京津冀及周边农村清洁能源供应模式研究

Clean Energy Supply Model in Beijing-Tianjin-Hebei and surrounding rural area

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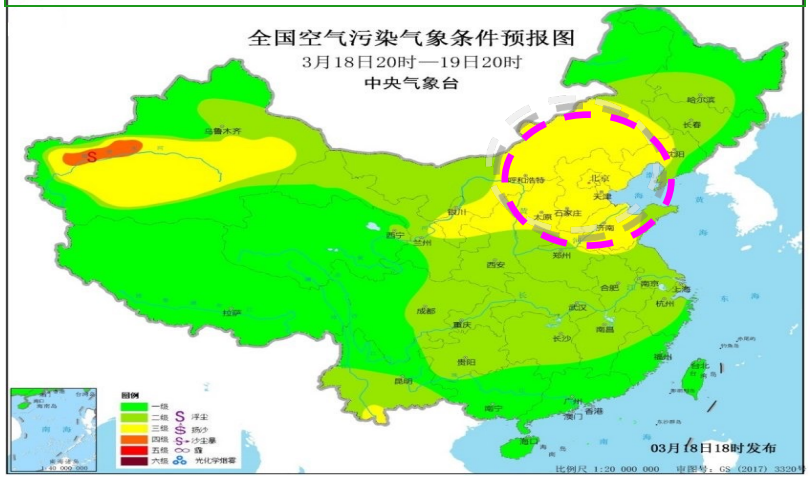
农村能源消费特点 Characteristics of rural energy consumption

	人口规模（万人）	农村人口（万人）	生产总值（亿元）	农村人均可支配收入（元）
北京市	2170.7	230.9	28000.4	24240
天津市	1556.87	268.55	18595.38	20076
河北省	7519.52	3383.03	35964.0	12881
山西省	3702.35	1863.02	14973.5	13432
内蒙古自治区	2504.8	685.63	16103.2	2600
山东省	10005.83	3944.3	72678.2	15117
辽宁省	4368.9	1420.3	23942.0	28000
河南省	9559.13	5171	44988.16	12719

该区域GDP约占全国1/3，土地总面积约占全国10%以上，耕地总面积占全国的25%左右，人口占全国总人口的25%以上，农村人口占比达45%。
The Region's GDP accounts for 1/3 of the country; the total area accounts for 10% of the country; the total population accounts for 25% of the country. Rural population of the region is 45% overall.

京津冀及周边地区是中国重要现代化都市圈之一，也是中国三大经济增长极之一。**主要以北京、天津、河北为中心，包括山西省、内蒙古自治区、山东省、辽宁省及河南省。**
The Beijing-Tianjin-Hebei region and its surrounding area is one of the important modern metropolitan areas in China, as well as one of the three major economic growth region. **The area centered on Beijing, Tianjin and Hubei, and include Inner Mongolia Autonomous Region, Shanxi, Shandong, Liaoning, and Henan Province.**



1.1 农村能源消费总量大

1.1 Large Rural Energy Consumption

京津冀及周边地区农村商品能源占生活能源消费总量的72.29%以上，人均商品能源消费量增至约270千克标煤。河北、河南、山东农村生活能源消费总量相对较大；辽宁、内蒙、山西农村能源消费总量居中，北京和天津农村生活能源消费总量相对较小。Rural commodity energy in Beijing, Tianjin, Hebei and surrounding areas accounts for more than 72.29% of total domestic energy consumption, and per capita commodity energy consumption is about 270 kg of standard coal. The total rural do mestic energy consumption in Hebei, Henan, Shandong province is relatively large; the consumption in Liaoning, Inner Mongolia, Shanxi is at middle; the consumption in Beijing and Tianjin is relatively small.

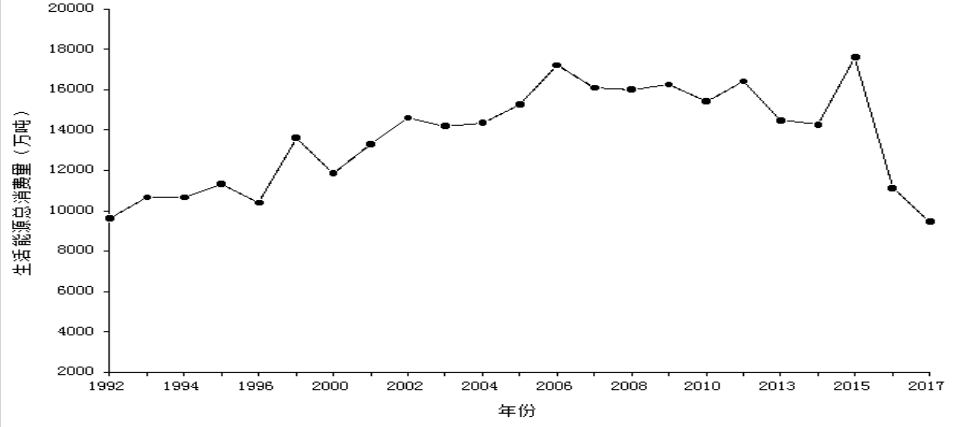


图1-1 京津冀地区及周边农村生活能源消费现状

1.2 农村能源消费结构不合理

1.2 Irrational structure of rural energy consumption

各地区能源消费结构差异较大，煤和电力占据农村生活商品能源消费的主导地位，新能源（太阳能、新型生物质能、水电和地热等）消费量为589万吨标准煤，仅占农村生活用能6.21%，农村能源消费结构亟需优化。The structure of energy consumption varies greatly, Coal and electricity dominating rural living commodity energy consumption. The new energy (solar, biomass, hydropower and geothermal, etc.) consumption is 5.89 million tons of standard coal, accounting for only 6.21% of rural living energy. The rural energy consumption structure needs urgent optimization.

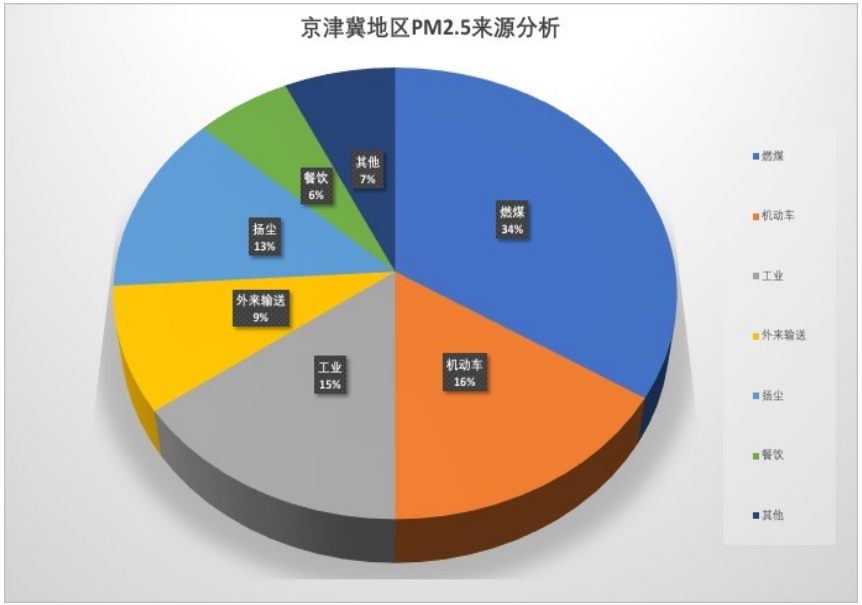
表1-1 京津冀地区及周边农村生活用能结构地区差异

地区	总量	商品能源						非商品能源		可再生能源	
		煤炭	电力	成品油	液化石油气	天然气	煤气	秸秆	薪柴	太阳能	沼气
北京市	147	3	96	31	1	1	0	0		14	1
天津市	141	60	51	9	9	0		4		5	2
河北省	2768	1195	239	167	166	115	1	471	298	86	32
山西省	1346	1114	64	31	5	2	1	52	36	36	4
内蒙	549	168	13	98	21	0	0	215	19	11	3
辽宁省	1064	333	124	24	48			298	200	31	6
山东省	2117	644	640	167	93	91	6	142	131	159	44
河南省	1342	365	446	114	84	6	0	86	84	76	80
总量	9472	3881	1673	642	428	215	9	1269	767	417	172

