

# TECHNOLOGY INNOVATION OF ENTERPRISES FOR GREEN ECONOMIC GROWTH IN VIETNAM

PhD. Nguyen Xuan Dien\*

**Abstract:** *Green economic growth is the essential condition for a sustainable development. In order to play their role in the green economic growth, Vietnamese enterprises have to implement a complex package of solutions and measurements, including the technological innovation, because almost tasks enabling the transformation from traditional economy to green one could be solved by technical and technological solutions. Currently, the technological capacity of Vietnamese enterprises is generally weak, their technological innovation should be urgently strengthened. For that purpose, Vietnamese enterprises need a reasonable strategies, appropriate resources, especially human and financial ones, rational organisational arrangement and good, efficient interactions with their domestic and international partners. Implementing this task is extremely complicated and difficult, because the technological innovation should be practiced while their production should be run at the same time and the quality should be maintained in accordance with customers' requirements. Under those conditions, Vietnamese enterprises need supports from the Government as well as the whole business community of the country in the right scope, appropriate forms at right time.*

• Keywords: *green growth, technology innovation, enterprise, green economy*

*Date of receipt: 28<sup>th</sup> February, 2024*

*Date of receipt revision: 14<sup>th</sup> May, 2024*

*Date of delivery revision: 01<sup>st</sup> March, 2024*

*Date of approval: 30<sup>th</sup> May, 2024*

## Introduction

In the economic literature and practice, there are different terminologies related to the topic of green economic growth, especially 3 categories: the green growth, green development, green economy and sustainable development. Some other terminologies are usually used in this context, such as the circular economy, environment friendly economy, environment friendly economical development, etc. These terminologies deal with a same content: they describe and analyse the relationships between the economic development as well economic activities/ processes with the environment and try to keep a balance between these two- the economic development and protection as well as maintenance of the healthy environment for the current and future generations. A development model with pillars was constructed for this strategy: The green production (with the aim to reduce the wastes from the production, to reduce the consumption of inputs per unit of goods and service and to replace the traditional inputs by environment friendly, renewable inputs), the green consumption (to rationally, effectively and efficiently use/ consume of goods and services, to reduce wastes from consumption of goods and services) and the maximal processing wastes from production processes as well as from consumption as well as correct environment damages from natural disasters.

For constructing and improving the steadiness of these pillars, technological innovation as a crosscutting factor plays an important role, influencing the green economic development/ growth in its whole cycle, from its establishment, its ongoing enrollment and its stabilisation. This paper tries to clarify the context mentioned above in Vietnam and possible solutions to strengthen the technological innovation and application in order to meet the target, a sustainable socio- economic development of Vietnam in the future.

## Method

The contribution is completed on the basis of an integration of commonly used methods and approaches:

- Secondary literature review. Literatures reviewed are monographs, publications on journals, magazines, reports of research groups or individual researchers, reports of government agencies, papers on newspapers on the topics of urbanisation and green economic growth, green economy and related issues, especially the transformation from the traditional economy to a green one.

- Direct individual interview with 1) enterprises managers, who are responsible for technological management and technology innovation; 2) officials of the MPI, MONRE, MOIT, MOF, VCCI; 3) scientists and researchers, who have solid understanding on issues of green economic growth, green economy

\* Academy of Finance; email: [nguyensexuandien.hvtc@gmail.com](mailto:nguyensexuandien.hvtc@gmail.com)

and transformation process from traditional to green economic model.

- Expert group discussion. Selected enterprises managers and officials, who were interviewed before, were invited to a round table discussion, on which findings were presented in order to get feedback and recommendation for the paper finalisation.

### Results

Reviewing the literature to date, Kasztelan definite the green growth as a economic development, which ensure “that natural assets continue to provide the resources and environmental services which contribute to the country’s prosperity” and “underpin sustainable development”. Ways to achieve the objective mentioned above consist of:

- Efficient use of natural resources (“use less, get more”), which led to reducing negative impact on the environment through reducing the mining industry, which may destroy the natural environment or led to deforming the earth surface;

- Improvement of the product design and technologies so that the production could cut down the production wastes;

- Change the consumption so that environment friendly goods and services could be consumed and less consumption wastes would be put into the environment;

- Processing production and consumption wastes, so that they could not harm the natural environment.

