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Green Technology in Vietnam: Current Status and Solutions

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Abstract

The national strategy on green growth for the period 2021-2030, vision 2050 sets three important goals: reducing emissions, greening economic sectors; greening lifestyle; and promote sustainable consumption. Accordingly, the overall goal of the Strategy is to promote economic restructuring associated with innovating economic growth models, environmental sustainability and social equity. The specific goal by 2030 is to reduce the intensity of greenhouse gas emissions per GDP by at least 15% compared to 2014, and by 2050 by at least 30% compared to 2014. Developing green technology and a circular economy is an inevitable trend that countries are moving towards. In Vietnam, the Government issued Decision No. 687/QĐ-TTg dated June 7, 2022 approving the Circular Economy Development Project in Vietnam. The specific goal of the Project is to contribute to concretizing the goal of reducing the intensity of greenhouse gas emissions per GDP by at

least 15% by 2030 compared to 2014, aiming for a net emission target of "zero" by 2050 (in accordance with Vietnam's commitments at COP26). The Vietnamese government has policies to develop green technology and green economy, however the challenges posed are not small, not only challenges in selecting and improving technology, but also huge challenges in the issue of financial resources for implementation. Therefore, each individual needs to be aware that green development will contribute to environmental protection, promoting better social development, following green, clean and safe trends. The article focuses on basic contents: theory of green technology, benefits of green technology, experience in developing green technology in China, current status of green technology development in Vietnam and from there, brings come up with solutions to develop green technology in Vietnam in the coming time.

Keywords: Green Technology, Green Transformation, Construction Industry

1. Introduction

In 2016, China proposed to establish a Green Technology Bank. The Green Technology Bank was founded by China's Ministry of Science and Technology (MOST) and the Shanghai Municipal Government. The establishment of the Green Technology Bank is an important initiative of China in its efforts to implement the United Nations 2030 Agenda and the Paris Agreement. Green technology banks are not exactly the same as other green banks. Green banks such as the UK Green Investment Bank can pour capital directly into supporting green industries^[4].

Green technology contributes to the balance between environmental protection and economic development, which is a key relationship to create a sustainable society^[7]. The importance of green technology is highlighted around the world, especially in China. According to Li (2018), the Chinese government is making efforts to promote industrial capacity due to innovation-driven production, industrial optimization, quality improvement and green development^[8]. There are many criteria for classifying green technology, however, there is no widely accepted criteria for classifying green technology^[9]. The lack of a standardized classification system can lead to uncertainty in the choice of green technology. Furthermore, green technology is a complex and dynamic concept that covers a wide range of fields. The lack of consistent taxonomy guidelines can lead to an ambiguous understanding of green technology. The green technology classification systems used in different regions are often inconsistent, creating obstacles to large-scale green technology transfer. To improve the efficiency of international green technology transfer, it is necessary to establish a common framework for many stakeholders such as technology suppliers, technology users and technology investors. The combined (hybrid) approach allows the creation of a green technology taxonomy by combining long-term visions and real-world practices. The classification system can be a useful reference for those involved in innovation and green technology transfer in different regions.

Green innovation not only benefits consumers and businesses, but can also significantly reduce adverse environmental

impacts^[10]. Green innovation is usually engineering related to energy saving, pollution prevention, waste recycling, design for green products, environmental management^[11]. Green technology innovation is a key part of green innovation, receiving great attention because the state of the environment is increasingly concerned^[12]. Green technology innovation is expected to create dual benefits: limiting the environmental burden while contributing to the technological modernization of the economy^[13]. Sustainable green technology is important to control pollution emissions effectively and economically^[1]. Far-reaching innovation is needed to address climate change and environmental challenges. Green technologies include Bio- and Nano technology, information technology and technology related to the environment,^[14]. The field of environment-related technology, including environmental management, water-related adaptation technology and climate change mitigation, to analyze the development of green innovation in China in 1990. Patent data are often used as a measure of technological innovation because these data focus on the output of the invention process^[15]. Patent data provide a wealth of information about the nature of the invention, its inventors, and its applicators.

