NEW TRENDS IN SCIENCE, TECHNOLOGY AND INNOVATION POLICY DEVELOPMENT TO PROMOTE GREEN GROWTH AND SUSTAINABLE DEVELOPMENT

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Summary:

Science, technology and innovation (STI) are key elements in ensuring and promoting green growth and sustainable development. Despite this, the world continues to face persistent challenges in energy, climate change, and environmental risks to people's health and well-being, while rapid technological advancements introduce new risks and uncertainties. Therefore, the problem for STI policymakers is to promote economic growth while minimizing the unwanted impacts of STIs on the environment and social security, with the core motto "leaving no one behind". This article aims to understand the trends of the STI policy development in the world in the context of green growth, and sustainable development thereby linking it to Vietnam and identifying the problems posed to it. The article comprises four sections: (1) Trends in green growth, and sustainable development and the role of STI; (2) Green growth and sustainable development requirements for the STI policy development; (3) New trends in the STI policy development in the context of green growth and sustainable development; (4) Implications for STI policy development in Vietnam.

Keywords: *Science and technology; Innovation; Policy; Green growth; Sustainable development.*

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1. Green growth, and sustainable development trends and the role of science, technology and innovation

1.1. Green growth, and sustainable development trends in the world and in Vietnam

The terms "*green growth*" and "*sustainable development*" first appeared in 1980 in the World Conservation Strategy (published by the International Union for Conservation of Nature and Natural Resources - IUCN) and were

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widely popularized in 1987 in the Brundtland Report (also known as Our Common Future Report) of the World Commission on Environment and Development - WCED (now the Brundtland Commission).

This report defines green growth as "development that can meet the needs of the present without affecting or harming the ability to meet the needs of future generations...". In other words, green growth must ensure effective economic development, social equity, and environmental protection and preservation. Green growth is an important orientation for sustainable development, contributing directly to reducing greenhouse gas emissions towards a carbon-neutral economy in the long term.

Green growth is characterized by: (i) development is based on the efficient use of resources through the application of advanced technologies, clean production processes, and energy saving; (ii) minimizing greenhouse gas emissions, and environmental pollution and protecting biodiversity; (iii) ensuring the social equity, improving people's living standards, creating job opportunities for everyone and innovation in the fields of science and technology, especially in the fields of renewable energy, green technology, and environmental protection.

Also in this Report, "sustainable development" is mentioned with the content: "*human development cannot only focus on the economic development but must also respect the essential needs of society and the impact on the ecological environment*". This report has put forward the goal of sustainable development as "*achieving sustainable development by conserving biological resources*". The term "sustainable development" here is referred to in a narrow sense, emphasizing the ecological sustainability of development, and calling for the conservation of biological resources.

The term gained widespread recognition in 1987 through the Brundtland Report (also known as the Our Common Future Report) of the World Commission on Environment and Development - WCED (now the Brundtland Commission). This report clearly stated that sustainable development is "*the development that can meet the needs of the present without affecting or compromising the ability of future generations to meet their own needs*...". This term mainly emphasizes the effective use of natural resources and ensuring the living environment for people in the development process. Sustainable development is a model of optimal transformation of economic and social benefits in the present without harming the potential of similar benefits in the future (*Godian and Hecdue, 1988, Prof. Grima Lino*).

The connotation of sustainable development was reaffirmed at the Earth Summit on Environment and Development held in Rio de Janeiro (Brazil) in 1992 and supplemented and completed at the World Summit on Sustainable

Development held in Johannesburg (South Africa) in 2002: "Sustainable development" is a development process that closely, reasonably and harmoniously combines three aspects of development, including economic development (especially economic growth), social development (especially making progress, social justice; hunger eradication, poverty reduction, and job creation) and environmental protection (especially pollution treatment, remediation, environmental quality improvement; forest fire prevention and deforestation; rational exploitation and economical use of natural resources). Sustainable development is the development that satisfies the needs of the present generation without harming the ability to meet the needs of future generations.

According to the Asian Development Bank (ADB): "*Sustainable development is a new type of development that integrates production processes with resource conservation and environmental quality improvement. Sustainable development must meet the needs of the present generation without harming our ability to meet the needs of future generations."*

Green growth and sustainable development have become a common trend and development strategy of the whole world, especially in the context of very strong integration and globalization process as well as climate change, which has become the biggest challenge for humanity in the 21st century. In September 2015, the United Nations adopted the 2030 Agenda for Sustainable Development. The core of the 2030 Agenda is 17 sustainable development goals (SDGs), in which science, technology and innovation are key tools for implement the SDGs, alongside financial investment and institutional environment.