The logics of these relations could be explained by the production function model, which described the national output (P) generally as a function of a “total productivity factor” (b) and national labourforce (L) as well as the nationally used amount of capital (C), in which the total productivity factor depend on the way of combining L and C and the efficiency of using L (quantitative L’s impact on P) is identified by a coefficient  $\alpha$  and the efficiency of using C by  $1 - \alpha$ . It means then:

$P = b * L^\alpha * C^{1-\alpha}$ , which is later continuously modified to  $P = b * L^\alpha * C^\beta$

in which  $\alpha + \beta$  is not equal 1 any more.

The economic growth could be described as:

$$\partial P = \partial b + \alpha * \partial L + \beta * \partial C$$

If resource use efficiency is improved, the sum  $\alpha + \beta$  will be  $> 1$ , meaning the economic growth ( $\partial P$ ) in the new development model will be higher than that one in the traditional model. The improvement of the product design and the improvement of technology

affects the scope of b and the increase of  $\partial b$  means also an adequate increase of  $\partial P$ .

The impact of the consumption on the economic growth could be explained according to other side of the GDP (P), which could be described as a sum of private consumption (C), total national investment (I), Government spending/ expenditures (G) and net export (NE)

$$P = C + I + G + NE$$

The GDP growth is:

$$\partial P = \partial(C + I + G + NE)$$

The maximisation of the consumption benefits in the new economic model (green economy) equals an increase of C in the traditional economic model.

The role of wastes processing could be explained by the relation of a nominal and real wealth fare ( $W^N$  and  $W^R$ ) growth in a period, which are different by the wealth fare loss caused by the environment damages ( $W^L$ ) in that period:

$$W^R = W^N - W^L$$

Similarly, the real GDP (P) is, in fact, the difference between the nominal GDP ( $P^N$ ) and the costs for the recovery of environment damages caused by cumulative wastes from the production and consumption in the actual and previous period ( $K^R$ ):

$$P = P^N - K^R$$

In that relation,  $K^R$  depends on the amount of wastes occurred and the amount of wastes processed in each period as well as the time difference between the time of wastes occurring and the time of wastes being processed. Theoretical studies and practical researches clarified that the longer a waste amount being unprocessed, the higher the costs for processing it and for recovering damages caused by that waste amount.

Among solutions and tools for solving problems mentioned at the begin of this session, technology applied and technological innovation plays a very important role. Observing and analysing the development in developed and highly developing countries, Hultman et al mentioned that “clean technology innovation has remained concentrated in higher- income countries, though the direction of device transfer is shifting away slowly from its historic North- South directional flow”.

Technology and its innovation doesn’t only play important role in reducing wastes, the source for actual environment pollution as well as environment damages in the future, but also for recovering damages

and negative impacts of previous hazards wastes and environment pollution. In addition, technological progress and technology innovation could help to recognise and identify potential pollutions and their sources, their consequences for living substances and the nature, to quantify the threats and scope of their impacts. On the other hand, technologies and their innovation/ application could contribute the decisive role in replacing traditional scare, expensive and hazardous natural resources by cheaper, hazardless and easily accessed available resources, etc. This is also a question of the development sustainability. Sun et al considered technology as the tool to ensures the balance between environment sustainability and economic growth. Traditional technologies will be replaced increasing ly in next decades.

A technology is understood as a combination between hardwares (machines, equipments, tools, etc.), factor inputs (materials and etc.) software and “organisational ware”, or in other words as a combination of “manufactured objects like tools (axes, arrowheads, and their modern equivalents) and containers (pots, water reservoirs, buildings)” either to enhance human capabilities (e.g., with a hammer you can apply a stronger force to an object) or to enable humans to perform tasks they could not perform otherwise”.

Impacts of technologies and technological innovation on the green growth could be reflected and measured by concrete indicators, such as the reduced amount of hazards wastes achieved by the use this technology, the amount of resources, especially scare resources, used really to produce a certain amount of products/ services (usually per goods/ service unit). The sum of the same indicator of a line of technologies or technologies of a sector, a branch or on a region reflects the impact of this technology line or that technologies of the sector/ branch on the aspect, which is characterised by the indicator. Clarifying impacts of a technology or a technology group demonstrates its/ their quantitative analysis/ assessment. In the qualitative way of technology and its impact analysis/ assessment, indicators like percentage of technologies innovated/ updated, percentage of modern technologies on total technology used by a sector/ branch or on a region will be addressed and compared.