2. Research overview

Green technology concept

Green technology refers to technological inventions that are environmentally friendly or at least do not have a negative impact on the environment. It can be any product or application in the fields of agriculture, industry or energy... Which brings economic benefits but also protects the environment. The concept of green technology originated in the 60s and 70s of the last century, stemming from people's awareness of the risk that technology can destroy the ecological environment, threatening the survival of humanity. From there, which technologies pose a risk of destroying the environment and which technologies have less negative impacts on the environment are distinguished. Green technology really started being mentioned in the 1990s, but it became an urgent need and became more popular in the 2010s. Some technological revolutions such as using solar panels or using Products that replace plastic waste have started a new trend in the world.

According to the English definition, green technology, also known as clean technology, is environmentally friendly technology based on clean production processes or supply chains. According to the definition in Clause 5, Article 2, Chapter I of the Law on Technology Transfer 2017, clean technology is technology that emits low levels of environmental pollutants according to the provisions of law on standards and technical regulations, uses fewer non-renewable resources than existing technology.

The main goal of green technology is to prevent and overcome the negative impacts that humans cause on the environment. It not only benefits nature but also creates clean and green habits for people, ensuring a healthy Earth so that life can thrive.

Today, when global problems pose challenges to all humanity, when geopolitical conflicts occur in the world, natural disasters, environmental changes occur, the world faces resource depletion, energy, food crisis, etc., green

technology becomes more necessary than ever. The green technology market is extremely potential and businesses that go first will have many advantages.

Benefits of green technology

Green technology is and will be a world trend. Green technology will gradually replace traditional technology. Because it brings great benefits not only to each profession, each business, and each individual, but it also brings benefits to the country and the whole world both now and in the future.

Economic

Although the green technology era has just begun, the achievements of green technology have created great breakthroughs, bringing great economic value to businesses as well as to life. It is even a turning point, affecting many global economic sectors.

Take Elon Musk, founder of SpaceX and Tesla, for example. It was the idea of transporting passengers by pipeline or producing electric cars that made Elon Musk the richest person in the world. Not only that, the world also entered a new race with new businesses such as sending people to space.

Or in the field of electric car manufacturing, which is becoming a huge profit-generating industry for this business. By using clean energy sources to replace gasoline, electric cars are being encouraged by governments as they help protect the environment and create many jobs for workers. So, not only does it bring benefits to businesses, but green technology also brings benefits to the government.

About environment

The biggest goal of green technology is to protect the environment. In other words, protecting the environment and making the environment cleaner is the mission of green technology.

Previously, a green city born in China became a model for many cities around the world by using public transportation systems, using waste water recycling equipment, wind technology or energy. The sun provides electricity.

When air pollution becomes a big problem in the city, the invention of eco-concrete becomes the savior as it absorbs all types of pollution and converts harmful nitrogen oxygen into non-harmful compounds. The Netherlands was the first country to use this concrete and as a result eliminated up to 45% of emissions.

Or like Boyan Slat's plastic collection solution for recycling. This guy has come up with a solution to get rid of the plastic that has invaded the ocean by using the ocean's natural currents to collect trash and then recycle it.

Traditional energy conservation

Green technology applications limit the use of traditional energy by finding new alternative energy sources. Using solar energy or using electricity, clean fuel... is preserving traditional energy sources. When traditional energy becomes increasingly scarce and expensive, green technology is the perfect alternative.

Change life

A green lifestyle, close to nature, is chosen by more and more people. Applying green technology to life also requires changes in consumption, living, and lifestyle habits. Of course, this brings great health benefits to people themselves and then contributes to making society happier.

