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PROBLEMS AND COUNTERMEASURES FOR THE TRANSFORMATION OF SCIENTIFIC AND TECHNOLOGICAL ACHIEVEMENTS IN ENVIRONMENTAL PROTECTION IN THE NEW ERA

The transformation of scientific and technological achievements in environmental protection in the new era is facing several challenges that need to be addressed. Firstly, there is a lack of investment in environmental protection research and development, which hinders the commercialization of environmental protection technologies. Secondly, the market demand for environmental protection products and services is still low, and the overall level of consumption is not high enough to support the development of the industry. Additionally, there is a lack of effective management and control mechanisms, leading to a weak market environment and limited market space. To address these challenges, a series of countermeasures can be taken. Firstly, it is necessary to increase investment in environmental protection and encourage enterprises to invest in the development of new technologies. Secondly, the government can create a favorable market environment by implementing policies and regulations that support the development of the environmental protection industry. Thirdly, it is important to improve public awareness and increase the level of environmental protection knowledge among the public, in order to increase the demand for environmental protection products and services. Finally, it is necessary to establish effective management and control mechanisms, to regulate the development of the environmental protection industry and ensure sustainable and healthy growth.

1. INTRODUCTION

Environment protection refers to the preservation, conservation, and improvement of the natural environment, including air, water, and soil, as well as the ecosystems that depend on them. It involves actions and policies aimed at reducing harmful human impacts on the environment and promoting sustainability [1]. Technology plays a crucial

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role in environmental protection by providing solutions to reduce pollution and minimize negative human impacts on the environment. Some examples of technology used in environmental protection include [2]:

- Renewable energy sources such as solar, wind, and hydropower that reduce our dependence on fossil fuels and lower greenhouse gas emissions.
- Clean technologies like electric vehicles, energy-efficient appliances, and smart grid systems that help reduce energy waste.
- Water treatment and purification technologies that help reduce water pollution and conserve scarce water resources.
- Recycling and waste management technologies that reduce the amount of waste that ends up in landfills.
- Green building technologies that promote sustainable design, construction, and operations of buildings, resulting in reduced energy and water consumption.

These technologies, among others, help to mitigate the negative impacts of human activities on the environment and promote sustainable development. There are several challenges in transforming technological achievements into environmental protection. Some of the main challenges are [3]:

- **Cost.** Implementing new and advanced technologies often comes with a high financial cost, which can be a barrier for developing countries or smaller organizations. Cost is a significant barrier to the implementation of environmental protection measures and the transformation of technology towards more sustainable practices. The cost of transitioning to new, more environmentally friendly technologies can be substantial and may include the cost of research and development, the cost of new equipment and infrastructure, and the cost of retrofitting existing systems. In addition, there may also be ongoing costs associated with the operation and maintenance of these new technologies. For example, renewable energy sources such as wind and solar power are more expensive to produce than traditional fossil fuels. This financial barrier can be particularly pronounced for developing countries, small businesses, and households, which may have limited resources to invest in new technologies. However, there are countermeasures that can help to reduce the financial barriers to environmental protection and technology transformation, including government incentives, subsidies, and tax credits, as well as private sector investment and partnerships. In the long run, investment in environmental protection and sustainable technology can have positive economic benefits, such as reducing resource costs, creating new jobs, and improving public health, which can offset the initial costs and contribute to a more sustainable future.

- **Public awareness.** There is often a lack of public awareness about environmental issues and the need for technological solutions, making it difficult to drive adoption and investment in these solutions. Lack of public awareness and understanding of environmental issues is a significant challenge in promoting environmental protection and the transformation of technology towards more sustainable practices. Many people may not be aware of the impact of their daily actions on the environment, and may not understand

the need for, or the benefits of, environmentally friendly technologies. This lack of awareness can make it difficult to drive widespread adoption and investment in these technologies. In addition, misinformation and conflicting information about environmental issues can further confuse the public and hinder progress in this area. To address this challenge, it is important to increase public awareness and understanding of environmental issues, and the role that technology can play in protecting the environment. This can be achieved through education, public outreach, and media campaigns, as well as through the development of innovative and engaging technologies that help to demonstrate the benefits of environmental protection. Involving the public in the decision-making process and giving them the tools and information they need to make informed decisions can also help to increase their engagement and support for environmental protection initiatives.