Along with many countries in the region and in the world, green growth and sustainable development are identified as one of the focuses in Vietnam's development policy, affirmed in important guiding documents of the Party and State. The Resolution of the 13th National Party Congress has identified the guiding viewpoint of "*rapid and sustainable development of the country*", building a green economy, a circular economy, and an environmentally friendly economy as an important orientation for national development during the 2021 - 2030 period.

In order to implement the above-mentioned orientation, Resolution No. 29-NQ/TW dated November 17, 2022, of the 13th Party Central Committee on continuing to promote industrialization and modernization of the country to 2030, with a vision to 2045; Resolution No. 50/NQ-CP dated May 20, 2021 of the Government on the Government's action program to implement the Resolution of the 13th National Party Congress were issued, creating a

foundation for organization and implementation, in which green growth is considered as a breakthrough with long-term strategic significance.

The Government, ministries, sectors, and localities have issued many legal documents, programs, action plans, and directives on green and sustainable growth such as National Green Growth Strategy for the period 2021 - 2030, and Vision to 2050; National Action Plan on Green Growth for the period 2021 - 2030; National Action Plan to implement the 2030 Agenda for Sustainable Development; National Strategy on Climate Change for the period up to 2050; Strategy for Science, Technology and Innovation Development to 2030; Strategy for Sustainable Agricultural and Rural Development for the period 2021 - 2030, and vision to 2050; Circular Economy Development Project in Vietnam;…

On the journey to achieve sustainable development goals, Vietnam continues to commit and act on transformation, development of a green economy, circular economy, and clean energy to achieve the net zero emissions goal by 2050. The National Strategy on Green Growth for the period 2021 - 2030, and vision 2050, affirms that Vietnam's green growth and sustainable development are based on the 3 main pillars foundation of: (i) Transforming the growth model towards greening economic sectors; (ii) Building a green lifestyle combined with beautiful traditional lifestyles to create a high-quality life in harmony with nature; creating a sustainable consumption culture; (iii) Improving the quality of life and the resilience of people to climate change, ensuring equality in conditions, and opportunities to develop the capacity and to enjoy the fruits of development, leaving no one behind in the green transformation process.

1.2. The role of science, technology and innovation in green growth and sustainable development

Science, technology and innovation are some of the main factors that play a positive or negative role in sustainable development, along with other factors such as governance (executive, legislative, judicial), management, education, and civil society (*Kongoli, 2016*). While advances in science, technology and innovation solve many practical problems, they also create challenges for society (*Parens et al., 2009*). The emergence of information technology has created great advances in health, education, transportation, and human-to-human communication. However, it has also introduced security risks and privacy violations. Rapid advances in biotechnology, nanotechnology, and neuroscience have the potential to be applied to other areas of science to improve the quality of human life, but the technologies and chemicals created from these areas will bring about unpredictable changes in human biology. Technological change will often entail a demand for capital and highly

qualified and skilled labor. As a result, unskilled labor may be displaced, leading to a reduction in employment. Therefore, the adoption of new technologies will also mean changes in the labor structure of society, which may lead to increased inequality. In particular, in the short term, developing countries may face a difficult adjustment process as their economies are hardly adapted to new production structures. The direct impact of innovation in the short term is to improve labor productivity, which can help to produce the same output with less labor force and therefore can have an adverse impact on workers' employment.

In Vietnam, science, technology and innovation are increasingly asserting their role as a strong driving force for the country's rapid and sustainable development, playing a strategic breakthrough role in shifting the economic model from "brown" to "green", and providing the solutions to address social and environmental challenges such as hunger eradication, poverty reduction, improving food security, nutrition and agricultural development, and promoting access to and efficiency of energy, disease prevention and health improvement, etc.

