

Good afternoon, it is a great honor to be speaking here as discussant. My name is Yaxin Zhang, currently working as director in Research Institute for Environmental Innovation, Tsinghua University. Also, I operate my own company as chairman of the board and CEO. I think it is my background in both technical innovation and industry that gave me the chance to be invited here in our session. So today, I would like to briefly introduce what I see of the status and path of technology and innovation in China.

One of the difficulties for sustainable social development and productive production is how to balance the environmental, social and economic parameters during developing. Most investigations in industrial restructuring and upgrading were generally conducted under the framework of the traditional economic paradigm which solely aims at economic expansion and economic growth, but ignores the extensive consumption of energy and the increasing environmental costs. Under the requirements of high-quality development of China's economy, how to impel the industrial structure towards a cleaner upgrading path becomes a matter of urgency. In China, technological innovation should be a solution to this problem. Green technologies, which combines efficiency improvements with environmental goals, have gradually played a central role in restructuring of industries, tackling major issues concerning public welfare, enhancing living standards and promoting sustainable social development.

The Chinese government have input a lot of efforts in promoting

environmental protection and cleaner production, with respect of political strategies, science and technical researches, as well as industrial orientations. China's National Development and Reform Commission, together with China's Ministry of Science and Technology, issued the "Guidance on Building a Market-oriented Green Technology Innovation System"; while The Ministry of Ecology and Environment of China compiles a "Catalogue for National Advanced Pollution Control Technologies" on a regular basis, and promotes the "Catalogue for National Advanced Cleaner Production Technologies".

Ever since the year 1982, China's Ministry of Science and Technology has initiated the "Key Technologies Research & Development Program", aimed to address major science and technology issues in national economic construction and social development. Over the past decades, the Program has made remarkable contributions to the technical renovation, upgrading of traditional industries and the formation of new industries.

One representing example is in the field of treatment and reutilization of bulk industrial solid waste, such as mine tailings, slag, coal gangue and construction solid wastes. The massive capital construction and development era of China has yielded millions of tons of industrial solid wastes per year, causing huge ecological risks, as well as severe water, air and soil pollution, leaving numerous piles of solid waste on the sites. The calling for new technology for decontamination and reuse of these wastes was urgent. In just the past 4 years, the Ministry of Science and Technology

has issued 22 projects in this field, with more than 800 million yuan of government spending on science and technology, over 200 companies, universities and institutes were involved. Nowadays, in China, the major parts of industrial solid waste can be turned into industrial raw materials, such as cement, roadbed, bricks and other construction materials. Due to technology innovation, what was once seen as low-value added wastes were even transformed into high valued consumables: for example, the extracts of manganese slag can be used in the production of ternary polymer lithium battery. After China announced it will achieve the peak of carbon dioxide emissions and carbon neutrality, reutilization of industrial solid wastes as matrix for carbon capture, utilization and storage (CCUS) has become an inevitable technology for China to achieve the goal. Countless firms and local governments are taking advantages of these opportunities.

The industrial development in China is strongly policy-dependent, the political regulations can effectively moderate the green innovation-upgrading relationship, and act as a valid vehicle for triggering the cleaner upgrading of China's industrial structure. China's National Development and Reform Commission, with relevant departments, issued the "2019 Green Industry Guiding Catalogue" to actively promote the rapid development of green industries, such as energy conservation, environmental protection, clean production, clean energy, ecological environment, green infrastructure upgrading, and green services, to channel private capital and advanced technologies toward green industries and spur on various favourable

national and provincial policies in this regard. At present, the production scale of China's wind power, photovoltaic power, and other clean energy equipment ranks first in the world, and its production of polysilicon, silicon wafers, cells and modules account for more than 70% of global production. In 2021, the output value of China's energy conservation and environmental protection industry was more than 8 trillion yuan, with an average annual growth of over 10% in recent years.

Green technology innovation has been empirically verified to be an effective impetus to promote the cleaner upgrading directly, both for the aggregate industry and different groups of industrial sectors. China's enterprises have gained abundant experience in innovating and adopting such advanced type of technologies, and achieved remarkable progress in green technology. The driving mechanism on cleaner upgrading of China's industry is transforming from an unsustainable factor-driven model towards a green innovation-driven one.

According to the experiences of China in technology innovation and industrial upgrading, to design and formulate corresponding green innovation strategies and industrial policies for high-quality and sustainable development, several basic recommendations can be provided for China's and other developing countries' policymakers, as well as for international communities.

The government and international community should devote more efforts to

provide appropriate supporting and incentives to encourage social green R&D activities. It at least refers to four major aspects. (1) Financial support, such as green R&D subsidies, tax exemption and awards for groups that have made key technological breakthroughs. (2) Green human resource support. Government can increase fiscal expenditures for ecological education, aiming at strengthening the training of green R&D personnel and enhancing the supply of green human capital. (3) Institutional support. Good institutional arrangements in environmental management and green innovation incentives should be provided, including but not limited to property rights protection, information service and legal construction. (4) External resource support, such as more opportunities to cooperate with lead users, universities, research institutes and other international communities to help develop environmentally-friendly new products or processes.

Thanks for listening.