1.3 农村能源消费环境压力大

1.3 Rural Energy Consumption Leading to High Environmental Pressure

京津冀及周边地区农村能源消费环境压力大，清洁能源需求迫切。京津冀地区单位GDP能耗较高，河北省为单位GDP能耗高于全国33%，分散燃煤高达4000多万吨。The environmental pressure caused by rural energy consumption is severe, the need of clean energy is in urgent. The energy consumption per unit of GDP in the region is relatively high. The energy consumption of Hebei Province is 33% higher than the national average. The consumption of scatter coal for burning reached 40 million tons.



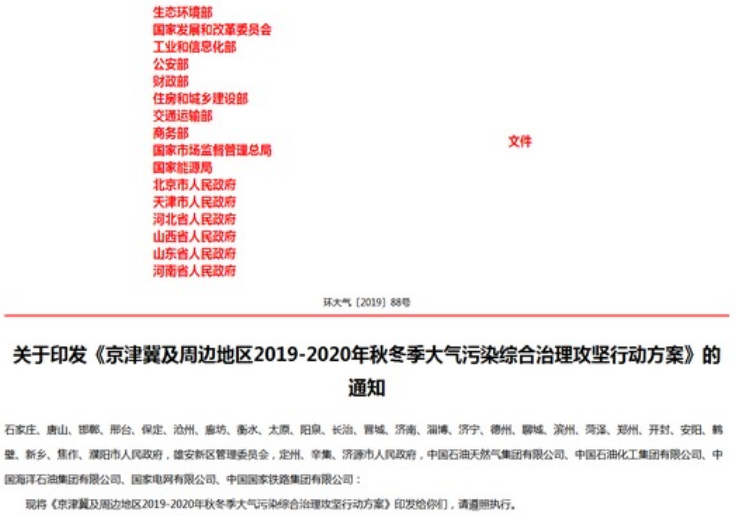
2018年中国、美国的GDP及三大产业增加值对比 由【南生】整理			
GDP及三大产业		中国	美国
GDP，万亿美元		13.6	20.494
第一产业	增加值,亿美元	9782.4	1641.88
	占GDP 比重	7.19%	0.8%
第二产业	增加值,亿美元	55308.88	38151.44
	占GDP 比重	40.65%	18.6%
第三产业	增加值,亿美元	70960.6	165147.47
	占GDP 比重	52.16%	80.6%
由【南生】整理，6.6174：1是去年人民币与美元平均汇率			

1.4 农村清洁能源供给缺口明显

1.4 Rural Clean Energy Supply Gap is Obvious

京津冀及周边地区能源消费总量巨大，环境压力大，对清洁能源利用提出了更高的要求，但农村清洁能源仅占农村生活用能6.21%，清洁能源供给缺口明显。

The total energy consumption in Beijing-Tianjin-Hebei region and surrounding areas is huge, with a high environmental pressure, which puts forward higher requirements for clean energy utilization. However, rural clean energy only accounts for 6.21% of the rural living energy, the clean energy supply gap is obvious.



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河北省人民政府
山西省人民政府
山东省人民政府
河南省人民政府

文件

环大气〔2019〕88号

关于印发《京津冀及周边地区2019-2020年秋冬季大气污染综合治理攻坚行动方案》的通知

石家庄、唐山、邯郸、邢台、保定、沧州、廊坊、衡水、太原、阳泉、长治、晋城、济南、淄博、济宁、德州、聊城、滨州、菏泽、郑州、开封、安阳、鹤壁、新乡、焦作、濮阳市人民政府，雄安新区管理委员会，定州、辛集、济源市人民政府，中国石油天然气集团有限公司、中国石油化工集团有限公司、中国海洋石油集团有限公司、国家电网有限公司、中国国家铁路集团有限公司：

现将《京津冀及周边地区2019-2020年秋冬季大气污染综合治理攻坚行动方案》印发给你们，请遵照执行。

PART TWO

农村清洁能源技术模式分析

Analysis of Rural Clean Energy Technology Models

2.1 煤改电技术模式

2.1 Technical Model of Coal-to-electricity

以煤改电为主的清洁能源供应模式是解决京津冀及其周边地区农村地区分散燃煤直排和煤炭扬尘污染的有效途径。京津冀及周边地区“煤改电”累计完成近6000个村、近200万户改造，供暖面积超1亿㎡。目前主要有三种模式：

The clean energy supply model mainly based on coal-to-electricity is an effective way to solve the direct emission of coal and coal dust pollution in the rural areas of Beijing-Tianjin-Hebei region and its surrounding areas. Beijing-Tianjin-Hebei region and surrounding areas has completed “coal-to-electricity” transformation for nearly 6,000 villages, nearly 2 million households, with heating area of more than 100 million square meters. At present, there are three main models:

一是直热式：包括低温发热电缆、电热膜、碳晶电热板和直热电锅炉等；

1. Direct Heating Type: including low temperature heating cable, electric heating film, carbon crystal electric heating plate, and direct heating electric boiler ;

二是蓄热式：包括固体蓄热式电暖器和蓄热电锅炉等；

2. Regenerative Type: including solid regenerative electric heater and regenerative electric boiler ;

三是热泵：包括空气源、地源和水源热泵等。

3. Heat Pump: including air source, ground source, and water source heat pump.

近年来，热泵技术在煤改电技术应用过程中，得到了普遍的推广，尤其是空气源热泵技术模式，更是得到广泛认可。以北京市为例，2016年“煤改电”工程中，使用地源热泵的农户2139户，使用蓄热式电暖器农户供给4.43万户，而使用空气源热泵的农户共15.1万户，占总改电户数的76.28%。目前，北京市使用空气源热泵技术模式的农户累计已达70余万户。

In recent years, heat pump technology has been widely promoted in the process of coal-to-electricity technology application, especially the air source heat pump technology model, which has been widely recognized. In Beijing, for example, in the “coal-to-electricity” project in 2016, there are 2,139 households using ground source heat pumps, 44,300 households using storage heaters, and 151,000 households using air source heat pumps, accounting for 76.28% of the total number of households converted to electricity. At present, the cumulative number of households using air source heat pump technology mode in Beijing has reached more than 700,000.