Table 1: Indicators for evaluating technology development related to the environment

| Numerical order | Development targets | Define |
|-----------------|------------------------------------|--|
| 1 | Percentage of all technologies | The number of environmentally related inventions is expressed as a percentage of all domestic inventions (in all technologies). Changes in the technological innovation "environment" can then be explained in relation to innovation in general. |
| 2 | Percentage of inventions worldwide | The number of environmentally related inventions is expressed as percentage of environmentally related inventions worldwide. This index indicates the importance of the contribution of invention activity in one country to the global invention pool. |
| 3 | Relative advantage | Technologies are a composite index of a country's specialization in environmental innovation relative to world value. It is calculated as the ratio of 1) the contribution of environment-related inventions to all inventions (in all technologies) in that country and 2) the contribution of environment across all inventions (in all technologies) in the world. Therefore, an index equal to one means that a country trades in 'green' technologies like the rest of the world; an index above 1 indicates relative technological advantage (RTA), or specialization, in environmentally related technologies relative to world values. |
| 4 | Inventions per capita | Number of environmentally related inventions expressed per million inhabitants (higher value inventions/million people). |

Source: Hašič and Migotto (2015) [15]

3. Green technology innovation in China

For technologies related to the overall environment, use comparative methods to study developments over 25 years. And for the development of technologies, four indicators (Table 1) are used to express the development of

technologies related to the environment: percentage of all technologies, worldwide invention rate, Relative advantage and inventions per capita.

To assess the degree of diffusion of environmentally relevant technologies, three indices (Table 2) were used in.

Table 2: Index to evaluate the degree of diffusion of environment-related technologies

| Numerical order | Indicators | Define |
|-----------------|--|---|
| 1 | % of all technologies | Environmentally related patents are expressed as a percentage of all patent applications filed in a jurisdiction (in all technologies). This allows changes to be interpreted generally in relation to diffusion. |
| 2 | % of inventions worldwide | This index is calculated by the percentage of total 'green' technologies demand is looking for protection in a single regional market determined. It is calculated by the number of inventions related to the lips market seeks patent protection in a regional market certain scope (the jurisdiction of a patent office) is expressed expressed as a percentage of inventions related to the environment seek patent protection anywhere in the world during the period paragraphs T-3 to T (i.e. patent applications in country/Area X is divided among worldwide patent applications gender in that year and the 3 year before that). Reason to take the whole world over 4 years is to use the patent inventory as the denominator, instead of just applicable worldwide in the current year |
| 3 | % of environment-related technologies by domain name | The number of inventions in a particular technology group submitted within a range is expressed as a percentage of the total number of environmentally related inventions. This index evaluates the relative importance of innovation activity within a particular domain for a particular environmentally relevant technological domain. |

Source: Hašič and Migotto (2015) [15]

4. Current status of green building development in Vietnam

With huge benefits, investing in green technology is becoming an attractive field. Even green technology is a race for the world's leading corporations and businesses. Investment in clean energy is constantly increasing. Green technologies are currently being developed and applied to production, construction, and environmental treatment activities, especially in the fields of energy production, mining, industrial production, agriculture, etc.

European countries have approved the "Climate Plan" proposed by the European Union, with a focus on banning the sale of new fossil fuel cars from 2035, thereby aiming at the ambition to transform Europe. Continental Europe will have zero carbon emissions in the mid-21st century. In the context of emissions from cars and vehicles that produce large amounts of carbon dioxide in Europe, this new proposal has received strong support from many countries. Car manufacturers in Europe will have to cut carbon dioxide emissions 100% by 2035 and cannot sell new cars using gasoline or diesel engines in the 27 EU member states.

Before the above deadline, car manufacturers must cut 55% of carbon emissions from cars shipped by 2030 compared to 2021. Green technology in the car sector is currently a very strong development trend in Vietnam. Countries, including Vietnam, has participated in the clean electric vehicle production chain, with electric vehicle models of Vinfast Group.

In the field of green energy, currently the world is developing 5 popular clean energy sources including: solar energy, wind energy, biomass energy, geothermal energy and ocean energy. Besides energy produced from traditional sources such as hydropower, thermal power, nuclear power, and gas power. Other new forms of energy such as green hydrogen, energy storage, etc. are being researched and deployed. According to the commitments of member countries at the 26th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP26), countries will limit the use of energy from coal and lead to the elimination of energy from coal. Absolutely, nuclear power poses great environmental risks in case of an accident (there have been lessons from Japan, Ukraine,).

