

# Chapter 12

## China's Military Development of Alternative Energy

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### I. Introduction

Under the pressure of the international outcry in recent years, China often showcases its activities in carbon reduction and the development of renewable energy. It has pledged to achieve carbon neutrality by 2060 after emissions peak in 2030 and indicated that fossil fuels would account for more than 50% of its energy mix at the end of the 14<sup>th</sup> Five-Year Plan. On top of its national targets, the military use of alternative energy has the benefit of better energy flexibility and greater battlefield survivability for field operations. In the process of stepping up invasive moves, China has noticed that traditional energy remains the military mainstay, while the increase in consumption and difficulty in transportation to remote areas cause problems in strategy security. The PLA announced in March 2021 the commencement of its first national-level on-site energy demonstration project in the Zhurihe Training Base in Inner Mongolia. Wind and solar will be its main power sources, supported with smart grids and storage and backup electricity from the grids and diesel generation.<sup>1</sup>

Other than the reduction in the reliance on fossil fuels and the enhancement of its application of renewable energy, the ambition to combine new types of weaponry, AI, big data, and cloud computing and to develop smart military energy

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<sup>1</sup> Hai-ching Yu, "PLA's First National-level on-site Energy Demonstration Project Comes Online," *Chinese People's Liberation Army Daily*, March 21, 2021, <https://reurl.cc/aN5vo7>.

sits behind China’s transformation in the military energy transition.<sup>2</sup> The bulletin of the fifth plenary session of the 19<sup>th</sup> Central Committee of the Communist Party of China in October 2020 declared China’s intention to realize the centenary goal for its military establishment in 2027 by accelerating the mechanization, informatization, and smartization of its national defense equipment.<sup>3</sup> With the approach of the Military-Civil Fusion, industries, military schools, and key universities develop joint R&D teams and deploy smart energy networks in military bases in remote mountains and on islands. The purpose of China’s military energy transformation is to complement equipment revamps and renewals and boost the PLA’s new warfare capabilities.<sup>4</sup> Compared to the use of fossil fuels, the PLA’s current scale in the use of renewable and low-carbon energy is not big. Nonetheless, it is necessary to keep an eye on the development, achievements, and the trend of moving forward.

## II. Development of Key Equipment

### 1. Smart Grid for Military Use

The PLA has been prioritizing the solution to the insufficient electricity supply and the challenge of transportation for supplies in remote areas and on sea islands. In November 2020, it indicated that more than 500 border defense sentry posts were connected to the state grid during the 13<sup>th</sup> Five-Year Plan (2016-2020), which previously brought electricity supply around the clock to border sites and was mainly dependent on diesel generation.<sup>5</sup> For instance, after the connection to the state grid, the Kunmuja Post in Tibet, at an altitude of over 4,900 meters, has

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<sup>2</sup> Chiang Chang, “Able to Think and Decide, Military Energy is Surely Getting Smarter,” *Science and Technology Daily*, March 19, 2021, <https://reurl.cc/6DajvZ>.

<sup>3</sup> Xinhua News Agency, “(release under authorization) Bulletin of the Fifth Plenary Session of the 19<sup>th</sup> Central Committee of the Communist Party of China,” *Xinhua Net*, October 29, 2020, <https://reurl.cc/95Zk3O>.

<sup>4</sup> Wei Liu, Deng-yue Wang, “Prospect of New Energy Applications for Military Purposes,” *China Teachers*, February 6, 2021, Cited from *chinaqing.com*, <https://reurl.cc/NZr4vn>.

<sup>5</sup> Hsing-Wei Sun and Shao-Hua Li, “More than 500 Border Defense Sentry Posts Connected to the State Grid,” *Chinese People’s Liberation Army Daily*, November 29, 2020, <https://reurl.cc/Q69YXq>.

been expanding its site facilities—even creating a smart greenhouse for growing vegetables.<sup>6</sup>

For the border defense sentry posts on islands and shoals and the western plateau yet to be connected with the state grid, the PLA adopts the case-by-case approach for each post by establishing smart microgrids with solar, wind, and storage complementary to diesel generation.<sup>7</sup> To this day, over 80 new energy smart microgrids have been constructed to enhance border warfare capabilities. Examples are the Shenxianwan Post in Xinjiang at an altitude of over 5,000 meters and the integration of smart microgrids and seawater desalination on the Tree Island of Paracel Islands.<sup>8</sup>