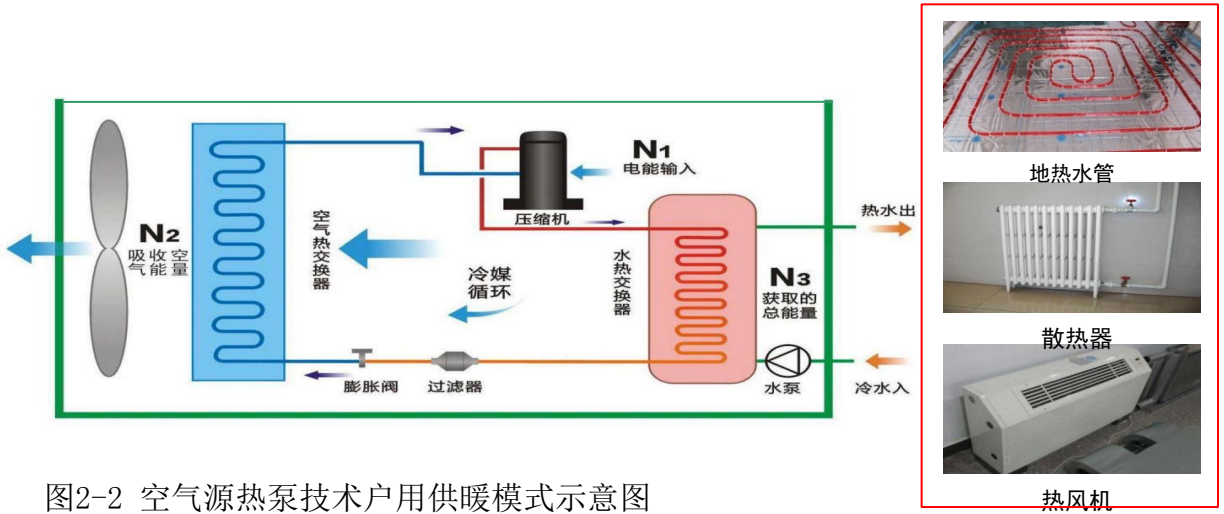


图2-2 空气源热泵技术户用供暖模式示意图

Figure 2-2 Schematic Diagram of Household Heating Model with Air Source Heat Pump Technology

2.2 煤改气技术模式

2.2 Technical Model of Coal-to-gas

目前，京津冀及其周边地区已完成“煤改气”改造347万户。其中，仅北京市完成“煤改气”村庄约457个，占煤改清洁能源村庄总数的29. 2%。

At present, Beijing-Tianjin-Hebei region and its surrounding areas have completed the “coal-to-gas” transformation of 3.47 million households. Among them, only Beijing completed “coal-to-gas” for about 457 villages, accounting for 29.2% of the total number of coal-to-clean energy villages.

技术特点：

Technical Features :

- 效率高、能耗低，方便、干净的特点；
  High efficiency, low energy consumption, convenience, and cleanliness.
- 技术设备相对成熟、操作简单、故障率低；
  Relatively mature technical equipment, simple operation, and low failure rate.
- 兼顾了炊事和取暖用能，解决了“两把火”问题，具有现实的推广意义；
  It solves the problem of “two fires” by taking into account both cooking and heating energy, which has practical significance for promotion.
- 对能源基础设施建设要求较高。
  High demand for development of energy infrastructure.

1）**管道气供气**。主要设备为中低压调压箱。

Pipeline gas supply. The main equipment is the medium and low pressure regulator.

2）**LNG供气**。主要设备包括低温储罐或瓶组、空温\水浴式气化器、计量调压撬等，还包括LNG槽车或瓶组储运车辆等。LNG供应站可分为LNG气化站和LNG瓶组气化站，前者用于供气规模较大的农村，后者常用供气规模较小的农村或独立用户。

LNG supply. The main equipment includes low-temperature storage tanks or bottle groups, air temperature / water bath vaporizers, metering pressure regulating lever, etc., and also includes LNG tankers or bottle group storage transportation vehicles. LNG supply stations can be divided into LNG gasification stations and LNG bottle gasification stations. The former is used in rural areas with large gas supply scale, and the latter is commonly used in rural areas or independent users with small gas supply scale.

3）**CNG供气**。系统主要由CNG运输槽车和农村输配管网组成。

CNG supply. The system is mainly composed of CNG tanker and rural distribution pipeline network.

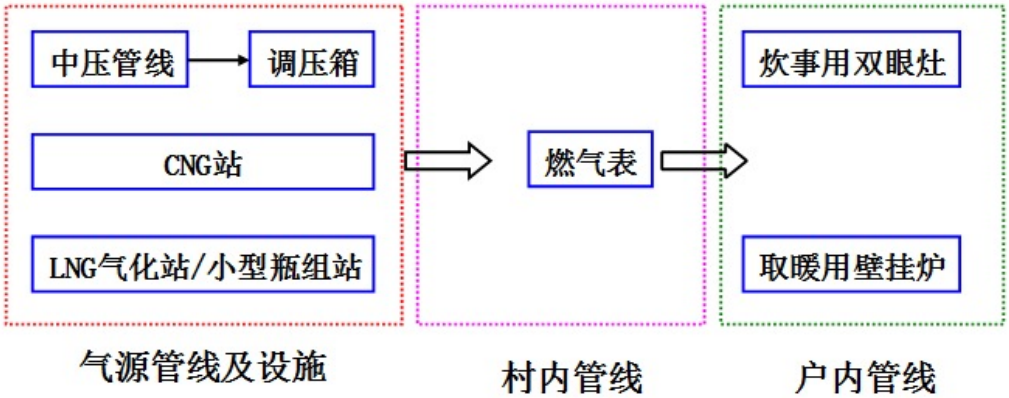


图2-3 煤改气分布式能源利用模式图

Figure 2-3 Coal-to-gas Distributed Energy Utilization Model

近年来，北京市“煤改气”工程中，管道气方式占绝大多数，约347个村，占总村数目的78.7%；户数方面，采用管道气方式约 14.5户，占总户数的82%。而CNG和LNG主要要用于大兴、平谷和延庆等外部距天然气管道较远的地区。

In recent years, the majority of “coal-to-gas” projects in Beijing have been piped gas, with about 347 villages, accounting for 78.7% of the total number of villages; the number of households is about 14.5, accounting for 82% of the total number of households. CNG and LNG are mainly used in Daxing, Pinggu and Yanqing district, which are far away from the gas pipeline.

表2-4 北京市“煤改气”工程投资与价格成本分析

Table 2-4 Investment and Price Cost Analysis of “Coal to Gas” Project of Beijing

	工程投入（万元/户）Project investment (10 thousand/household)	投入影响因素影响 Influencing Factors	年单位面积耗气量 Annual gas consumption per unit area	燃气销售价格（元/m^3）Gas Sales Prices (yuan/m^3)
管道气供气 Pipeline gas supply	1.16	气源管线的设施基础情况或管线铺设的远近 The condition of the facility foundation of the gas source pipeline or the distance of the pipeline laying	9.9-10.8 m^3/m^2	2.5
LNG供气 LNG Supply	1.64	采用气化站方式，工程会随着供气规模的增加 Utilizing the gasification station method, the scale of the project will increase with gas supply		3.6-4
CNG供气 GNG Supply	0.8	气体压缩后槽车转运，工程投入相对较小 Utilizing tank car to transport compressed gas, project investment would be relatively small		3.16

2.3 太阳能热利用技术模式

2.3 Solar Thermal Utilization Technology Model

京津冀及周边部分农村地区太阳能资源较为丰富，内蒙古、河北北部、辽宁北部等地区，日照时数在2600-3400h之间，属于太阳能资源区划的二、三类地区，具有较好的开发利用价值。

Beijing-Tianjin-Hebei region and parts of the surrounding rural areas are richer in solar energy resources, Inner Mongolia, northern Hebei, northern Liaoning province and other areas, sunshine durations between 2600 to 3400 hours, belonging to the solar energy resources second and third categories of regions, with development and utilization value.