Therefore, developing other clean energy sources to replace coal is extremely necessary.

Vietnam has had explosive development in renewable energy (wind and solar energy) in recent times. According to World Bank data, Vietnam currently has the most comprehensive installed solar power capacity in Southeast Asia, with 16,500 MW produced in 2020 and is in the top 10 countries with installed capacity. Highest solar power globally in 2020. With huge potential for solar power and ambitious green energy targets by 2050, Vietnam has many opportunities to become a global leader. Demand for renewable energy. In addition, there is a compelling reason to establish wind energy projects in Vietnam due to its long coastline, the largest wind resource in the region with great potential.

Regarding agricultural production in Vietnam, greenhouse gas emissions focus mainly on the fields of wet rice cultivation, animal husbandry, land management and fertilizer use. Therefore, solutions to apply green technology to reduce greenhouse gas emissions in the agricultural sector need to focus on these three main areas. Vietnam is currently one of the countries that exports many agricultural products and has applied high technology and clean technology in the field of agricultural production to create high quality products that bring value. Large increase with clean, modern production process, meeting the regulations of foreign importers.

For the industrial production sector, greenhouse gas emissions come mainly from manufacturing industries such as: mining and enriching metal ores; Metallurgical; production of paper, pulp, fiberboard (MDF, HDF); production of chemicals, chemical fertilizers, and plant protection drugs; dyeing (fabric, yarn), washing and grinding; leather tanning; oil refinery; Coal thermal power, coke production, coal gasification, nuclear power; waste recycling treatment; plating, cleaning metal surfaces with chemicals; production of batteries and accumulators; clinker production; rubber latex processing; cassava starch processing; sugar cane processing; seafood processing. According to the provisions of the Law on Environmental Protection 2020, investment projects are classified into one of 4 groups (groups I, II, III and IV) to carry out legal procedures on environmental protection, in Accordingly, investment projects in group I have a high risk of negative impacts on the environment and a part of group II projects have a risk of negative impacts on the environment. Classifying projects according to the type of production as above will attract the attention of management agencies, requiring stricter environmental monitoring and the application of greener, cleaner technology to protect the environment.

In 2021, the resurgence of carbon capture and utilization (CCUS) green technology industry is reinforced as the global trend towards climate goals gathers momentum. The pipeline for large-scale CCUS projects increases sharply in 2021, and several governments recognize the importance and are collectively investing billions of dollars in developing this industry. Transportation and storage hubs are becoming an increasingly important driver of future carbon capture developments, allowing more industries and small factories to consider carbon capture as a viable option for decarbonization goal. Countries in North America and Europe lead the market, especially countries with the goal of reducing net emissions to zero as committed at COP26.

Currently, there is a shift from traditional natural gas processing facilities to other, more diverse types of production, including heavy industries, chemical industries, hydrogen production and power generation. Growing demand for low-carbon materials such as cement and steel will drive applications of hydrogen/CCUS as a key technology for industrial decarbonization.

In the field of environmental treatment, the volume of solid waste has been increasing rapidly in Vietnam in recent years, requiring timely measures and appropriate treatment technology to protect the environment and health. People's health. Currently, the trend of solid waste treatment is to recycle, reuse and utilize energy from waste, considering waste as a resource. European countries and G7 countries are currently following this trend of solid waste treatment. Currently, waste treatment plants in Europe have strictly prohibited the application of solid waste burial technology, requiring treatment facilities to apply clean methods in solid waste treatment, ensuring a clean environment. In Europe, the types of solid waste treatment technology are very diverse, but the most popular are waste electricity technology from biogas fermentation of organic products, and waste electricity technology directly from waste. Waste, fertilizer production technology and creating RDF pellets as raw materials for steel, cement factories...

