European Journal of Sustainable Development Research
2023, 7(4), em0235
e-ISSN: 2542-4742
https://www.ejosdr.com

MODESTUM

Review Article

OPEN ACCESS

Current deficiencies and reinforcement of institutional pillars for reform in the green insurance market: A systematic review

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Citation: Lee, W. Y., & Fung, D. W. H. (2023). Current deficiencies and reinforcement of institutional pillars for reform in the green insurance market: A systematic review. *European Journal of Sustainable Development Research, 7*(4), em0235. https://doi.org/10.29333/ejosdr/13634

ARTICLE INFO

Received: 28 Jun. 2023

Accepted: 09 Aug. 2023

ABSTRACT

Despite the fact that green insurance makes up a significant portion of green finance, there is a lack of systematic understanding and analysis on the international green insurance market in the literature. In this paper, we study how the market for green insurance has evolved and discuss the current challenges. The important elements promoting sustainable growth in the market include universal consensus on the definition of green insurance, an optimal regulatory framework, technological advancement, and talent nurturing, and rising social acceptance. We apply the institutional framework to explore the future direction of market reform for a sustainable market. Reinforcing the three institutional pillars will help to address the current deficiencies in the market. The pollution liability market in China is examined as a case study. This paper gives insight to both academic and industry fields on drivers and challenges in the increasingly complex and fast-growing green insurance market.

Keywords: Green insurance, sustainability, climate change, pollution liability insurance, institutional pillars

INTRODUCTION

Climate change has brought great challenges to sustainability. In IPCC Sixth Assessment Report (2022), the impact of climate change is investigated across the ecosystems and the human systems. It is pointed out in IPCC (2018) that climate-related risks to economic growth are projected to increase with global warming of 1.5 °C. The discussion of how climate change is affecting the development of the economy has become imperative not only for the researchers, but also the practitioners and the policymakers. The insurance sector, which traditionally takes up the role of risk pooling and risk financing, bears the brunt of the consequences brought by climate change. For example, the natural catastrophes caused a worldwide insured losses amounted to 75.82 billion U.S. dollars in 2020[1]. Insurance industry is facing new challenges in product design, product pricing, and risk management. The sustainability issues, or now more specifically known as the environmental, social, and governance (ESG) issues, have brought increasing pressure on the global insurers. In 2012, the United Nations established the first collaborative initiative with the insurance industry on providing the principles for sustainable insurance (PSI). According to PSI (2012), "sustainable insurance aims to reduce risk, develop innovative solutions, improve business performance, and contribute to environmental, social and economic sustainability." In 2020, PSI project team of the United Nations has issued the first ESG guide for the global insurance industry (United Nations, 2020). Green innovation on insurance products is an inevitable trend to achieve ESG goals in face of the increasingly complex risk landscape.

In this paper, we will provide a complete picture on the landscape and evolution of green insurance for two main reasons. The first type of green insurance appeared in the 1970s, which is the pollution liability insurance. The market continues to evolve and green insurance has been expanded to cover different areas. Facing such a big market, there has yet been any clear definition of green insurance from official publications or academic literature. Thus, we are unable to give accurate statistics on the exact size and overall state of the current green insurance market. By providing a systematic analysis on the current status of the green insurance market, it helps to facilitate a better understanding of the development and the way forward of the market. The second is that there is a lack of systematic analysis and discussion of the international green insurance market in academic literature. Although there have been studies on specific types of green insurance, the market for green insurance has rarely been studied from a macro perspective. In this paper, we will examine the development of the green insurance market and discuss the challenges faced. By applying the institutional

[1] Statista. https://sthjt.hubei.gov.cn/fbjd/zc/zcjd/202112/t20211213 3911006.shtml

Table 1. Three categories of green insurance products

Category	Objective	Examples
Climate change adaptation	Insurance products are designed to respond to climate change & manage extra risks due to change.	Catastrophe insurance, weather insurance, & agricultural insurance
Climate change mitigation	Insurance products are designed to protect environment & slow down climate change.	Pollution liability insurance, usage-based auto insurance, green building insurance, & renewable energy insurance
Carbon initiative	Insurance products are designed in related to carbon removal activities.	Carbon credit insurance

theory, we also explore the future direction of reform for a sustainable market. This paper gives insight to both academic and industry fields on the drivers and barriers in the complex and fast-growing green insurance market.