由于太阳能资源禀赋特点和区域经济发展不平衡、城镇化进程差异加大、农户住宅较分散等原因，我国北方农村地区逐步形成了以太阳能热利用为主，同时辅以生物质能、地热能等可再生能源，构建多能互补、多元利用的“太阳能+”综合利用模式。

Due to the characteristics of solar energy resource endowment, regional economic development imbalance, increasing differences in urbanization, farm residences are scattered, and other reasons, the rural areas in northern China have gradually formed a comprehensive utilization model of “solar energy +” based on solar thermal utilization, supplemented by biomass energy, geothermal energy, and other renewable energy.

太阳能+电热装置采暖模式 Solar + Electrothermal Device Heating Model

在电力供应基础较好地区，可推广太阳能+蓄热电暖器/空器源热泵/电热膜采暖模式。

In areas with sufficient electricity supply, solar energy + storage electric heater / air source heat pump / electric heating film heating model can be promoted.

➢实现了日间太阳能与夜间谷电的优势互补，可满足极端情况，启动频率极低，运行费用低。

➢The advantages of daytime solar energy and night valley electricity are complementary, which can meet needs under extreme conditions, the start-up frequency and the operating cost is low.

➢弥补日间阴天、雨雪等无日照天气太阳能热水系统无法启动的短板。

➢Covers the shortage of solar water heating system that operates insufficiently in cloudy, rain, snow, and other sunless days.

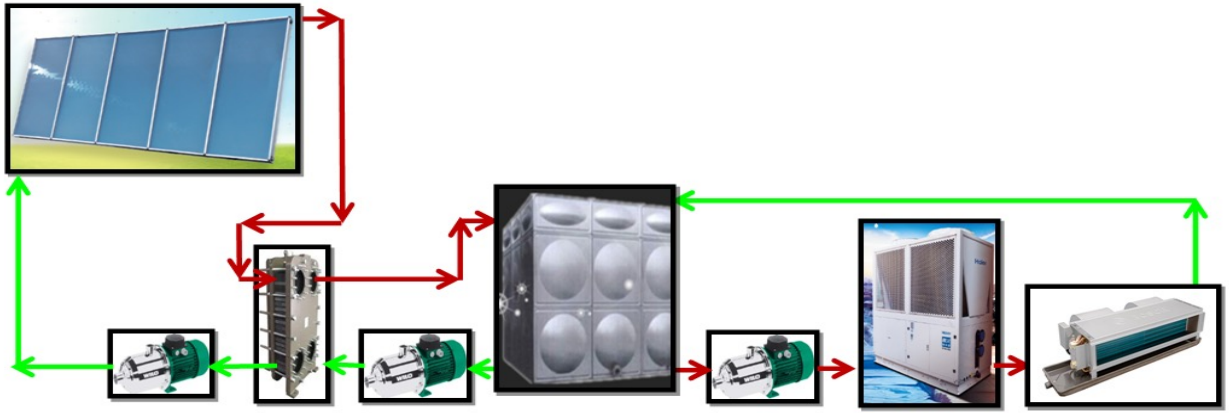


图2-4 太阳能+电热装置采暖模式流程图

Figure 2-4 Flow chart of solar + Electrothermal Device Heating Model

太阳能+生物质炉采暖模式

Solar + Biomass Stove Heating Model

在生物质资源较丰富地区，可推广形成太阳能+生物质炉采暖模式，生光互补采暖系统可实现智能控制，能够最大程度的环保、节能，全天候、全自动、低能耗运行。

In areas rich in biomass resources, the solar energy + biomass stove heating model can be promoted and formed. The bio-solar complementary heating system can achieve intelligent control, which can maximize environmental protection, energy saving, 24-hour, fully automatic, and low energy consumption operation.

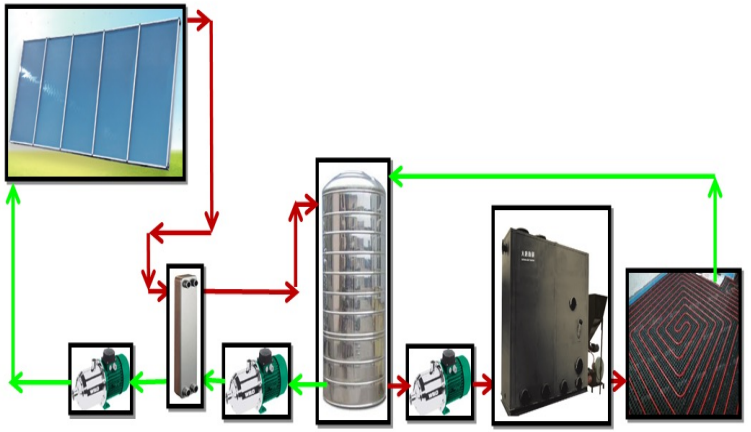


图2-5 太阳能+生物质炉采暖模式流程图

Fig 2-5 Solar energy + biomass stove heating model flow chart

太阳能+燃气锅炉采暖模式

Solar + Gas Boiler Heating Model

在天然气供应较充足地区，利用碟式太阳能聚光跟踪集热技术，高效聚集太阳能量，通过导热油将太阳能高温热量置换成蒸汽从而进行供暖。该模式环境及社会效益高，太阳能保证率可达60%以上。

In areas with sufficient natural gas supply, the dish solar concentrating and tracking heat collector technology is used to efficiently gather solar energy and replace the solar high temperature heat into steam through heat conduction oil for heating. This model has high environmental and social benefits, and the solar fraction can reach more than 60%.

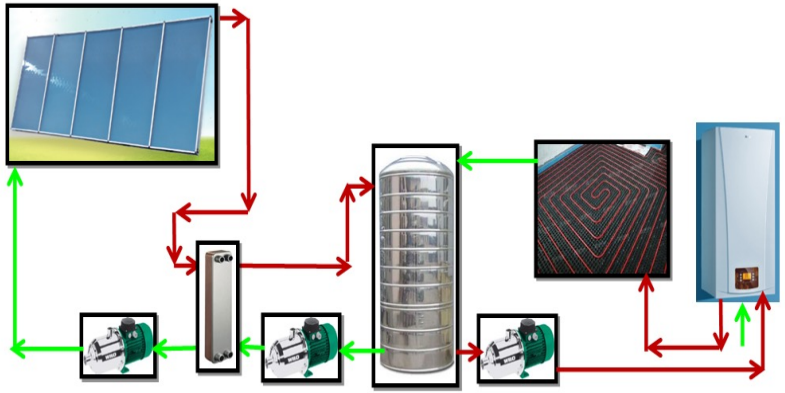


图2-6 太阳能+燃气锅炉采暖模式流程图

Figure 2-6 Solar energy+ gas boiler heating model flow chart

2010年以来，河北省在1000余户农宅开展了“太阳能+”多能互补采暖模式示范。系统设计保证太阳能贡献率为70%，其余由辅助能源补充供暖，包括电锅炉、生物质成型燃料、燃气和空气源热泵等多种，每百平方米建筑配集热器30平方米以上，室内温度可达16-22℃。

Since 2010, Hebei province has carried out a demonstration of the “solar +” multi-energy complementary heating model in more than 1,000 households. The system is designed to ensure that solar energy contributes 70% for heating, and the rest is supplemented by ancillary energy sources, including electric boilers, biomass briquettes, gas and air-source heat pumps, etc. Every 100 square meters of building is equipped with more than 30 square meters of heat collectors, and the indoor temperature can reach 16 to 22°C.

