abroad, with a wealth of pioneering scientific achievements, as well as case studies of public facility renovations and the tangible benefits geothermal energy has brought to society.

Looking ahead, we remain committed to the mission of the magazine. We will continue to offer valuable insights for government policy-making on energy, serve as a platform for promoting geothermal energy enterprises, and provide a space for dialogue between designers and the general public. We will continue to highlight the application of shallow geothermal energy and showcase successful implementation examples. Through these efforts, we aim to contribute our wisdom and strength toward environmental protection, sustainable development, and enhancing social well-being.

Editorial Department of China Geothermal Energy Magazine

敬告读者

《中国地热能》是由中国地热能出版社主办，北矿大（南京）新能源环保技术研究院、首都科技发展战略研究院、北京工业对外经贸促进会、北京节能环保促进会浅层地（热）能开发利用专业委员会、中国地热与温泉产业技术创新战略联盟、中国热冷一体化清洁能源研究院协办的科技期刊，双语半年刊。我们的办刊宗旨是为政府制定能源政策提供参考建议；为地能开发企业提供宣传平台；为设计者、大众提供交流空间；推广浅层地热能利用经验，展示应用实例。

我们始终不忘读者的期待，用心用力办好期刊。毫无疑问，优化空气、节能减排、治理雾霾是当前摆在全体中国人民面前一个重大课题，我们期望《中国地热能》这本小小的期刊能够为攻克这一难题贡献微薄之力。

立足长远，着眼当前，在继承中创新，在变革中发展。自创刊以来，期刊一直得到了业内专家学者和广大读者的热情支持，在此致以我们的衷心感谢。大家的关注是我们的追求，大家的支持是我们的动力。让我们携手共进，共同打造《中国地热能》的美好明天。

《中国地热能》编辑部

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中國地熱能
CHINA GEOTHERMAL ENERGY

EDITOR'S NOTE

"China Geothermal Energy" is a scientific journal sponsored by China Geothermal Energy Publishing House, and co-organized by the Nanjing New Energy and Environmental Technology Research Institute of Beijing University of Science and Technology, the Capital Science and Technology Development Strategy Research Institute, the Beijing Industrial Foreign Trade Promotion Association, the Shallow Geothermal Energy Development and Utilization Professional Committee of the Beijing Energy Conservation and Environmental Protection Promotion Association, the China Geothermal and Hot Spring Industry Technology Innovation Strategic Alliance, and the China Thermal and Cold Integrated Clean Energy Research Institute. It is a bilingual semi-annual publication. Our mission is to provide meaningful proposals to policymakers in energy sector, to offer a promotional platform for geothermal energy development enterprises; to create a communication channel for providers and consumers; and to showcase the good practices and applications of shallow geothermal energy for efficient heating.

We always strive to constantly improve the journal, so as to live up to the expectations of our readers. Undoubtedly, optimizing air quality, energy conservation and emission reduction, and smog control are significant challenges facing all Chinese people today. This journal "China Geothermal Energy" is designed with a hope to make its contribution to overcoming these challenges.

Looking towards the future while staying focused on the present, we strive to innovate and evolve in our practices. Since its establishment, our journal has received tremendous support from industry experts, scholars, and readers, for which we are sincerely grateful. Your attention is our treasure, and your support serves as our motivation. Let us join hands and work together to shape a brighter future for "China Geothermal Energy".

Editor's Office of China Geothermal Energy Magazine

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关于能耗和近零能耗建筑的概念

作者：周彬

能 耗

能耗即能源消耗总量（吨标准煤），是指在一定时间内，一个国家（地区）国民经济各行业和居民生活消费的各种能源的总和。能源包括一次能源，一次能源通过加工、转换产生的二次能源和同时产生的其他二次能源。

其中，一次能源是指自然界中以天然形式存在，不经任何改变或转换的天然能源资源，包括原煤、原油、天然气、水能、核能、风能、太阳能、地热能、海洋能、生物质能等。二次能源是指为了满足生产工艺或生活的特定需要以及合理利用能源，将一次能源直接或间接加工转换产生的其他种类和形式的人工能源，如由原煤加工转换产出的洗煤、焦炭、煤气等，由原油加工产出的汽油、煤油、柴油、燃料油、液化石油气等，由原煤或石油或天然气转换产出的电力、热力等。在核算能源消费总量过程中，一次能源、二次能源不能重复计算。

——引自国家统计局《单位 GDP 能耗核算方法》

近零能耗建筑

适应气候特征和场地条件，通过被动式建筑设计最大幅度降低建筑供暖、空调、照明需求，通过主动技术措施最大幅度提高能源设备与系统效率，充分利用可再生能源，以最少的能源消耗提供舒适室内环境，且其室内环境参数和能效指标符合本标准规定的建筑，其建筑能耗水平应较国家标准《公共建筑节能设计标准》GB 50189-2015 和行业标准《严寒和寒冷地区居住建筑节能设计标准》JGJ 26-2010、《夏热冬冷地区居住建筑节能设计标准》JGJ 134-2016、《夏热冬暖地区居住建筑节能设计标准》JGJ 75-2012 降低 60% ～ 75% 以上。

——引自《近零能耗建筑技术标准》GB/T 51350-2019

UNDERSTANDING ENERGY CONSUMPTION AND THE CONCEPT OF NEARZERO ENERGY BUILDINGS

Author:Zhou Bin

Energy Consumption

Energy consumption refers to the total amount of energy consumed (tons of standard coal), which means the sum of various types of energy consumed in a fixed period of time by all industries in the economy of a country (or a region). Energy includes primary energy, secondary energy produced through processing and conversion of primary energy, and other secondary energy produced simultaneously.

Primary energy refers to natural energy resources that exist in their natural form without any change or conversion, including raw coal, crude oil, natural gas, hydro energy, nuclear energy, wind energy, solar energy, geothermal energy, ocean energy, biomass energy, etc. Secondary energy refers to artificial energy of other types and forms produced by directly or indirectly processing and converting primary energy to meet specific production processes or life needs or to use energy more rationally. Examples include washed coal, coke, coal gas, etc., produced from the processing and conversion of raw coal; gasoline, kerosene, diesel, fuel oil, liquefied petroleum gas, etc., produced from the processing of crude oil; and electricity, heat, etc., produced from the conversion of raw coal, oil, or natural gas. In calculating total energy consumption of an economy, primary and secondary energy should not be double-counted.

—Sourced from the National Bureau of Statistics "*Methods for Calculating Energy Consumption Intensity per Unit of GDP*"

Near-Zero Energy Buildings

These are buildings that adapt to climatic characteristics and local conditions, in order to significantly reduce the demand for building heating, air conditioning, and lighting through passive design, and significantly improve the efficiency of energy equipment and systems through active technical measures, making full use of renewable energy to create a comfortable indoor environment with minimal energy consumption. The indoor environmental parameters and energy efficiency indicators of these buildings comply with the general applicable standards. The energy consumption of such buildings shall be 60-75% less compared to the national standards regulated in the "Energy-saving Design Standards for Public Buildings" GB 50189-2015, the "Energy-saving Design for Residential Buildings in Severe and Cold Regions" JGJ 26-2010, the "Energy-saving Design Standard for Residential Buildings in Hot Summer and Cold Winter Regions" JGJ 134-2016, and the "Energy-saving Design Standard for Residential Buildings in Hot Summer and Warm Winter Regions" JGJ 75-2012.

—Sourced from the "*Technical Standard for Near-Zero Energy Buildings*"GB/T 51350-2019

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