2. Requirements from green growth and sustainable development to science, technology and innovation policy development

2.1. Challenges for green growth, and sustainable development

Green growth and sustainable development are inevitable trends. However, they require significant investments to transform the system from "brown" to "green". According to the World Bank (WB), to realize the goal of achieving net zero emissions by 2050 to implement Vietnam's commitment at the 26th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP26), Vietnam will need up to 380 billion USD to invest in. In context, Vietnam faces numerous challenges, including the instability of the global economy which is still having certain impacts on the macro economy, and making the economic recovery process potentially risky, forcing policymakers and localities to not only have to consider long-term sustainable development but also have to overcome the immediate difficulties and shortcomings that businesses, people and localities are facing at.

In addition, there are challenges in infrastructure, energy, policy, and awareness, specifically:

- Infrastructure constraints: Lack of infrastructure needed to support green growth, which can hinder the widespread adoption of green technologies and sustainable production methods;

- High energy demand: Increasing energy demand puts pressure on natural resources, and the transition to renewable energy sources requires time and large investment capital;
- Policy barriers: Support policies for green growth are still inadequate, such as tax incentives, subsidies, or regulations, compulsively requiring the application of green technologies;
- Awareness constraints: Many people and businesses are still not fully aware of the importance of green growth and sustainable development, leading to hesitation or lack of interest in transitioning to green solutions.

2.2. Requirements for science, technology and innovation policies

The above challenges pose new requirements for science, technology and innovation, asking science, technology and innovation policies to be adjusted to meet the requirements of transformation. Specifically:

- Science, technology and innovation policies need to support shortening the innovation cycle for technologies serving sustainable development: The International Energy Agency (IEA)'s "Net Zero Emissions by 2050 Scenario" (NZE) states that without accelerating innovation toward low carbon emissions, it will be impossible to achieve the net zero emissions goal by 2050, so it is necessary to shorten the innovation cycle for clean energy technologies in the early stages of technology. This creates new demands on innovation systems and, more broadly, on science, technology and innovation policies that support shortening the innovation cycle for technologies serving sustainable development;
- Science, technology and innovation policies need to guide the development of technology: The challenge of sustainability requires clearer guidance in science, technology and innovation policymaking. The potential of science, technology and innovation will only be realized through deliberate and committed action (UNESCAP, 2015). However, over the past few decades, policies supporting research and development (R&D) activities have lacked direction guidelines for research and technology. The lesson of many countries' confusion in responding to emerging pandemics is a typical example of this kind of limitation of science, technology and innovation policies;
- Science, technology and innovation policies need to be designed with citizen participation: Inclusive and human-centered transitions are key to helping the world move faster towards achieving climate targets, towards net zero emissions by mid-century. Public acceptance is crucial to legitimizing and support for bold transition policies. Gaining momentum to address green techno-social transitions will require citizen support for

policies that are based on technical evidence, as well as public discourse on the future of technology in society. Furthermore, in complex contexts, engaging citizens in science, technology and innovation policies can tap into diverse sources of ideas and information, as well as help to identify the real needs and concerns of different social groups. This could lead to more legitimate policy decisions that better meet people's needs and consider broader socio-economic impacts. Therefore, broadening the participation of stakeholders in science, technology and innovation policymaking is necessary.

Besides that, according to UNCTAD (2018), for developing countries, to gain more benefits from science, technology and innovation for sustainable development, the requirements for science, technology and innovation policies are:

- Building science, technology and innovation policies to develop the capacity to learn, apply, and disseminate the existing and new knowledge and technology to promote sustainable and inclusive development;
- Prioritizing resources, and time to build and manage the national innovation system, focusing on 3 main contents: (i) Capacity of subjects and stakeholders; (ii) Networks and linkages that enable cooperation and learning; (iii) Favorable environment for improving the capacity to absorb, learn, apply and disseminate technology;
- More fully consider the potential of innovation systems to address sustainable development issues, and develop a comprehensive view of all types of innovation, new actors, and partnerships, as well as a new and broader view of the framework conditions and innovation environment.

The above-mentioned requirements of green growth, and sustainable development for science, technology and innovation policies create the foundation for the formation of a number of new policy trends called "*new science, technology and innovation policy frameworks for sustainable development*" (*UNCTAD, 2018).* This content is presented in the next section of the article.

3. Some trends in developing new science, technology and innovation development policies in the context of promoting green growth and sustainable development

3.1. Adjusting the target orientation of science, technology and innovation policy

In recent times, science, technology and innovation policies have been considered tools to enhance the economic competitiveness of countries.