表2-6 河北省太阳能+多能互补取暖运行经济性对比

Table 2-6 Economic Comparison of Solar Energy + Multi-energy Complementary Heating in Hebei Province

模式 Model	投资额 Investment	单位取暖费用（元/㎡） Unit Heating Cost (yuan/m²)	5年总费（万元） 5-Year Total Cost (10 thousand yuan)	单一辅助能源5年费用 5-year Cost of Single Ancillary Energy
太阳能+生物质能 Solar Energy + Biomass Energy	4.3	9~13	4.85	/
太阳能+燃气 Solar Energy + Combustion Gas	4.6	10~12	5.1	5.9
太阳能+热泵 Solar Energy + Heat Pump	6.5	10~12	7.05	6.3
太阳能+电能 Solar Energy + Electrical Energy	4.3	20~29	5.5	8.5

2.4 生物质气化集中供能技术模式

2.4 Biomass gasification centralized energy supply technology model

- 生物质气化不仅解决秸秆等废弃物污染，而且有利于增加燃气等高品位能源有效供给，变废为宝，化害为利；
- Biomass gasification not only solves the problem of waste disposal of straw and other wastes, but also helps to increase the effective supply of high-grade energy such as gas, turning waste into treasure and cons into pros.
- 生物质气化抑制NO_X产生，生产的可燃气清洁，无污染，农户使用方便，效率高；
- Biomass gasification inhibits production of NO_X, produces clean, non-polluting, convenient, and efficient gas for farmers.
- 生物质资源丰富，利用潜力大，符合我国“多用气，少用煤”的能源发展策略，一般1t秸秆可产约1000-2000m^3可燃气；
- Biomass resources are abundant, with great potential for utilization, in line with China's energy development strategy of “using more gas and less coal”. Usually 1 ton of straw can produce about 1000 to 2000 cubic meters of gas.
- 终端用能方式灵活多样，可以供热、供气、发电，也可生产合成液体燃料和制氢等终端能源产品；
- The energy usage patterns of terminal are flexible and diversity, which can supply heat, gas, and electricity, and can also produce terminal energy products such as synthetic liquid fuels and hydrogen production.
- 可燃气热值高、燃烧温度高，解决了生物质直燃效率低问题。
- High calorific value and high combustion temperature of combustible gas solve the problem of low direct combustion efficiency of biomass.

与传统的散煤采暖方式相比，生物质气化集中供气可有效解决城市燃气管道覆盖不到的农村地区供气问题，农户使用方便，加温效果好，既能解决气源缺乏地区冬季供暖，也可为农户提供炊事和洗浴用能等。

Compared with the traditional coal heating method, biomass gasification centralized gas supply can effectively solve the problem of gas supply in rural areas not covered by city gas pipelines, which is convenient for farmers to use and has good heating effect. It not only solves the problem for areas lack of gas source for heating in winter, but also provide cooking and bathing energy for farmers.

- 工程投资高，投资回收长。High investment cost and long investment return period.
- 长期以来，该技术存在焦油含量高，处理难，易造成二次污染等问题。For a long time, this technology has problems such as high tar content, difficult to disposal, and easy to cause secondary pollution.
- 单位供气采暖成本缺乏一定的价格优势。Unit heating cost lacks of price advantage

河北肥乡区秸秆热解气化集中供暖工程，采用外加热连续式热解炭气联产集中供暖模式，热解炉和燃气锅炉采用一体化设计，热解产生的高温混合热解气直接进去燃气锅炉燃烧集中供暖，为肥乡区东、西贾北堡村共计396户提供冬季清洁取暖。

Straw pyrolysis and gasification centralized heating project of Feixiang District, Hebei province, using external heating continuous pyrolysis charcoal gas co-production centralized heating model, pyrolysis furnace and gas boiler are integrated designed, pyrolysis generated high-temperature mixed pyrolysis gas directly into the gas boiler combustion centralized heating for a total of 396 households in East and West Jiabeipu Village, Feixiang District to provide clean heating in winter.

➢农户按照实际取暖面积缴纳取暖费，每个取暖季每平方米18元，比城市取暖费低，比农户自己烧煤取暖效果好，且节省费用。

➢Farmers pay for the heating fees in accordance with the actual heating area, 18 yuan per square meter every heating period, which is lower than urban heating fees, it also has a better heating effect than their own coal-burning heating and cost savings.

➢项目供暖面积达39600㎡，每天需要生物质燃料12-16吨。每户年可以减少散煤使用量2. 5-3吨，总减少散煤使用量990-1188吨，减少二氧化碳排放2653-3183吨。

➢The heating area of the project reaches 39,600 square meters, requiring 12 to16 tons of biomass fuel per day. Each household can reduce the use of scattered coal by 2.5 to 3 tons per year, the total reduction of scattered coal amount is 990 to1188 tons, and the reduction of carbon dioxide emission is 2653 to 3183 tons.

2.5 秸秆打捆直燃集中供暖技术模式

2.5 Bundled Straw Direct Combustion Centralized Heating Technology Model

◆原料适应性：炉型适合各种打包规格；对水分、杂质要求不严格

Raw Material Adaptability: Stove type suitable for various packaging specifications; the requirements for moisture and impurities are not strict

◆成本低廉性：田间到炉头，随取随用，减少中间环节和防范消防风险

Low Cost: From field to stove, take as you go, reduce intermediate links and prevent fire risks

◆技术兼容性：适于乡镇政府、学校、浴池、养殖场和住宅分散或集中取暖

Technical Compatibility: Suitable for township governments, schools, plunge baths, farms, and residential decentralized or centralized heating

◆生态耦合性：收获期和供暖期季节同步，秸秆过炉还田，实现养分循环。

Ecological Coupling: Harvest and heating season synchronization, straw returning to the field after processed by the stove, in order to achieve nutrient cycling.

由供热企业或合作社负责秸秆原料收储，农户不需要承担秸秆收集离田所需人工及机械工作费用。供暖企业协调供热管理运营，农户及相关取暖部门，采用供热服务购买方式，保障企业经济效益。最终实现 “秸秆收储—自动上料—秸秆进料直燃—小区供热—灰渣排出—有机肥制备—生物质灰基肥还田”整套工艺流程。

The heating enterprise or cooperative is responsible for the collection and storage of straw raw material, and farmers do not need to bear the cost of manual and mechanical work for straw collection. The heating enterprise coordinates the heating management and operation, while farmers and related heating departments purchase heating service to ensure economic efficiency of the enterprise. Finally, the whole process of “straw collection and storage- automatic feeding- straw feed direct combustion- district heating- ash discharge- organic fertilizer production- biomass ash based fertilizer returning” was realized.