Actually, developed countries, such as the US, Germany, Japan, France, Korea and other OECD countries are major suppliers on the green technology markets. Their market share was around 90% in 2020,

estimatly. Emerging economies, s such as China, India, Austria and Brazil, are playing an increasing role in developing, innovating, transferring and applying green technologies in the previous years.

### Discussion

In Vietnam, the Government issued the National Strategy on Green Growth since 2021, aiming to strengthen the restructure of the national economy in the direction of sustainable development, to innovate the development model in order to ensure an economic wealth fare and environment sustainability and social equality. Among solutions and measurements for achieving the target, the Government of Vietnam clarified prioritised areas and sectors, including:

- Energy (improving the efficiency of energy consumption, ensuring the national energy balance by utilising all energy sources and replacing mineral by renewable energy);

- Agriculture (developing the green, clean, organic, modern, sustainable agriculture and applying efficient technologies on the area of processing agricultural products);

- Environment friendly sectoral development (encouraging the development of sectors/ subsectors, which consumes less resources, produced less environment harming wastes, process more wastes and reuse, recycle more consumed products);

- Strengthening the smart, sustainable urbanisation, which enable to adapt with the climate change;

- Development of modern, sustainable rural area, which enable living styles could be harmonised with thee nature and modern living standards;

- Improving the capability of the wastes management and air quality management as well as managing water and land resources and biodiversification;

- Strengthening the green consumption and green procurement;

- Strengthening the green transformation.

The result of the development and application of green technologies differed among economic sectors. Reviewing plans for realising the National Strategy for green growth, Ho Thuy Ngoc/ Nguyen Tu Anh indicated “Green technologies are primarily used in only six areas: construction, transportation, agriculture, industry, energy and waste treatment. 41% of the green technologies used in waste treatment are for filtration, clean water supply, and waste collection from production, medical facilities and residential use. Most of the green patents in energy

are devoted to the production of electricity using solar and wind energy. R&D activities in construction, transportation and agriculture are not fully invested despite their important role in the process of greening the economy”.

To date, the energy is the main source of CO<sub>2</sub> emission in Vietnam. In 2010, the energy sector provided 63% total amount of green house gas of Vietnam. In 2020, the figure increased to 67.7% and expected to be 73.1% in 2030. Therefore, Vietnam’s energy sector was restructured strongly in the last years. The share of renewable energy on total electricity output increased from 1.9% in 2010 to 7% in 2022. The share of coal on energy output increased, too, but their technologies are improved in many aspects. The percentage of hydro electricity went down continuously, from 37.1% in 2010 to 20% in 2022 (table 1). Up to the 8/ 2020, 102 solar energy projects with a capacity of 6,314 MWp completed their construction works and started to operate commercially. In 5/ 2021, operators of 130 wind energy projects signed commercial contract with EVN to put their electricity on the grid.

**Table 1: Share of Vietnam’s electricity output by source between 2010 and 2022 (%)**

	Hydro	Coal	Oil	Gas	Renewable	Solar	Wind	Import
2010	37.1	20.6	35.8		1.9			4.7
2015	33.2	28.2	30.6					
2020	28.5	30.2	26.7					5.8
2022	20	45	22	6		5	2	

Source: R. Ramsawak, R. Baulch and Dai Viet Securities Company

Parallely to restructuring of the energy sector, Vietnam urged energy consumers to use this resource more efficiently and save it as much as possible. In the period 2011- 2015, activities in this direction helped to save 5.65% of total energy consumption (equivalent with 11.25 million tones of oil). “Big energy consumers” are top energy savers: steel production saved 8.09%; textile industry saved 7.32%, cement industry 6.33%.