These policies focus on promoting economic growth and developing national innovation systems. Science, technology and innovation policies focus on policies such as R&D funding and taxes, intellectual property protection, and policies to enhance the capacity to absorb and learn of the national innovation system. The negative impacts of science, technology and innovation on society or on the environment are not placed at the center of the policy.

However, the fact is that economic growth alone does not guarantee social well-being, and its benefits are not evenly distributed. Evidence shows that in some OECD countries that have achieved economic growth, people at the bottom of the income distribution chain have benefited little. This has led to inequalities within countries. Many emerging and developing countries that have experienced positive growth drivers have also found that poverty and social inequality continue to be a challenge. In addition, income inequality in high-income countries has increased. Some middle-income countries are stuck in resource-dependent growth, and low-income countries have made little progress in catching up with more developed countries. This raises the question of whether increased investment in R&D and building national innovation systems will lead to national development and catching up; Does R&D investment reduce inequality and solve social problems because only a small portion of each country's population will receive the main benefits from these investments?

To address this issue, countries are experimenting with new policy tools, such as challenge-based funding and mission-oriented innovation policies that engage multiple stakeholders, including businesses and public research institutions, to co-innovate and collaborate on a path to net zero emissions. Many countries in the European Union (EU), especially Sweden and Germany, have pioneered adjusting the target orientation of science, technology and innovation policy not only limiting technology development but also serving as a tool to address social, economic, and environmental challenges. Adjusting the target orientation of policy plays an important role in promoting the digital economy, applying clean technology, developing renewable energy, contributing to environmental protection, and improving the quality of life of people.

Sweden has implemented several renewable energy support programs to promote the development of green technologies, such as the Renewable Energy Promotion Program, which provides financial and technical support for clean energy projects (wind, solar, and bioenergy). The government encourages green technology innovation through incentives and research support. Initiatives such as the Green Technology Research and Development Fund fund projects that develop clean technologies and reduce environmental impacts. Sweden is one of the leaders in biotechnology

research. The government supports R&D projects in the field of biology through funds such as the Swedish Foundation for Strategic Research (SSF), which promotes innovation in areas such as medicine, agriculture, and biotechnology. Sweden is promoting AI R&D through programs such as AI Innovation of Sweden, which supports AI projects in a variety of fields, from healthcare to industry. These efforts aim to foster innovative solutions and boost productivity. Sweden has implemented many effective policies to support innovation, focusing on facilitating research and development of new technologies and promoting green technology, renewable energy, AI, and biotechnology. These policies not only promote domestic innovation but also help Sweden maintain its leading position in high-tech and sustainable development.

Germany has developed clear policies to promote the green economy and Industry 4.0, focusing on the use of new technologies to improve economic efficiency and reduce environmental impact. Germany has many important strategies and plans to promote science, technology and innovation to address major challenges as the National Industrial Strategy 2030 promotes the application of digital technologies and renewable energy to minimize environmental impact, developing industries in a sustainable direction; the National Hydrogen Energy Strategy aims to develop and use green hydrogen energy, with the goal of reducing greenhouse gas emissions and building a sustainable energy economy; the Research and Innovation Strategy "Future-oriented framework" supports research and innovation in many areas, from biotechnology, renewable energy to healthcare and digital transformation with the goal of addressing global challenges such as climate change, sustainable energy, health care through research and innovation; encourages interdisciplinary research projects, international cooperation, technology transfer, etc.

The European Council's Framework Programme for Research and Innovation (*Horizon 2020*), *Horizon Europe*[2], is the typical example with the aim of harmonizing three goals: (i) enhancing Europe's S&T capacity; (ii) enhancing innovation capacity, and competitiveness, solving employment problems and ensuring Europe's technological sovereignty; (iii) building a sustainable society. The 2015 Lund Declaration affirmed that Europe needs to accelerate the solutions to address major challenges through global linkages, research, and cooperation. According to this Declaration, Europe is still facing major social and environmental challenges despite achieving economic development. Therefore, strengthening cooperation at national and

[2] Horizon Europe is built on the success of Horizon 2020 to promote science, technology, and innovation and address pressing societal challenges.