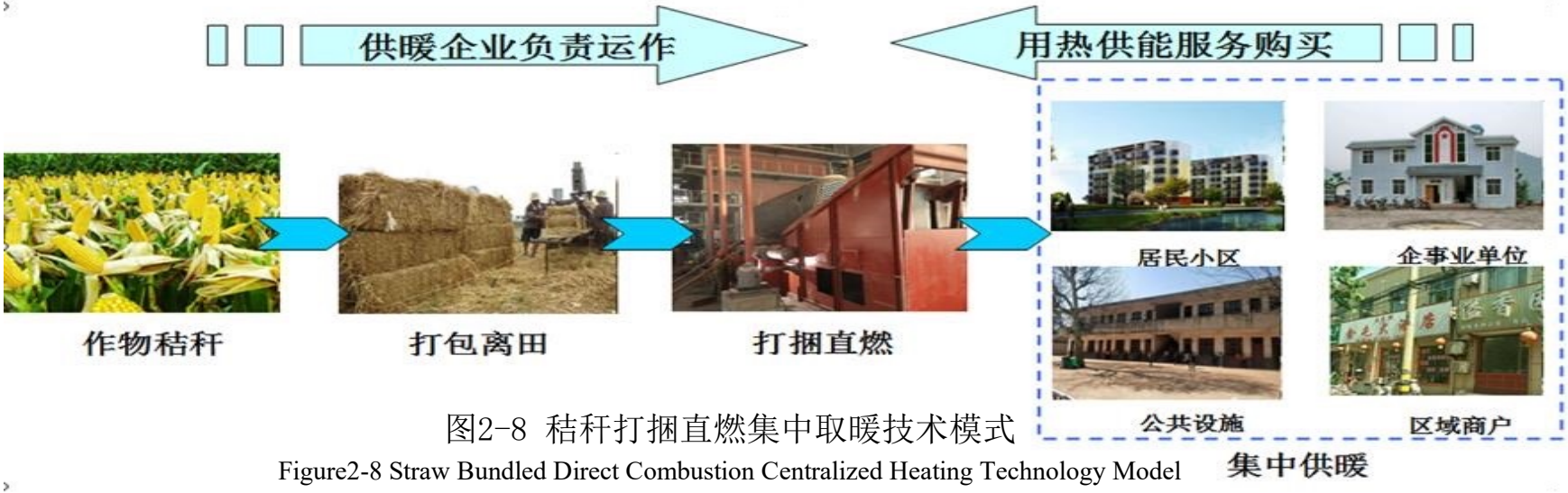


图2-8 秸秆打捆直燃集中取暖技术模式

Figure2-8 Straw Bundled Direct Combustion Centralized Heating Technology Model

辽宁省铁岭市铁岭县新台子镇，原有燃煤锅炉燃烧效率低、燃煤费用高，电机噪音影响小区生活，排烟污染环境。通过老式燃煤供暖锅炉改造，采用10t打捆直燃锅炉供热，改造费用137万元，集中供暖面积7. 3万平米，年消耗生物质秸秆4000t。

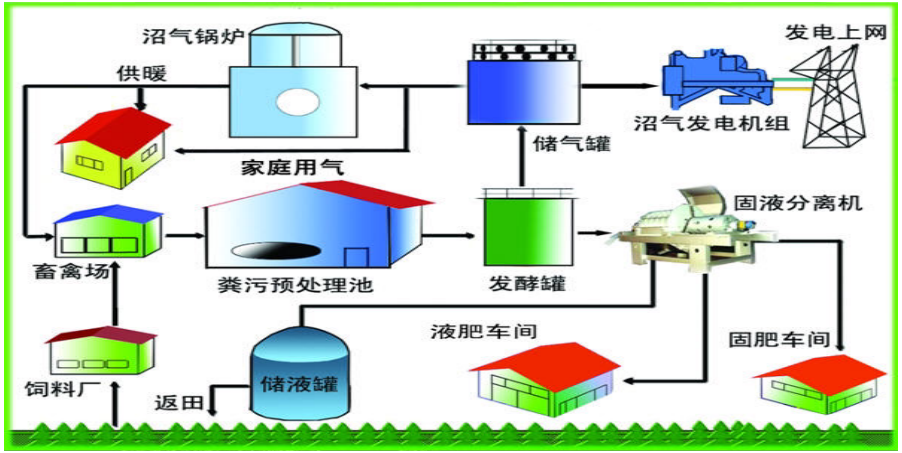
The original coal-fired boilers of Xintaizi Town, Tieling County, Tieling, Liaoning Province have low combustion efficiency, high costs, electrical noise affects daily life of the community, and smoke emission pollutes the environment. Through the transformation of the old type coal-fired heating boiler, 10 tons bundled direct combustion boilers are used for heating, with a transformation cost of 1.37 million yuan, a centralized heating area of 73,000 square meters, and an annual consumption of 4,000 tons of biomass straw.

2.6 农村沼气技术模式 Rural Biogas Technology Model

利用厌氧消化技术产沼气是对农业废弃物处理的有效途径之一，对经济的可持续发展和农村能源供给具有重要的意义。

Biogas production by anaerobic digestion technology is one of the effective ways to treat agricultural waste, which is of great importance for sustainable economic development and rural energy supply.

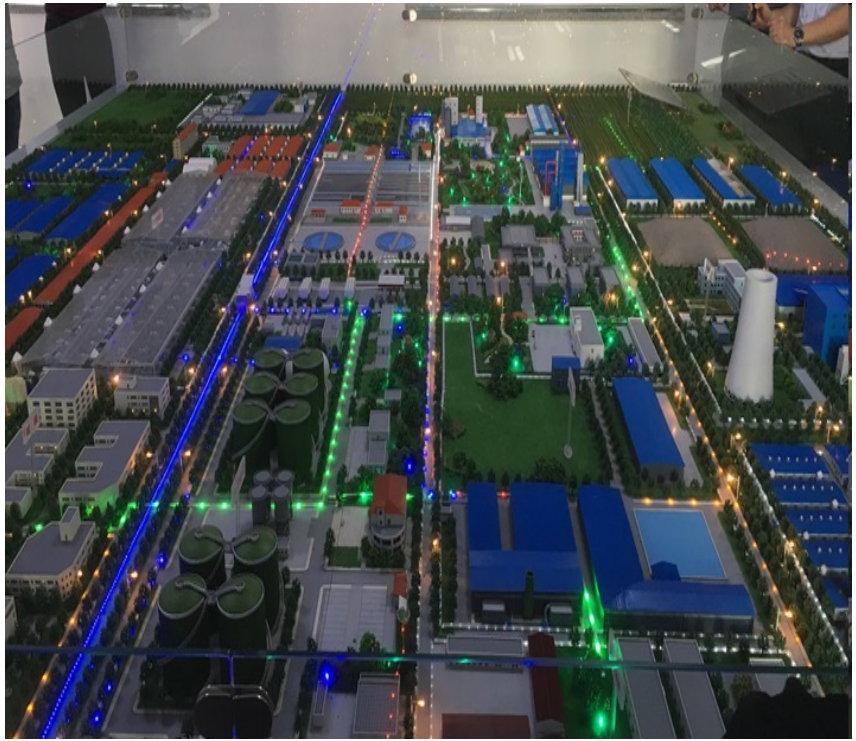
1. 提供清洁能源
   Provide Clean Energy
2. 改善农村的卫生条件
   Improve Rural Sanitary Conditions
3. 可实现农业废弃物的多途径利用
   Achieve Multiapproach Utilization of Agricultural Waste
4. 可促进养殖业和农业的发展
   Promote Development of Breeding Industry and Agricultural