## 2. Military Applications of Lithium Iron Phosphate Batteries

Lithium iron phosphate batteries have been widely used in green energy storage, unmanned vehicles, electric vehicles, aviation, and communications due to their long service life, superior safety, resistance to both high and low temperatures, and better environmental friendliness.<sup>9</sup> In expanding its civil market for lithium iron phosphate batteries, China is also extending its military use by developing batteries that can function in extremely low temperatures of -40 to -50 degrees. It is hoped that the portability and high power of these batteries enhance the mobility of the military force and its weaponry.<sup>10</sup> Chinese companies, such as Heter Electronics and Hunan Bolt Power New Energy, have received the PLA quality certification for the supply of military batteries and continued to develop the fast charging

<sup>6</sup> Wu-Bin Chen, Yi Chou and Yun-Hong Cui, “How do Soldiers Live at the Sentry Post above 4,000 Meters in Altitude?,” *China Veterans Magazine*, 5, 2021, [https://www.mva.gov.cn/sy/zzxc/202107/t20210716\\_48822.html](https://www.mva.gov.cn/sy/zzxc/202107/t20210716_48822.html).

<sup>7</sup> Hsing-Wei Sun and Hai-Ching Yu, “Over 80 New Energy Microgrids Installed in Border and Marine Defense Troops,” *Chinese People's Liberation Army Daily*, February 5, 2021, <https://reurl.cc/L7bLl3>; Yan-Liang, Da-Hui Liu, “Customized Solutions and Accurate Services to Sentry Posts in the Snow Territory,” *Chinese People's Liberation Army Daily*, March 24, 2021, <https://reurl.cc/bnXar6>.

<sup>8</sup> Op. cit. 7; Chao Liu, “Chronicle of Sansha City as the 11<sup>th</sup> National Double Support Model City,” *Hainan Daily*, September 25, 2020, <https://reurl.cc/DZgLz5>.

<sup>9</sup> “Application of Lithium Iron Phosphate (LFP) Battery Packs in Special Industries,” *Juda Lithium Battery*, August 14, 2020, <https://reurl.cc/2oYg1E>.

<sup>10</sup> “Introduction to Major Applications of Lithium Iron Phosphate (LFP) batteries,” *OFweek Battery*, July 20, 2021, <https://reurl.cc/dxnGey>; Ryder, “Issues of Attention for Special and Customized Low Temperature Lithium Batteries able to Operate in Low Temperatures,” *Rydbatt*, September 2, 2020, <https://reurl.cc/NZQrnn>.

performance of these batteries.<sup>11</sup>

### 3. Military Use of Hydrogen Fuel Cells

As one of the alternative energy sources, hydrogen attracted much attention during the oil crisis in the 1970s. As there is almost no carbon emission in the manufacturing process, the surplus of green energy, such as solar and wind, and green hydrogen generated with the electrolysis of water are believed by all countries in the world to be the key to zero carbon emission.<sup>12</sup> With the high energy density of hydrogen, hydrogen fuel cells ensure the continuous working of renewable energy and microgrids.<sup>13</sup> In addition, they have high energy efficiency and longer life than that of lithium batteries. They are also relatively quiet in operation; hence, suitable for unmanned military equipment. Meanwhile, the PLA is currently developing the military use of hydrogen fuel cells, which can be observed from the progression of hydrogen fuel cells for civil purposes during the past few years:

#### (1) *Multicopter drones powered by hydrogen fuel cells*

In April 2016, the MMC Company launched the world’s first multicopter drone, “HyDrone1800”, powered by hydrogen fuel cells, which can fly for 273 minutes.<sup>14</sup> Meanwhile, in December 2019, the Innoreagen Company and the Shouhang Guoyi Company jointly developed a six-rotor drone powered by hydrogen fuel cells, claiming that the flight time was even longer; that is, up to 331 minutes.<sup>15</sup>

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<sup>11</sup> “Top Supplier Hunan Bolt Power New Energy: Top-notch Exporter of the First Aluminum-ion Battery Fast Charge Technology for Emergency Energy Storage,” *China Battery Enterprises Alliance*, October 7, 2020, <https://reurl.cc/n5N5Vv>.

<sup>12</sup> Hui-Ling Shi, “Development and Trends of Global Hydrogen Production Methods”, *MOEA Department of Industrial Technology*, May 26, 2021, <https://reurl.cc/yeEjE8>.

<sup>13</sup> Chi-Jun Lin, “Application of Microgrids in Storage Systems,” *Newsletter of Taiwan Association of Energy Service Companies*, Vol. 33, August 2018, <https://reurl.cc/GbmRgG>.