The current green insurance products can be broadly divided into three categories based on their objectives, which are climate change adaptation, climate change mitigation, and carbon initiative. Each category of products has its own characteristics and deserves a separate analysis. In this paper, we will focus on products under the category of climate change mitigation. This category was chosen because it contains pollution liability insurance, which is the type of green insurance with the longest history. The products under the categories of climate change adaptation and carbon initiative will be reserved for future research. Then, we will investigate the major deficiencies in the green insurance market that are impeding its development. After that, we explore the future direction of market reform. The three institutional pillars, namely the regulative, normative, and cultural-cognitive pillars, should be reinforced simultaneously to support sustainable growth in the green insurance market. The environmental liability market in China is the focus of our final empirical investigation. The market's progressive pilot projects have had some success, but they have also steadily revealed issues such as the need for better coordination between laws, the lack of talents and so on. The analysis of this market has implications for how to increase the effectiveness in the emerging green insurance market.

This paper aims to provide a systematic analysis on the current state and development challenges of the green insurance market, which has received little attention in academic literature. We aim to identify the major deficiencies in the current market and the challenges that the market is facing for sustainable growth. Based on the institutional framework, we propose recommendations for the direction of market reform. The key findings of this paper will provide insights for both the academia and the industry on driving sustainable growth in the complex and evolving green insurance market.

OVERVIEW OF GREEN INSURANCE MARKET

The green insurance market is ever changing and has been a booming one. There has been no universal definition of green insurance. A conceptual understanding of green insurance in the literature can be dated back to DeVuyst and Ipe (1999) in which green payment is studied as an economic incentive to the farmers to control the agricultural nonpoint source pollution. A definition of the green insurance is later given in Baerenklau (2005) and adopted in Wang et al. (2017), "green insurance is a type of technology insurance, which, like a green payment, provides an economic incentive to encourage behavioral change." However, this definition is not sufficient to describe the current green insurance market as the products are becoming more diversified and covering more areas.

Due to the growing awareness on green issues, there have been discussions on reaching a consensus on the formal definition of green insurance. While the goal of our study is not to arrive at a universal definition, we still need grounds to analyze the increasingly complex market. Here, we propose a framework to categorize green insurance products. Based on the nature of the products, they can mainly be put under three categories as shown in **Table 1**. Each category of products has its own unique characteristics. Here, we focus on the category of products that aim at climate change mitigation. Pollution liability insurance, usage-based auto insurance, green building insurance, and renewable energy insurance, are the products that take up most of the market share under this category. We will discuss in detail the developments of these representative products in the sequel.

Pollution Liability Insurance

Origin of green insurance

Pollution liability insurance is the first type of green insurance developed in the market. Historically, the liability arises from pollution was covered under the commercial general liability insurance. In face of the rising number of accidents and pollution costs, the pollution liability was first excluded from the standard comprehensive general liability policy in the United States in 1973 (Richardson, 2002). The market of pollution liability insurance started to develop in countries going through industrialization such as the United States, the United Kingdom, and Germany. Pollution liability insurance has emerged to cope with the rising costs of pollution and increasing environmental regulation.

Increasing complexity of pollution risks

Over the years, there is an increasing awareness of environmental issues in society and more regulations on pollution have been set up. As described in Foggan and Gridley (2014), pollution liability insurance nowadays takes various forms and cover for different risks, including on-site and off-site risks, property damage, death or bodily injury, and cleanup costs. An example of an industry that poses great risks to the environment is the chemical industry. Wang et al. (2021a) examined the interactions among the three parties, namely the chemical companies, the insurers, and the local government, in the application of environmental pollution liability insurance for the risk management of chemical industrial parks. Yi et al. (2020) pointed out that the

environmental risks brought by the chemical industrial parks have become highly complex and existing pollution liability insurance products can hardly meet the needs. The market therefore is not only fast-growing but is still in evolution.