1m³沼气≈1kg原煤≈0.7kg标煤

1 m³ Biogas ≈ 1 kg Raw Coal ≈0.7 kg Standard Coal

河北安平县京安集团建成“热、电、气、肥”联产循环利用模式，**2MW沼气发电工程。**年可处理畜禽粪污30万t，年产沼气657万m^3，可解决年存栏10万头猪场粪污问题；**生物天然气工程。**年可消纳玉米秸秆7万t，处理畜禽粪污10万t，年可生产沼气1152万m^3；**生物质热电联产项目。**年耗秸秆约28万t，可发电2.4亿度，供热55万吉焦。



Jing'an Group, Anping County, Hebei Province has built “heat, electricity, gas, fertilizer” co-production and recycling model, 2MW biogas power generation project. It can disposal 300,000 tons of livestock manure per year and produce 6.57 million cubic meters of biogas per year, which can solve the manure problem of 100,000 pig farms; biogas project. It can consume 70,000 tons of corn straw per year, disposal 100,000 tons of livestock manure, and produce 11.52 million cubic meters of biogas per year; biomass cogeneration project. The annual consumption of straw is about 280,000 tons, which can generate 240 million degrees of electricity and 550,000 GJ of heat.

2.7 农村户用清洁炉具技术模式

2.7 Rural Household Cleaning Stove Technology Model

与传统炉具相比，农村户用清洁炉具改变了内部结构，对炉具的燃烧室、进风口、炉箅等内部结构进行了合理改造，增加了保温材料和余热利用装置等，热效率可以高达70%以上。

Compared with traditional stoves, the internal structure of clean stoves in rural households has been changed, the combustion chamber of the stove, air intake, grates and other internal structure of a reasonable transformation, increased insulation materials and waste heat utilization equipment, etc., the thermal efficiency can be up to 70% or more.

主要特点Main features：

- 燃料适应性广，可适合生物质、煤炭等不同燃料需求；
- Wide fuel adaptability could be suitable for different fuel requirements such as biomass and coal.
- 燃烧充分，热效率高，污染物排放低，尤其是利用生物质燃料，二氧化硫排放较少，实现二氧化碳零排放；
- Full combustion, high thermal efficiency, low pollutant emissions, especially with biomass fuels, sulfur dioxide emissions are less, and achieve zero emissions of carbon dioxide .
- 符合农村用能习惯，能够同时满足农户取暖与炊事需求。
- In line with the rural habits of power using, and is able to meet the needs of heating and cooking for farmers.

表2-9 农村户用清洁采暖炉分类 Classification of Rural Household Clean Heating Stoves

Ⅰ类 Category I	煤 Coal	A．煤球采暖炉 Coalball Heating Stove
		B．蜂窝煤采暖炉 Honeycomb Coal Heating Stove
		C．兰炭采暖炉 Semi-coke Heating Stove
		D．烟煤采暖炉 Bituminous Coal Heating Stove
Ⅱ类 Category II	生物质 Biomass	A．生物质压块采暖炉 Biomass Briquette Heating Stove
		B．生物质颗粒采暖炉 Biomass Pellet Heating Stove

生物质成型燃料+专用炉具

Biomass Briquette+ Special Stove

洁净型煤+环保炉具

Clean Briquette+ Environmentally Friendly Stove

兰炭+环保炉具

Semi-coke+ Environmentally Friendly Stove

蜂窝煤+环保炉具

Honeycomb Coal+ Environmentally Friendly Stove

2.8 农村建筑节能技术模式

2.8 Rural Building Energy Saving Technology Model

农村建筑节能主要包括围护结构保温隔热和建筑布局节能两个方面内容。

Building energy conservation in rural areas mainly includes two aspects: thermal insulation of building envelope and energy conservation of building layout.

- 围护结构保温隔热–外墙、门窗、屋面、地面
- Building envelope thermal insulation- exterior wall, doors and windows, roof, and ground
- 建筑布局节能–结构形式、建筑材料及设备
- Building layout energy saving- structure form, building materials, and equipment

目前，中国建筑能源消耗约7.5亿t标煤，农村住宅耗能碳排放量约13亿t，建筑用能一直维持在社会总能耗的20%-25%。北京、河北、辽宁等地区近年来已逐步开展建筑节能技术的推广，建筑热损失可降至15%以下，建筑能耗可降至53kWh/m²。

At present, building energy consumption in China is about 750 million tons of standard coal, and carbon emissions of rural residential energy consumption are about 1.3 billion tons. Building energy consumption has been maintained at 20%-25% of social total energy consumption. Beijing, Hebei, Liaoning province and other regions have gradually carried out the promotion of building energy-saving technologies in recent years, and the heat loss of buildings can be reduced to less than 15%, and the energy consumption of buildings can be reduced to 53kWh per square meter.

01

新型保温建筑节能技术模式

New Insulation Building Energy Saving Technology Model

02

一体化墙体结构保温技术模式

Thermal Insulation Technology Model of Integrated Wall Structure

03

被动式太阳能集热蓄热墙技术模式

Technical Model of Passive Solar Energy Collector Wall

04

建筑节能保温措施技术

Building Thermal Insulation Measure Technology

我国北方地区建筑冬季采暖平均需热量为0.33GJ/(㎡.a)，以北京、天津、河北部分地区为例，按照50%节能标准的建筑，室内平均升高1℃需热量将增加5-6.5%。我国北方地区现有约32万个村镇，若按50%住宅进行建筑节能技术推广应用，每年可节省燃煤5000余万t，减排二氧化碳超1亿t，可占全国建筑用能碳排放总量的10%左右。

The average heat demand for winter heating of buildings in northern areas of China is 0.33GJ/(㎡.a), and taking Beijing, Tianjin and parts of Hebei province for example, heat requirements will increase by 5 - 6.5 % for an average of 1 ℃ increase in indoor buildings practice 50% energy-saving standard. There are about 320,000 villages and towns in the northern region of China, if the building energy-saving technology is promoted and applied to 50% of the residences, it can save more than 50 million tons of coal and reduce more than 100 million tons of carbon dioxide every year, which accounts for about 10% of the total carbon emission of building energy use through the country.

表2-12 建筑围护与门窗质量传热系数对比

Table 2-12 Comparison of heat transfer coefficient between building envelope and doors and windows

建筑类型 Building Type	传热系数 Heat Transfer Coefficient W/（㎡.K）	门窗结构 Door and Window Structure	换气次数（次/h） Ventilation Frequency (times/h)
传统砖混结构 Traditional Masonry Structure	1-1.5	外窗质量不高，房间密闭性不好 Low quality external window, tightness of the room is not good	1-1.5
100mm混凝土板和单层钢窗 100mm Concrete Slab and Monolayer Steel Sash	2	建筑节能新型门窗 New doors and windows of building energy efficiency	0.5以下 Under 0.5
现代城镇住宅 Modern Urban Residence	0.7-1.2		
新型建筑节能技术 New Building Energy Saving Technology	0.4		

北京市房山区二合庄村共198户，住宅多为砖混结构，围护结构热工性能较差，墙体平均厚度约37cm，门窗多以单层玻璃木床为主，改造完成后，墙体和屋顶传热系数分别下降了69%和37%，门窗换气次数降低了50%左右，为0.5次/h。采暖季平均室温提升4-7℃，燃煤消耗降低了27-44%，建筑综合节能效率达到55%-70%，节能效果显著。

In Erhezhuang Village, Fangshan District, Beijing, there are 198 households, most of which are of brick masonry structure, with poor thermal performance of the building envelope, average wall thickness of about 37cm, and doors and windows are mostly single glass wooden windows; after the completion of the renovation, the heat transfer coefficient of the wall and roof decreased by 69% and 37% respectively, and ventilation frequency of the windows and doors decreased by about 50% to 0.5 times/h. The average room temperature in the heating period increased by 4-7℃, coal consumption decreased by 27-44%, and the comprehensive energy-saving efficiency of the building reaches 55%-70%, with remarkable energy-saving effect.