- **Regulation.** In some cases, there may be insufficient regulations or a lack of enforcement to ensure that new technologies are used in an environmentally responsible manner. Regulations play an important role in promoting environmental protection and driving the transformation of technology towards more sustainable practices. However, there are several challenges and issues associated with the implementation of regulations in this area. Regulations may not be stringent enough to effectively address environmental issues, or they may be inconsistent or contradictory, making it difficult for companies and individuals to comply. Regulations may not be effectively enforced, either due to a lack of resources or political will, which can reduce their impact and undermine their effectiveness. Regulations can impose significant costs on companies and individuals, which may make it difficult for them to comply, particularly for small businesses and developing countries. Regulations may be overly complex and difficult to understand, which can make it difficult for companies and individuals to comply, and can increase the cost of implementation. There may be resistance to regulations from industries and individuals who view them as burdensome or harmful to their business interests. To overcome these challenges and ensure the effective implementation of regulations for environmental protection, it is important to balance the need for environmental protection with the need for economic growth and competitiveness. This can be achieved through a well-designed and transparent regulatory framework, which takes into account the needs and concerns of all stakeholders, and provides clear and consistent guidelines for implementation. In addition, it is important to ensure that regulations are effectively enforced and that there are mechanisms in place to monitor and review their impact over time. This can help to ensure that regulations remain effective in promoting environmental protection and driving the technological transformation towards a more sustainable future.

- **Infrastructure.** The lack of necessary infrastructure and support systems can also be a barrier to the widespread adoption of new environmental technologies. Infrastructure is a critical component in the transformation of technology towards environmental protection.

- Technological limitations. The technologies themselves may have limitations in terms of their efficiency, scalability, and long-term impact, which can impact their effectiveness in protecting the environment. Technological limitations are a significant challenge in promoting environmental protection and transforming technology towards more sustainable practices. These limitations can include:

- Unproven technologies. Many new technologies for environmental protection are unproven and untested, making it difficult for companies and individuals to invest in and adopt them.

- Limited capacity. Existing technologies may have limited capacity to effectively address environmental issues, such as the limited storage capacity of batteries for renewable energy sources.

- Inadequate research and development. There may be an inadequate investment in research and development for environmental protection technologies, which can limit their development and widespread adoption.

- Technical complexity. Some environmental protection technologies can be complex and difficult to implement, which can increase the cost of implementation and make it difficult for companies and individuals to adopt them.

- Interoperability. Different environmental protection technologies may not be compatible or interoperable with each other, which can make it difficult to integrate them into existing systems and reduce their effectiveness.

To overcome these technological limitations and promote environmental protection, it is important to invest in research and development and to provide incentives for the development and adoption of new technologies. In addition, it is important to address technical barriers, such as the need for more storage capacity for renewable energy sources, to ensure that these technologies are practical and effective. Collaboration between industry, government, and academia can also help to overcome technological limitations, by sharing expertise and resources, and by working together to find innovative solutions to environmental challenges.

Despite these challenges, there is a growing recognition of the need for technological solutions to environmental problems, and ongoing efforts to overcome these challenges and drive progress in this area.

2. TRANSFORMATION OF SCIENTIFIC AND TECHNOLOGICAL ACHIEVEMENTS. RELATED THEORIES

The transformation of scientific and technological achievements refers to the process of taking the results of scientific research and technological development and converting them into practical applications and products that can be used in the real world. This transformation process involves several steps, including [4]:

- **Research and development.** The initial stages of scientific research and technological development, where new ideas are explored and developed.
- **Prototyping.** The creation of a preliminary model or prototype of the product, which is used to test and refine the technology.
- **Testing and validation.** The testing of the technology to determine its performance and effectiveness, and to identify any limitations or challenges.
- **Commercialization.** The process of converting the technology into a commercial product that can be sold and used by customers.
- **Market launch.** The introduction of the product into the market and the start of commercial sales.
- **Continuous improvement.** Ongoing efforts to improve the technology and the product, based on feedback from customers and the market.

The transformation of scientific and technological achievements is an important process that helps to bring the benefits of research and development to society and to drive economic growth. It requires collaboration and cooperation between a wide range of stakeholders, including researchers, engineers, business leaders, and government agencies.

There are several theories and approaches that are related to scientific and technological achievements in environmental protection in the new era. Some of the most notable include:

- **Circular economy** proposes a shift from a traditional linear model of resource use and waste to a more circular system where waste is minimized and resources are used, reused, and recycled as much as possible.
- **Sustainable development** aims to balance economic growth with environmental protection, in order to ensure that development is sustainable over the long term.
- **Green technology** focuses on the development and implementation of environmentally friendly technologies, such as renewable energy, energy efficiency, and waste reduction, as a means of mitigating environmental impact.
- **Eco-innovation** involves the development of new products, services, and business models that are designed to be more environmentally friendly and sustainable.
- **Life cycle assessment** considers the entire life cycle of a product, from its raw materials to its end-of-life disposal, in order to identify and reduce its environmental impact.
- **Corporate social responsibility** proposes that companies have a responsibility to consider the social and environmental impact of their activities and to work towards creating a more sustainable future.