European levels; and increasing investment in research and innovation to address major social challenges are urgent tasks for this continent. The Lund Declaration identifies four priority areas and calls for the involvement of all stakeholders, in particular the business sector, civil society, and citizens. The European Union's evaluation highlights Horizon 2020's significant contributions to economic development and solving societal challenges. Europe's rapid response to the COVID-19 pandemic and its achievements in climate science are some examples of Horizon 2020's results (*Sylvia et al., 2023*).

3.2. Expanding stakeholder engagement in the science, technology and innovation policy-making process

Current trends in science, technology and innovation policy emphasize the engagement of stakeholders to seek comprehensive solutions to address environmental and social challenges (*Diercks et al., 2019*). In addition to stakeholders such as governments, research and training sectors, and businesses (*Schot and Steinmueller, 2018; Grillitsch et al., 2019*), there is also a need to engage international stakeholders and responsible, informed citizens (*Amanatidou et al., 2014; Steward, 2012*).

Governments are responsible for organizing, developing, and implementing science, technology and innovation policies. However, governments cannot do everything. In practice, even well-intentioned policies can have unintended consequences. Sometimes, the interests of policymakers may not be aligned with the long-term interests of society. Broadening the participation of stakeholders at all stages of the policy cycle is a move to prevent and reduce the risk of policy failure. The involvement of international organizations in policy formulation is important because the major challenges of sustainable development are global in nature and therefore countries benefit greatly from leveraging the experience and investment of other countries. Similarly, related major challenges are better addressed if they are based on a deep understanding of needs and leverage the contributions of people of all genders, age groups, and ethnicities.

Countries around the world have taken initiatives to increase the influence of stakeholders on the outcomes of the policy-making process through forms such as encouraging citizens to share ideas for research and innovation programs, surveying and citizens polling on issues that need to be researched, organizing opinion exchanges and discussions to build future scenarios, mobilizing citizens to participate in science and technology programs, organizing innovation awards, building online collaboration platforms, building living laboratories... In which, typical cases are as follows:

Creating our future in Ireland is a national initiative of the Government in 2021-2022 to encourage citizens in Ireland to share their ideas to inform future research and innovation programs. Over 18,000 online applications were received between July and November 2021. These initiatives provided important input into the development of Ireland's Research and Innovation Strategy 2030, which was published in May 2022, as well as other challenge-based funding initiatives (*SFI, 2022; Government of Ireland, 2022*).

The Flemish Science Agenda (2017) in Belgium mobilized citizens to explore what research issues they considered most important. Over 10,000 questions were submitted on 82 overarching topics. "Five nights of science" were then held, where people sat down with experts to engage in conversations about the questions raised.

The Netherlands Research Programme (2016) was initiated by the Dutch Government to set research priorities and create a better match between research and economic and social needs (*NWO, 2022*). Citizens submitted more than 12,000 scientific questions via a web platform. A jury of leading researchers from all fields organized the questions into problem clusters, resulting in 140 overarching questions for research and innovation.

Citizens provided input to the identification of priority areas in the *Horizon Europe Programme* by participating in events organized to collect suggestions from the public. Citizens were also able to upload their ideas on the digital platform. In Korea, X-Project is a national R&D program that involves citizens in identifying research problems to be solved through S&T solutions developed by researchers (*OECD, 2017*).

The BioKompass project (2017-2020) funded by the German Federal Ministry of Education and Research (BMBF) aims to engage citizens in a dialogue on the transition to a bio economy. The research team developed a future dialogue with more than 60 citizens and experts to discuss how the bio economy could affect people's everyday lives in specific areas, such as transport, housing, consumption, and work. Based on this process, alternative scenarios for 2040 were co-developed using citizen input, stakeholders' positions, and trend research. At a second citizen dialogue with more than 50 participants, the scenarios were discussed and enriched by using a co-creation narrative method. Each scenario addresses different development trajectories for the central themes of any future bio economy development and their implications for policy areas, technological developments, economic structures, individual practices, and quality of life (*Rosa et al., 2021*).

At the continental level, the CIMULACT project (2015-18), funded by the European Union's Horizon 2020 Programme, engaged citizens to redefine the European Research and Innovation agenda based on shared visions, needs,

and demands *(CIMULACT, 2018)*. More than 1,000 citizens in 30 European countries participated in national visioning workshops to discuss and develop their visions for a desirable sustainable future. All countries adopted the same format and materials (e.g. inspirational journals and images, facilitator scripts) to have a consistent and comparable approach to generating these visions. The citizens' visions were then translated into recommendations for future research and innovation topics, including 23 recommendations for Horizon 2020 themes. The results were then validated, enriched, and prioritized by over 3,400 online consultations (*CIMULACT, 2018*).