PART Three

发展建议

Suggestions

3.1 加大政策扶持

3.1 Enhance Policy Support

在《可再生能源法》、《可再生能源中长期发展规划》框架下，推动和引导国家建立京津冀及周边地区利用可再生能源的政策机制，制定出台具有可操作性的细则和实施办法，逐步完善农村清洁能源开发利用的政策法规体系。

Under the framework of the *Renewable Energy Law* and the *Mid- and Long-term Development Plan for Renewable Energy,* promote and guide the country to establish a policy mechanism for the utilization of renewable energy in Beijing-Tianjin-Hebei region and the surrounding areas, formulate and introduce regulations and implementation methods with operability, and gradually improve the policy and regulatory system for the development and utilization of clean energy in rural areas.

3.2 拓宽融资渠道

3.2 Expand Financing Channels

充分利用政府引导资金，加大对农村清洁能源开发利用。以亚行等国际金融组织为重要参与方，积极建立并推动京津冀及周边地区可再生能源产业发展与乡村振兴的绿色金融模式，为产业融资、市场化、生态宜居提供系统的金融支撑。

Make full use of government guiding funds to increase the development and utilization of clean energy in rural areas. With ADB and other international financial organizations as key participants, actively establish and promote the green financial model for the development of renewable energy industry and rural revitalization in Beijing-Tianjin-Hebei region and surrounding areas, and provide systematic financial support for industrial financing, marketization and eco-friendly livability.

3.3 推进农村清洁能源基础设施改造

3.3 Promoting Rural Clean Energy Infrastructure Transformation

针对京津冀及其周边地区能源供应发展需求，充分考虑区域资源禀赋，经济发展特点与能源供应需求，以能源清洁高效利用为主导，因地制宜建设农村沼气入户管网、太阳能热利用设施、空气源热泵、生物质直燃及生物质气化设施、生物质能炉具等清洁能源基础设施装备，对农村清洁能源设施进行升级换代。

In accordance with the development needs of energy supply in the Beijing-Tianjin-Hebei region and surrounding areas, fully consider the regional resource endowment, economic development characteristics and energy supply demand, take the clean and efficient use of energy as the leading, based on the clean and efficient utilization of energy, the rural biogas household pipe network, solar thermal utilization facilities, air source heat pump, biomass direct combustion and biomass gasification facilities, biomass stoves and other clean energy infrastructure equipment are constructed according to local conditions, and upgrade and replace clean energy facilities in rural areas.

3.4 加快生物质能开发利用

3.4 Accelerating the Development and Utilization of Biomass Energy

在京津冀及周边地区，结合燃煤锅炉改造和散煤治理工作，着力推广对住宅小区、公共服务设施、企事业单位等设施的秸秆生物质直燃供暖技术；在居住相对集中地区，以生物质气化集中供气为纽带，以自然村镇为单元设置集中供气系统，实现气、电、热、肥等生物质多用途利用；结合炉具升级换代，积极发展生物质固化，生产生物质成型燃料。

In Beijing-Tianjin-Hebei region and surrounding areas, combined with the renovation of coal-fired boilers and the governance work of scattered coal, focusing on the promotion of straw biomass direct combustion heating technology of residential districts, public service facilities, enterprises and institutions, and other facilities; in relatively concentrated areas of residence, set centralized gas supply system to achieve gas, electricity, heat, fertilizer and other biomass multi-function utilization using biomass gasification centralized gas supply as a link and villages and towns as units; with the upgrading of stoves, actively develop biomass solidification and the production of biomass briquettes.

3.5 实施农村可再生能源替代

3.5 Implementation of Rural Renewable Energy Alternatives

在环京津冀及周边的村庄，在具备天然气管网接气条件的村，采用管网供气取暖的方式，在天然气管网不能覆盖、经济条件较好的村庄，大力推广蓄热式电暖气、空气源热泵、碳纤维等煤改电清洁取暖方式。因地制宜发展生物质能、太阳能等清洁能源供暖。

In villages around Beijing-Tianjin-Hebei region, in villages with natural gas pipeline network connection conditions, supply heating with pipeline network; as for villages that can not be covered by the natural gas pipeline network and with a fine economic conditions, vigorously promoting thermal storage electric heating, air source heat pump, carbon fiber and other coal-to-electricity clean heating methods. Developing biomass, solar energy, and other clean energy heating according to local conditions.

3.6 建设农村低碳村镇

3.6 Establish Low-carbon Villages and Towns in Rural Area

在双碳战略背景下，结合京津冀可再生能源资源特点、社区用能特点和资源产业发展方向，利用节能、可再生能源产业开发、分布式能源体系市场化的综合措施，建设农村低碳村镇，积极发展太阳房、太阳能路灯、太阳能热水器等，大力推广蓄热式电暖气、空气源热泵等清洁供暖，合理开发利用生物质能资源，推广农村节能建筑，推进农村地区碳达峰碳中和，为实现国家碳达峰碳中和目标提供支撑。

In the context of the dual carbon strategy, combining the characteristics of renewable energy resources in Beijing-Tianjin-Hebei region, the characteristics of community energy consumption and development direction of resource industry, utilizing the comprehensive measures of energy conservation, renewable energy industry development, and marketization of distributed energy system to establish rural low-carbon villages and towns, actively developing solar houses, solar street lights, solar water heaters, etc., vigorously promoting regenerative electric heating, air source heat pumps, and other clean heating, developing and utilizing biomass energy resources as appropriate, promoting rural energy-efficient buildings, promoting carbon peak and neutrality in rural areas, and providing supports for achieving the national carbon peak and neutrality targets.

3.7 提升农村清洁能源产业

3.7 Improve Rural Clean Energy Industry

大力培育农村清洁能源产业，抓紧制定完善农村清洁能源供应设备的标准、规范，推进产品标准化、产业化发展，支撑发展壮大产业。培育农村清洁能源服务产业，形成全过程的服务模式，建立产业化服务体系。同时，不断完善相关设计、建设和运行标准，从标准体系建设上保障农村清洁能源服务产业健康有序发展，培育健全服务市场。

Vigorously foster rural clean energy industry, urgently develop and improve the standards and norms for rural clean energy supply equipment, promote product standardization and industrialization, in order to support the development and growth of the industry. Foster the rural clean energy service industry, form a service mode for the entire flow, and establish an industrialized service system. Meanwhile, constantly improve relevant design, construction and operation standards, ensuring a healthy and orderly development of the rural clean energy service industry under the standard system construction, and foster a sound service market.

Thank You