These theories and approaches can provide a framework for the development and implementation of scientific and technological achievements in environmental protection, and help to ensure that progress in this area is sustainable, responsible, and effective.

3. EXISTING PROBLEMS AND COUNTERMEASURES IN TECHNOLOGY TRANSFORMATION FOR ENVIRONMENTAL PROTECTION

There are several challenges and problems in the transformation of technology for environmental protection, including [5, 6]:

- **Cost.** Implementing new and advanced technologies often comes with a high financial cost, which can be a barrier for developing countries or smaller organizations.
- **Public awareness.** There is often a lack of public awareness about environmental issues and the need for technological solutions, making it difficult to drive adoption and investment in these solutions.

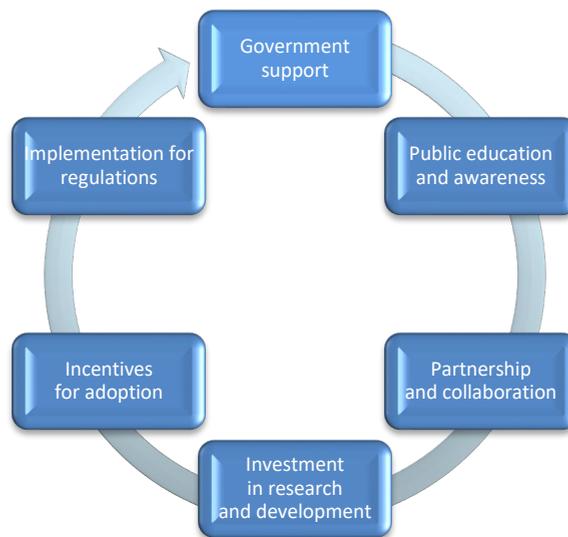


Fig. 1. Countermeasures to address the challenges in technology transformation for environmental protection

- **Regulation.** In some cases, there may be insufficient regulations or a lack of enforcement to ensure that new technologies are used in an environmentally responsible manner.
- **Infrastructure.** The lack of necessary infrastructure and support systems can also be a barrier to the widespread adoption of new environmental technologies.
- **Technological limitations.** The technologies themselves may have limitations in terms of their efficiency, scalability, and long-term impact, which can impact their effectiveness in protecting the environment.
- **Resistance to change.** Some individuals and organizations may resist change and the adoption of new technologies, due to concerns about cost, unfamiliarity, or potential disruption to established ways of doing things.

- Lack of coordination. There may be a lack of coordination and collaboration between different stakeholders involved in the transformation process, leading to inefficiencies and obstacles to progress.

Despite these challenges, there is a growing recognition of the need for technological solutions to environmental problems, and ongoing efforts to overcome these challenges and drive progress in this area.

There are several countermeasures that can be taken to address the challenges and problems in technology transformation for environmental protection [7–9] as shown in Fig. 1.

3.1. GOVERNMENT SUPPORT

Governments can provide financial and regulatory support to incentivize the development and adoption of new environmental technologies. Government support is an important factor in promoting environmental protection and transforming technology towards more sustainable practices. The role of government can include setting regulations and standards for environmental protection, providing financial incentives to encourage the adoption of sustainable technologies, investing in research and development for these technologies, supporting infrastructure development, and raising public awareness about environmental protection. Regulations can help drive technology transformation and encourage companies and individuals to adopt environmentally friendly practices, while financial incentives can help to overcome economic barriers to adoption. Government investment in research and development can help overcome technological limitations and drive innovation in the field of environmental protection. The development of infrastructure such as renewable energy sources and waste management systems can provide a solid foundation for sustainable growth. Finally, raising public awareness and educating individuals and communities about environmental protection can encourage everyone to play a role in promoting sustainability. In order to effectively promote environmental protection, it is important for governments to take a comprehensive and coordinated approach that addresses both technological and economic challenges.

3.2. PUBLIC EDUCATION AND AWARENESS

Raising public awareness about the importance of environmental protection and the benefits of new technologies can help to drive adoption and investment. Public education and awareness play a critical role in promoting environmental protection and transforming technology towards more sustainable practices. A well-informed public can help drive demand for environmentally friendly technologies and practices, and encourage individuals and communities to adopt more sustainable lifestyles. Education can help raise awareness about the importance of environmental protection, the impact of human activities on the environment, and the benefits of sustainable practices. This can

include education in schools, community outreach programs, and through media campaigns. Public education and awareness can also help to address some of the barriers to environmental protection, such as a lack of understanding of the issue, or a perception that environmentally friendly technologies are too expensive or difficult to use. By increasing public understanding of environmental protection, governments, organizations, and individuals can work together to create a more sustainable future. Through public education and awareness, individuals and communities can become more empowered to take actions that promote environmental protection and can help to drive the transformation of technology towards more sustainable practices.