In Valencia (Spain), citizens and civil society organizations are encouraged to become ambassador organizations for the Missions Valencia 2030 initiative. Ambassadors commit to supporting the transitions within their reach, participating where possible in research and innovation efforts to have a positive impact on one or more missions, and becoming a multiplier channel to disseminate information related to the program (*Missions Valencia, 2023*).

Mobilizing international participation:

In addition to initiatives to mobilize people's participation, there are also initiatives to mobilize the participation of international organizations in the policy-making process to address major challenges. International participation in policy-making takes the form of coordination in the development of mechanisms and policies; development of joint programs on research and application of technological solutions; development of policy initiatives...

A typical example of international participation in policy-making is the international initiative "*mission-driven innovation*". This is a global initiative launched with the Paris Agreement in 2015 to promote investment in R&D to make clean energy affordable, attractive, and accessible to all countries in the next decade. The Mission-Driven Innovation Initiative brings together governments, public agencies, businesses, investors, and academia to collaborate on public-private action and investment through sector-specific "missions" to promote clean energy innovation in key areas.

Another initiative, launched at COP26 in 2021, is the "*Breakthrough Agenda*", in which 45 countries commit to work together to accelerate innovation and deployment of clean technologies and make them accessible and affordable to all by 2030. This agenda is designed to encourage international cooperation involving both the public and private sectors. More recently, the Group of Seven (G7) Climate Club initiative aims to create an intergovernmental forum to promote ambitious climate policy worldwide, and the OECD Comprehensive Forum on Low-Carbon Approaches aims to facilitate multilateral dialogue on climate change mitigation policy.

International engagement is important in policy formulation for the following reasons: (i) Major sustainability challenges such as climate change are global and therefore international coordination can promote innovation, increase incentives for investment, and promote a fair and equal playing field where necessary; (ii) Sharing experiences across countries can help reduce risks and accelerate progress towards viable low-carbon solutions. Some measures and implementation commitments can accelerate economic efficiency by scale and reduce costs accordingly.

Inclusive and human-centered transitions are crucial for accelerating progress toward mid-century climate targets and net zero emissions. Broad societal acceptance is needed to build legitimacy and support for bold transition policies. Gaining momentum to address green socio-technical transitions will require public support for policies based on technical evidence, as well as public discourse about the future of technology in society. Furthermore, in complex contexts, engaging citizens in the science, technology and innovation policy process can tap into diverse sources of ideas and information, and help identify the real needs and concerns of different societal groups, including those underrepresented in science, technology and innovation. This could lead to more legitimate policy decisions that better meet people's needs and take into account broader socio-economic impacts and ethical implications.

The trend towards a "just" transition, with the aim of ensuring that the costs and benefits of the transition to a more sustainable future are shared fairly and that no one is left behind, is a testament to the broadening of participation in policy-making and its benefits. Policies include measures to provide support for working-age people who may be displaced by the low-carbon transition, investing in education and training to help people adapt to new industries, and ensuring that disadvantaged communities have a voice in the transition. For example, the European Commission has launched the Just Transition Mechanism, mobilizing around EUR 55 billion over 2021-2027 to alleviate the socio-economic impacts of the transition in the most affected regions. The International Energy Agency (IEA) has established a Global Commission on People-Centred Clean Energy Transitions, which has published 12 key recommendations designed to help people benefit from the opportunities and respond to the changes brought about by the clean energy transition.

3.3. Addressing new disruptive forces through flexible public management policies

STI policies need to adapt to disruptive technologies and business models. Innovation in artificial intelligence, biotechnology, and other areas is

changing the way businesses operate and deliver value (*OECD, 2024*). This requires policymakers to proactively identify and assess new disruptive forces in STI activities; reassess traditional STI policies, including policy bottlenecks, non-technological barriers affecting innovation, limiting the diffusion of new technologies that affect economic growth and social benefits; strengthen international monitoring of R&D to assess the impact of emerging technologies; develop strategies to evaluate the social benefits and economic impacts of new technologies. At the same time, policymakers can use policies to promote experimentation, especially through support for R&D to build living labs and sandboxes to develop technological solutions, services, and organizational processes that address major social and environmental challenges.