Green technology not only brings green environmental protection but also brings innovation to daily life, ensuring continuous scientific and technological progress. Green technology is now impacting more than just simple activities from homes to industrial systems. Environmental awareness plays a huge role while designing products. Manufactured using green technology, the resulting products can reduce waste, minimize pollution and even reduce fossil fuel use by a huge percentage compared to older products. These products not only protect the environment, but also help save fuel and production costs. That's why businesses are focusing on and upgrading conventional products into environmentally friendly green products.

The National Strategy on Green Growth for the period 2021-2030, with a vision to 2050 recently approved by the Government, affirms that green growth contributes to promoting economic restructuring associated with innovating growth models, aiming to achieve economic prosperity, environmental sustainability and social justice; towards a green, carbon-neutral economy and contributing to the goal of limiting global temperature rise. The development of green technology plays an important role in implementing the country's green growth.

In the current context, encouraging businesses to follow clean technology is not only timely but also in line with the country's orientation. To achieve this, the government needs to have preferential policies for science and technology development activities, promoting the spirit of entrepreneurship and creativity. Businesses need to proactively seek opportunities, exchange and learn, and be ready for challenges to create new breakthroughs.

Each individual will not be able to stand aside from the trend of green technology, green consumption, and green lifestyle. Your choice to use clean, environmentally friendly products also makes a small contribution to promoting the development of the green technology industry.

5. Solutions for developing green technology in Vietnam

Recent Chinese innovation has focused on green

technology. Most green technologies are related to water, energy, health and mobility technologies. During the period 2000 - 2015, China's environment-related technological innovation made great progress and took the lead in green technology growth; especially in the areas of water and wastewater treatment, solar photovoltaic (PV) energy, lighting, bulk chemical or pharmaceutical related innovations, electric vehicles and other technologies has achieved great achievements. Compared with most countries and regions in the world, China's environment-related green technologies are among the highest in the world (Qinhua Wang, 2019). Some major achievements in China's green technology innovation development (Qinhua Wang, 2019): most developed green technology (period 1990-2015); the contribution of environment-related technologies to the international community increases; Environmental innovation policy promotes innovation and development of environment-related technologies. From the results of green technology innovation that China has achieved recently, it shows the leading role of the Ministry of Science and Technology in establishing a Green Bank and collecting data on green technology and construction. Database for green technology banks. Besides, we must also mention the role of other parties such as customers, technology investors and especially technology inventors.

From China's experience in developing green technology, we can suggest some of the following suggestions to Vietnam to help promote the development of green technology in Vietnam (including research & development; investment by investors). Investors and customers) contribute to achieving the goals of sustainable development and ecological civilization:

First, establish a specialized organization to develop green technology similar to China's green bank: organizational leaders, supervision and executive experts.

Second, the Green Technology Organization is responsible for collecting and building the Vietnam green technology database according to the annual green technology classification system.

Third, based on the green technology database according to the annual classification system, to have solutions to research, deploy, invest, and promote green technology in limited groups.

Fourth, build a set of indicators to evaluate the level of GT development according to 5 groups in the green technology classification system compared to all technologies.

Fifth, build a set of indicators to evaluate the level of technology diffusion based on the set of indicators China's environmental technology diffusion numbers but assess the degree of diffusion canopy for each of the five groups of the green technology classification system.

Sixth, developing and implementing green technology faces many barriers (Murillo-Luna *et al.*, 2011; Luthra *et al.*, 2015; Xia *et al.*, 2019). Therefore, Vietnam needs to clearly identify specific barriers to developing and deploying green technology. Barriers include policies (Yoshino *et al.*, 2019; Darko *et al.*, 2018; He *et al.*, 2019), markets (Campiglio, 2016; Agyemang *et al.*, 2018), knowledge and awareness (Darko *et al.*, 2017; Liao and Shi, 2018) and financial barriers (Wakeford *et al.*, 2017; Ji and Zhang, 2019; Bhandari *et al.*, 2019).

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