3.3. PARTNERSHIP AND COLLABORATION

Encouraging partnerships and collaboration between different stakeholders, including government, industry, and academia, can help to overcome barriers and drive progress in this area. Partnerships and collaborations are essential in promoting environmental protection and transforming technology towards more sustainable practices. Working together, governments, organizations, communities, and individuals can pool resources, knowledge, and expertise to tackle the challenges of environmental protection more effectively. Collaborative approaches can help to overcome some of the barriers to environmental protection, such as a lack of funding, expertise, or political will. For example, partnerships between government agencies and private sector organizations can help to overcome the economic barriers to adopting environmentally friendly technologies. Collaboration between different levels of government can help to ensure that policies and programs are effectively coordinated and aligned. Partnerships between community organizations, NGOs, and academic institutions can help to raise public awareness and education about environmental protection and promote the adoption of sustainable practices. By working together, partners can leverage their collective strengths and resources to make a greater impact in promoting environmental protection and transforming technology towards more sustainable practices. Through partnerships and collaborations, everyone can play a role in creating a more sustainable future for our planet.

3.4. INVESTMENT IN RESEARCH AND DEVELOPMENT

Investing in research and development of new environmental technologies can help to address technological limitations and drive progress in this area. Investment in research and development is crucial in promoting environmental protection and transforming technology towards more sustainable practices. Research and development can help to overcome technological limitations and drive innovation in the field of environmental protection. By investing in research and development, governments, organizations, and private companies can support the development of new technologies and solutions that can address the environmental challenges of our time. This can include the

development of cleaner energy sources, more efficient waste management systems, and technologies that reduce greenhouse gas emissions. Investment in research and development can also help to create new economic opportunities, by opening up new markets for environmentally friendly technologies and products. Moreover, by investing in research and development, governments and organizations can help to ensure that future generations have access to the resources and technologies they need to sustainably manage the environment. Through investment in research and development, everyone can play a role in promoting environmental protection and creating a more sustainable future. By fostering innovation and supporting the development of new technologies and solutions, investment in research and development can help to drive the transformation of technology towards more sustainable practices and ensure a healthier and more resilient planet for generations to come.

3.5. INCENTIVES FOR ADOPTION

Providing incentives for individuals and organizations to adopt new environmental technologies, such as tax credits or subsidies, can help to drive widespread adoption. Incentives play a key role in promoting the adoption of environmentally friendly technologies and practices in environmental protection. By providing financial, regulatory, and other incentives, governments and organizations can encourage individuals, businesses, and communities to adopt more sustainable practices and technologies. For example, tax credits and subsidies can make it more economically viable for businesses to adopt cleaner technologies, while regulatory incentives such as emissions standards can help to ensure that companies adopt environmentally friendly practices. Additionally, incentives such as awards, recognition programs, and public-private partnerships can help to promote the adoption of sustainable practices, by recognizing and rewarding individuals, organizations, and communities that are taking action to protect the environment. Through incentives, governments and organizations can create a supportive environment that encourages and accelerates the adoption of environmentally friendly technologies and practices. By providing tangible benefits to those who adopt sustainable practices, incentives can help to drive the transformation of technology towards more sustainable practices and promote a more resilient and healthy planet for all.

3.6. IMPLEMENTATION OF REGULATIONS

Implementing and enforcing regulations that promote the use of environmentally responsible technologies can help to drive progress in this area. The implementation of regulations plays a crucial role in promoting environmental protection and transforming technology towards more sustainable practices. Regulations help to ensure that individuals, organizations, and communities are taking the necessary steps to protect the environment and adopt more sustainable practices. For example, environmental regulations

such as emissions standards, waste management requirements, and water quality standards can help to reduce the negative impacts of human activities on the environment. Regulations can also provide a level playing field for businesses, by ensuring that all companies are held to the same environmental standards, regardless of their size or sector. Furthermore, regulations can help to drive innovation, by encouraging the development and adoption of new technologies and solutions that can address environmental challenges. However, regulations must be implemented effectively in order to achieve their intended goals. Effective implementation of regulations requires strong enforcement mechanisms, effective monitoring and reporting, and public engagement and education. By ensuring that regulations are effectively implemented, governments and organizations can help to promote environmental protection and the transformation of technology towards more sustainable practices and ensure a healthier and more resilient planet for all.

By taking these countermeasures, it is possible to overcome the challenges and drive progress in technology transformation for environmental protection, and help to ensure a sustainable future for our planet.

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