<sup>14</sup> Chuan-Shu Liu, “First Multicopter Drone Powered by Hydrogen Fuels Takes Flight,” *Science and Technology Daily*, April 11, 2016, <https://reurl.cc/ARkvnd>.

<sup>15</sup> “331 Minutes of Battery Life for Newly Developed Six-rotor Drone Powered by Hydrogen Fuel Cells Sets World Record,” *China Hydrogen*, December 17, 2019, <https://reurl.cc/Q69Kj2>.

(2) *Hydrogen-powered vertical take-off and landing (VTOL) drones and unmanned helicopters*

In October 2020, the Mobility Innovation Company, a member of the Doosan Group from Korea, worked with Chengdu JOUAV Automation to launch “DJ25”, the world’s first hydrogen-powered vertical take-off and landing (VTOL) drone, with a flight time of up to 303 minutes. In the same year, Mobility Innovation worked with the Ziyuan UAS Company to launch “DZ15”, the world’s first hydrogen-powered unmanned helicopter, with a flight time of 330 minutes.<sup>16</sup>

(3) *Cars powered by hydrogen fuel cells*

In the past five years, many provinces from northern China to southern China, including Hebei, Wuhan, Zhejiang, and Guangdong, have established hydrogen industrial parks, hydrogen stations, and fuel cell car demo sites. In 2021, this trend moved further westward with the development of Hydrogen Valley in Chongqing in order to expand the supply chain of hydrogen fuel cells in China and reduce the cost of application to military equipment in the future.<sup>17</sup>

(4) *Portable hydrogen fuel cells*

These type of cells uses MgH<sub>2</sub> as the storage material. As the electricity is generated for immediate use, light and convenient materials can be used for the metal casing for hydrogen storage, reducing the manufacturing cost and the weight of cells. Although the weight can be minimized to 25 g, the generation is up to 25 Wh, higher than that of a smartphone battery.<sup>18</sup> Lightweight and portable batteries

<sup>16</sup> Ziyuan UAV, “World’s First Hydrogen-powered Unmanned Helicopter about to Strike,” *Zhuhai Ziyuan Unmanned Aerial Vehicle’s company website*, July 3, 2020, <https://reurl.cc/1oYaAG>; “Portable Hydrogen Fuel Cells Energize Military Equipment,” *people.cn*, January 7, 2019, <https://reurl.cc/XIWY8a>; Doosan Mobility Innovation, “The 4<sup>th</sup> Shenzhen International UAV Expo — Review of Hydrogen Power Products,” *website on drones*, October 3, 2020, <https://reurl.cc/q1gWrn>.

<sup>17</sup> “Faster Development of Fuel Cells and Domestication of Key Technologies,” *people.cn*, May 6, 2018, <https://reurl.cc/Gbm0VZ>; “Portable Hydrogen Fuel Cells Energize Military Equipment,” *Science and Technology Daily*, January 7, 2019, <https://reurl.cc/Q69KA2>; “First China-made Fuel Cell Generators Come Online and PLA’s Use of Fuel Cell Technology for Military Purposes,” *kknew.cc*, August 26, 2017, <https://kknews.cc/zh-tw/military/kaexkpv.html>.

<sup>18</sup> “Portable Hydrogen Fuel Cells Energize Military Equipment,” *Science and Technology Daily*, January 7, 2019, <https://reurl.cc/kLZzrq>.

reduce the burden on soldiers and increase the life of electronic equipment, such as portable radio, night vision systems, and single-soldier systems, which boosts an individual’s battlefield capabilities.<sup>19</sup>

#### 4. Military Application of Solar Energy Generation

##### (1) *High-altitude Long-endurance Solar-powered UAV*

The term “near space” refers to a 20- to 100-kilometer distance above the surface—higher than where airplanes fly but below where satellites orbit. High altitude long endurance (HALE) vehicles can fly in near space, 20 kilometers above the earth’s surface, for days, months, and even years. Compared to traditional satellites, HALE vehicles are less costly and more mobile. With longer endurance than regular drones, HALE aircraft is deemed one of the new weapons essential to battlefield victory.<sup>20</sup>

In June 2017, the China Aerospace Science and Technology Corp. (CASC) Academy No. 11 launched “Rainbow”, the first near space, solar-powered UAV. It has the potential of performing high-altitude surveillance, serving as a portable WiFi station in the air and supporting emergency communications during a disaster. In terms of carrying capacity, endurance, and flight altitude, it also claims to be superior to the Airbus Zephyr solar-powered UAV (which can fly up to 14 days).<sup>21</sup> The PLA’s R&D progress in the high-altitude long-endurance solar-powered UAVs has become a concern for countries like the U.S. due to a lower production cost, small size, and high stealth to threaten aircraft carriers.<sup>22</sup>

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<sup>19</sup> Op. cit. 4.