Usage-Based Insurance

New technologies tracking driving behavior

Traditionally, actuaries determine the premium of the motor insurance by the information of the driver and the vehicle. The rating factors include gender and age of the driver, individual driving history, engine power of the vehicle, and use of the vehicle. With the telematics advancement in vehicles, data is more easily collected and accurately recorded from cell phones or GPS devices. Some insurers started to introduce the driving behavior such as speed, miles driven, and the time of driving as a pricing factor. A driver with good driving behavior will receive a discount on his motor insurance.

Types of usage-based insurance

In recent years, usage-based pricing is getting more popular in motor insurance. In usage-based insurance, drivers will pay a premium based on their driving behavior. Bian et al. (2018) showed how the development of usage-based insurance is facilitated by the arrival of the new era of data. At present, there are two types of usage-based insurance in the market, which are pay-as-you-drive and pay-how-you-drive. The pay-as-you-drive insurance turns out to be a kind of green insurance as it gives people an incentive to drive less and facilitates the use of public transportation. The market for pay-as-you-drive insurance has been growing fast in the past decade as public awareness on environmental protection has increased and people enjoy premium discounts if they are willing to share with the insurers their driving records.

Green Building Insurance

Role of insurance in covering green building risks

Green constructions are growing over years and itbecomes popular both in industry and in the academic research field. From World Green Building Council, green building is defined as "a building that, in its design, construction or operation, reduces or eliminates negative impacts, and can create positive impacts, on our climate and natural environment"[2]. In green building development, insurance plays an indispensable role. Wang et al. (2021b) mentioned that green finance is a fundamental factor to promote the green technological innovation in the construction industry. Green insurance covers the insurable risks related to green buildings, including upgrading a traditional building to a green property, costs of building vegetated roofs, and costs of recycling construction debris/wastes (Akomea-Frimpong et al., 2022).

Green insurance as a driver of green innovation

In addition to providing coverage on the risks of green building, the insurance industry supports the growth of green building market by promotion of green insurance products. Olubunmi et al. (2016) pointed out that the insurance industry plays an important role in boosting the green building concept by communicating the benefits to different stakeholders. The insurance sector collaborates with players across the green building value chain to communicate the role and benefits of insurance in facilitating green initiatives.

Insurance for Renewable Energy Projects

Urge of carbon neutrality

The global renewable energy market has shown a strong growth in influence of the drivers such as the pressing issue of the reduction of greenhouse gases emission and enhancement of energy security. Wind energy, solar energy, hydro and tidal energy are well-known examples of renewable energy. According to the report by Allied Market Research[3], the global renewable energy market amounted to US$881.7 billion in 2020 and is projected to hit US$1977.6 billion by 2030 (Allied Market Research, 2021). China, India, and the United States are by far the largest contributors to renewables growth. These countries produce 50% of the global CO_2 emissions (Li et al., 2022) and therefore they are scaling up the renewable energies markets to accomplish carbon neutrality.

Insurance as important risk management tool in renewable energy sector

For a sustainable growth of the renewable energy market, Gatzert and Kosub (2016) indicated that the availability of adequate insurance solution is crucial for the investors to manage and mitigate the complex risks in renewable energy projects. Kirillova et al. (2021) identified the specific risks to the renewable energy industry, analyzed the related insurance coverages, and pointed out a close interaction between insurance and technological advancement and a formal regulatory basis is vital to ensure the sustainable development of the renewable energy market.

DEFICIENCIES AND CHALLENGES IN THE GREEN INSURANCE MARKET

Lack of Universal Characterization on Green Concept

Difficulty in establishing green standards, regulations, and guidelines

The concept of transitioning towards "green" is constantly evolving and developing. So far, there is not a worldwide consensus on the definition of green financial activities. For instance, EU taxonomy published in 2020 provides an official definition and classification on different aspects of green finance in Europe, while the green bond endorsed project catalogue released in 2021 provides the latest guideline for the green bonds market in China. The green standards are set according to the environmental issues and economic demands in different places. While there are variations among these guidelines, there is a general trend towards convergence in their content.

[2] World Green Building Council. https://www.worldgbc.org/what-green-building

[3] Renewable energy market by type (hydroelectric power, wind power, bioenergy, solar energy, and geothermal energy) and end use (residential, commercial, industrial, and others): Global opportunity analysis and industry forecast, 2021-2030. Allied Market Research.