Another focus sector, of which technologies should be improved with the support of the green technologies, is the transportation, which produced a large amount of glass house gas by an increasing amount of private transport means. The transport sector is the source of around 70% of air pollution in cities of Vietnam. The technological innovation in the sector focuses on 1) replacing transportation means operating on mineral energy basis by environment friendly, especially electric, ones; 2) application of new, more capable IT and digital technologies

in transport management and regulation and 3) rationalising the territorial structure in order to reduce city internal transportation needs of citizen. At the end of 2023, 13.6% of public transport means (public bus, in particular) were electric; the City plans to continue this transformation process with annual rate of around 6% in the period 2025- 2030 and 8% between 2031- 2035. In Ho Chi Minh City, at the begin of 2024, around 30% of total bus of Saigon Bus, the city internal public transport company of the City, use the CNG (compressed natural gas). Between 2022 and 2023, The City replaced 15 bus and around 600 taxi cars by electric ones.

The implication of green urbanisation policies is focusing currently on following issues:

- Designing and developing new green city projects as well as restructuring existing cities into the model of green city. In 4/ 2020, 150 urban housing projects were recognised as “green urban housing complex”, but no city is recognised as a green city as a whole. On the other hand, these green urban complex usually fulfil 2 criteria of a green city: the green space and green construction/ building. Technology innovation on this field included technologies supporting the urban design, construction technologies, construction materials research and production, technologies for processing construction wastes, etc.

- Reducing the urban wastes emission (including waste water, solid wastes and dust in the air) from all sources (industrial and agricultural production, wastes of urban living) and strengthening the wastes processing.

- Reorganisation and improving the internal urban transportation to reduce CO<sub>2</sub> emission. Vietnam’s cities, especially big cities like Hanoi and Ho Chi Minh City, spent lots of efforts to set up and expand their public transportation, including replacing the traditional bus by electric bus and other environment friendly transportation means.

Agricultural technologies and their application are the next topic of technological innovation for the green growth in Vietnam. The green technology in the agriculture is not only important for a green economy, but also for the social development and sustainability, either for rural, but also for urban regions. Concretely, the application of green technologies in the agriculture aims currently on 1) providing organic agricultural products for the market (including for consumers as well as for further industrial processing); 2) improving the efficiency of the agricultural production; 3) replacing manual

agricultural works by machines; 4) maximising benefits from usage of natural resources, especially the land and natural water) and finally, 5) contributing to implement the commitment of the Government of Vietnam on the sustainable development (i.e. reducing the CO<sub>2</sub> emission, ensuring an environment friendly economic development, etc.). For achieving these objectives, a series of complex solutions are launched, such as: 1) launching the circular economy and expanding the production chain in the agriculture (processing by- products from rice, cassava, corn, vegetables production to animals' foods or basic prices can for growing beneficial insects, worms, etc., processing by- products of agricultural products to organic fertilizers, processing animal manures and straws/ fresh grass to biogas, etc.); 2) replacing chemical fertilizers by organic ones; 3) mechanising and automatising the agricultural production and agricultural product processing process; 4) rationalising cultivation regimes in order to ensure the biodiversification in each agriculturally cultivated land; 5) researching and developing new kinds of plants and animal varieties and 6) applying information technologies in monitoring and managing agricultural production and business.

Results of such solutions are: The area of organically cultivated land area increased from 77,000 ha in 2016 to 240,000 ha in 2022. In that year (2022), nearly 20,000 farmers in 46 (out of 63) provinces/ cities of Vietnam cultivated in green agricultural model; 34 high tech agriculture zones were clarified and approved by authorised agencies; export of Vietnam's green agricultural products (in nearly 180 countries and territorial regions) achieved a value of USD 335 million. At the end of 2023, there were 2,204 collectives (in comparison with 1,700 in 2020), 517 collective groups, 1,091 enterprises and 186,829 farmers practising the green agriculture. Technological progress contributed more than 30% of value added of the agriculture, 38% of value added in the plant and animal varieties. Moreover, 2146 green agricultural projects with an investment amount of VND 11,440 billion were for the next period approved.

### Conclusions and recommendations

The technological innovation and applying new, advanced technologies are surly one of main success factors for ensuring the green growth in Vietnam in coming decades. In the last years, Vietnam spent lots of efforts for the modernisation and innovation of technologies in key sectors/ areas of the green

economy. Either the Government of Vietnam or Vietnam's enterprises invested lots of money as well as other resources for developing new technologies, receiving and adapting transferred technologies. Green technologies are preferred objects in economic development projects. Such green technologies in the country need to be developed, received, adapted and applied in following focus directions:

- Producing and consuming green products.
- Producing and consuming renewable energy.
- Developing and using new environment friendly materials.
- Recycling and reuse of products.