<sup>20</sup> “Future of Unmanned Capabilities: MALE vs HALE,” *Defense Systems*, May 27, 2015, <https://reurl.cc/pxgE0d>.

<sup>21</sup> “China’s First Near Space Solar-powered UAV Conducts a Successful Test Flight,” *people.cn*, June 14, 2017, <https://reurl.cc/oxgGE3>; Science, Technology, and Information Technology Bureau, “Application of Near Space Solar-powered Drones in Emergency Communications,” *Ministry of Emergency Management*, September 19, 2019, <https://reurl.cc/ZjG6GW>; “Flying Close to the Sun,” *Global Times*, June 21, 2017, <https://reurl.cc/35a2LM>.

<sup>22</sup> Op. cit. 18.

## (2) *New detachable warm barracks*

In May 2020, when the border conflict erupted between China and India, the PLA installed the new detachable warm barracks on the border for camping in the cold highlands. These reusable and easy-to-assemble barracks were developed by the PLA's Army Engineering University. Powered by solar generation, the structure retains the warmth from the sun and is connected to a microgrid with wind and diesel generation. When the outside temperature falls below -40 degrees Celsius, the indoor temperature stays above 15 degrees Celsius, greatly reducing the logistic burden.<sup>23</sup>

### III. Battlefield Values and Impacts

Traditional fossil fuels remain the bulk of China's military energy consumption. While the application of renewable and low-carbon technologies is still limited, its progress and potential impacts cannot be ignored. At the end of 2016, the National Energy Administration of China and Logistic Support Department of the Central Military Commission started to promote the "Implementation Plan for Frontier Power Grid Construction", hoping to provide electricity to all of the PLA's and the armed police's border defense troops by 2020.<sup>24</sup> China's installation of smart microgrids on islands and shoals and in remote mountains and plateaus intends to enhance the combat power of border defense sentry posts in inaccessible regions. It is undeniable that some border defense sentry posts need to be connected to the state grid for fundamental solutions to electricity requirements. More so, there are still uncertainties about whether the electricity grid system and relevant facilities built in a harsh environment are resilient enough to weather out the extreme climate on an ongoing basis in the future.

<sup>23</sup> Hsing-Hsiung Sun, Yan Chao, "China's New Detachable and Self-sufficient Warm Barracks Debut for Highlight Border Defense," Ministry of National Defense of the People's Republic of China, October 8, 2019, <https://reurl.cc/73r1pQ>; "Solar is on China's Border with India to Protect Warriors in Defense of the Country," *china5e.com*, October 22, 2020, <https://reurl.cc/Gbm3eA>.

<sup>24</sup> "Border Defense Troops into the New Era of Electricity Consumption," *people.cn*, March 26, 2019, <https://reurl.cc/V5EdYN>.

In addition to the diversification of the risks associated with overreliance on fossil fuels, all of the aforesaid hydrogen fuel cells and solar energy applications have high energy efficiency, long lives, small sizes, and high mobility. While it is advocating the achievement in the military energy transformation, the most important consideration for China should be the high stealth and stronger distributed killing power (e.g., unmanned weapon stations). As China is expanding its civil market for hydrogen, creating the hydrogen supply chain from upstream to downstream, and developing the hydrogen sources for hydrogen stations, the question on China’s military energy transformation remains whether it is propelled towards green hydrogen for net-zero or towards brown hydrogen and blue hydrogen with high carbon emissions from the manufacturing process.<sup>25</sup>

#### **IV. Conclusion**

Ultimately, China seeks to combine its military energy transformation with smartization and informatization. The expansion of its domestic market via the Military-Civil Fusion aims to reduce the cost of technology and manufacturing in order to dominate in the new type of warfare. May it be the development of long-endurance solar-powered UAVs, the installation of warm barracks on the highland along the China-India border, or the deployment of renewable energy smart microgrid and desalination plants on the islands and shoals in the South China Sea, these are all part of China’s military ambition and invasive moves. Furthermore, it is up for debate whether these activities can reduce carbon emissions and diversify the risks of over-reliance on fossil fuels and whether key renewable energy facilities have the functions and resilience to survive extreme climates.

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<sup>25</sup> “New Energy? Hydrogen Could be Worse Than Fossil Fuels,” *Taiwan Institute for Sustainable Energy*, August 24, 2021, <https://reurl.cc/q1gIK3>.