4. Implications for Vietnam's science, technology and innovation policy development in the context of green and sustainable growth

4.1. The new context requires adjustments in science, technology and innovation policies

The international context, the domestic context of politics, economics, technology, globalization, and the implementation of sustainable development goals create opportunities for science, technology and innovation of countries around the world as well as Vietnam to access new achievements from outside, suggesting new ways to solve newly arising problems to enhance science, technology and innovation capacity, and make leaps to shorten the gap with leading countries.

The international context opens up common opportunities for many countries, but there will be fierce competition between countries in seizing opportunities from the international context such as strategic competition, trade wars, and fighting for resources, markets, technology, and high-quality human resources. Developing countries like Vietnam will face certain difficulties in transitioning to a green and sustainable growth model, which requires recognition, analysis, and assessment of bottlenecks in science, technology and innovation policies in order to make appropriate adjustments.

4.2. Some specific implications for Vietnam's science, technology and innovation policy development

- Regarding the target orientation of science, technology and innovation policy:

Science, technology and innovation policy needs to orient the results of science, technology and innovation activities to serve the implementation of sustainable development goals through the requirement to integrate

sustainable development goals into science and technology tasks. The requirement to integrate sustainable development goals into science and technology tasks needs to be stipulated in official guidelines on science and technology task planning. The integration of sustainable development goals must be carried out based on the results of the analysis and assessment of science, technology and innovation needs in implementing Vietnam's sustainable development goals.

- *Regarding the participation of stakeholders in the science, technology and innovation policy-making process:*

+ It is necessary to correctly identify the roles of stakeholders in the sustainable development process to maximize their participation and contributions;
+ Promote coordination between stakeholders in implementing sustainable development goals to take advantage of good capacity foundations in creating technology as well as using available knowledge to serve green and sustainable growth;
+ Promote the role of people, businesses, socio-political and professional organizations, and communities in participating in developing, criticizing, and monitoring the implementation of laws, mechanisms, and policies on science, technology and innovation;
+ Develop an open, collaborative, and inclusive knowledge economy by: (i) consulting all stakeholders in the STI strategies preparation, particularly to ensure that economic, social, and environmental challenges are integrated (short-term); (ii) committing to an open knowledge-sharing ecosystem to promote cross-sectoral STI collaboration through physical and virtual infrastructure for knowledge sharing; (iii) adopting open and inclusive approaches to innovation by engaging diverse stakeholders, including women, the poor and citizens.

- *Regarding policy tools:*

+ Perfecting policies on knowledge promotion, dissemination, and diffusion, including open science policies to ensure that all people have access to scientific research information and results, providing provisions for businesses to compete strongly in the international market, making scientific information more accessible to help students and apprentices grasp new advances, thereby developing their capacity and understanding in the community, improving the effectiveness of education and training;

- Encouraging businesses to invest in science, technology and innovation to address challenges in implementing sustainable development goals through public procurement policies and tax incentives;
- Expanding policy tools to incentivize businesses to adopt eco-friendly technologies with low energy consumption and emissions;
- Focus on human resources training to carry out future technology forecasting activities to support information for science, technology and innovation action plans in line with sustainable development goals;
- Build a specific legal corridor and an inter-sectoral mechanism to have appropriate solutions for unprecedented products and services;
- Build a mechanism to apply a controlled testing institutional framework (sandbox) for scientific research, technology development, and innovation activities in several science and technology projects.

5. Conclusion

In the context of increasingly depleted natural resources, extreme and unpredictable climate change, environmental degradation and pollution, and declining natural ecosystems, green and sustainable growth is an urgent need and an inevitable trend in the development process of every country. The global competitive trend will be "green competition" (*UNCTAD, 2023*), so the success and leadership of this trend will belong to countries that can grasp early, and act immediately and flexibly in the process of policy development and perfection.

In the context of a developing country like Vietnam, there are still many difficulties and challenges that require the active and effective participation of stakeholders in research and discussion to grasp new trends in mechanisms, and policies and propose solutions in developing and implementing strategies, policies, programs, tasks and solutions on science, technology and innovation to achieve the goal of green growth and sustainable development of the country./.

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