The technological innovation is a major solution and a major direction of Government's interaction to put the transformation of the traditional to green economy and to ensure the green growth of Vietnam's economy ahead. However, the interruption of the Government of Vietnam could not replace efforts of business community as well as country's citizen. Therefore, technological capacity of business entities should be key the target object with highest priority for all supporting activities and investments of the Government of Vietnam as well as international organisations/ agencies.

### References:

- Anh Duong (2022), *Developing green transport is the key for solving the urban pollution problems*. Xay Dug (online newspaper of the MOC) on 15/ 4/ 2022.
- Levis Akenji, Magnus Bengtsson (2014), *Making Sustainable Consumption and Production the Core of Sustainable Development Goals*. Sustainability 2014.
- Charles W. Cobb, Paul H. Douglas (1928), *A theory of production*. American Economic Review, No. 18/ 1928 (Supplementary).
- Decision 1658/ QĐ-TTg on 01/ 10/ 2021 of the Prime Minister approving the national strategy on green growth in the period 2021- 2030 and vision to 2050.
- Developing a green transportation system focusing on the Zero net emission. Newspaper online of the Communist Party of Vietnam on 20/ 11/ 2023.
- Duong Vu (2020), *Patent landscape on green technology in Vietnam*.
- Forum "Reality and solutions for green transformation of the energy sector- the green industrial economic sector". Newspaper online Construction of MOC on 24/ 5/ 2024.
- Arnulf Grübler: *Technology and global change*. International Institute for Applied Systems Analysis Laxenburg, Austria. tech98.pdf (iiasa.ac.at)
- Ho Thuy Ngoc, Nguyen Tu Anh (2016), *Green Economy Development in Vietnam and the Involvement of Enterprises*. Low Carbon Economy, 7.
- Phan Thi Hue (2023), *High tech agriculture in Vietnam- Obstacles and perspectives*. Journal Economics and Forecasting, no. 26, 9/ 2023.
- Nathan Hultman, Katherine Sierra, Allison Shapiro (2012), *Innovation and Technology for Green Growth*. The 2012 Brookings Blum Roundtable Policy Briefs.
- Michael Jacobs (2012), *Green Growth: Economic Theory and Political Discourse*. Centre for Climate Change Economics and Policy, Working Paper No. 108.
- A. Kasztelan (2017), *Green growth, green economy and sustainable development: terminological and relational discourse*. Prague Economic Papers 5/ 2017
- Nguyen Tuan Phong (2021), *Developing green economy in Vietnam in the period 2011- 2025*. Journal Finance and Economy, no. 4/ 2021. Chi tiet tin (mof.gov.vn)
- OECD (2011), *Towards Green Growth*. Paris.
- Richard Ramsavak, Robert Baulch (2024), *Making the renewable technology goals achievable for Vietnam*. The Business School, RMIT Vietnam. Electricity of Vietnam. Electricity sector analysis by Securities Company Dai Viet.
- John M. Reilly (2012), *Green Growth and the Efficient Use of Natural Resources*. Energy Economics, 34. <https://doi.org/10.1016/j.eneco.2012.08.033>
- Yamei Sun, Yonglong Lu, Tiejun Wang, Hua Ma, Guizhen He (2008), *Pattern of patent based environmental technology innovation in China*. Technological Forecasting and Social Change, 2008. 75(7).
- Nguyen Van Tien (2024), *Developing green agriculture: Actual status and solutions*. Newspaper online of the Communist Party of Vietnam on 87/ 7/ 2024.
- Trinh Viet Tien (2023), *Developing green agriculture- Reality and some solutions*. Journal Economics and Forecasting, no. 17, 6/ 2023.
- Vo Le (2024), *Ho Chi Minh City encourage green transportation*. Nhan Dan online on 18/ 02/ 2024.
- World Intellectual Property Organization (WIPO, 2022), *Green Technology Book 2022- Solutions for climate change adaptation*. Geneva.