Despite the increasing maturity of the green finance framework worldwide, there is still a lack of overarching concept and formal classification specific to the insurance market. This presents a significant obstacle for insurers who seek to shift their businesses towards a low-carbon model, as pointed out by Gatzert et al. (2020).

Hard to build confidence among customers

The lack of a clear definition of green insurance is a significant hurdle to its future development, as it creates several challenges that make it hard to build confidence among customers. The absence of industry standard for the insurers to follow in product development, pricing, reserving, and reporting makes it difficult for insurers to develop standardized products. Without a clear classification and common understanding, the customers would find it difficult to compare the coverage and prices of green insurance products from different companies and as a result are skeptical about the new products.

The absence of a clear definition also creates a greenwashing risk in which green features of an insurance product can be deceptive. This can undermine the credibility of green insurance products and lead to a loss of customer trust.

As stressed by Golnaraghi (2018), the fragmentation in climate policies and regulations lowers the confidence of investors in scaling up green investments. A common understanding and standards for green insurance products are therefore crucial to build trust among customers and investors.

In Exploration of an Optimal Regulatory System

Regulatory imperative of pollution liability insurance

There are ongoing debates over the degree of government intervention in the insurance market. To discuss the regulatory imperative of green insurance, let us take pollution liability insurance as an example in the following discussion. This type of insurance has the longest history among different types of green insurance products, and discussions among businesses, insurers, and policymakers continue as to whether it should be mandatory. By examining the laws and regulations in different countries, the nature of pollution liability insurance can be categorized into three different modes, which are mandatory insurance, voluntary insurance, and insurance supplemented with guarantee or security in respect to the liability risks.

Countries that make pollution insurance coverage mandatory to specific industries include the United States and Sweden, and countries such as the United Kingdom and France adopt the voluntary mode (Feng et al., 2014a). Guo (2016a) gave the details of the development of the environmental pollution liability insurance system in the United States and France as examples of the compulsory and voluntary modes, respectively, and presented the details of mixed system of insurance and guarantee in Germany.

The pollution liability insurance market in China is another fast-developing market that is widely studied. In view of the increasing number and amounts of lawsuits concerning environmental pollution, China has begun a pilot program on pollution liability insurance in 2007. Since then, China has made remarkable progress in the environmental pollution insurance system and has made it mandatory to selected high risk industries. The development of this market in China will be studied in detail later.

Pros and cons of different modes

The need for a mandatory system is apparent, especially when the pollution costs are increasing and there are more accidents in recent years that have caused catastrophic damage to the environment. Such a system can also support steady economic growth by pooling the risks and costs of pollution among companies, reducing the likelihood of bankruptcy in the event of environmental accidents (Feng et al., 2014a). However, there is also a downside of a mandatory insurance system. Since insurance acts as a safety net, a company with insurance coverage may have less incentive to take precautionary measures to reduce environmental risks. Mandating the purchase of pollution liability insurance may exacerbate the moral hazard problem. In a recent study, Chen et al. (2022) analyzed the firm-level data in China and found that the adoption of environmental liability insurance policies leads to a significant reduction in firms' efforts to mitigate water pollution.

Insurance Market Unable to Keep Up With Social and Technological Green Development

Lack of a robust pricing model for usage-based insurance

The green insurance market is far from mature, and its development is slow as compared to the social and technological green development. For a more in-depth discussion, let us use usage-based insurance as an example.

The market for usage-based insurance is growing, however, it remains a small part of the overall motor insurance market. According to Tselentis et al. (2017), out of one billion insured vehicles worldwide, 4.5 million of them were using usage-based insurance in 2013. By 2030, the usage-based insurance is expected to grow and take up half of the market share of motor insurance in the world.

Despite this emergence, pricing models for usage-based insurance remain underdeveloped. As discussed in Huang and Meng (2019), the development of in-vehicle networks and big-data technologies is fast, machine learning is applied for the usage-based insurance pricing. However, the interpretability of rating factors in machine learning pricing models still needs to improve.

Low acceptance from customers and slow industry progress

The transparency of the pricing mechanism is crucial not only to the acceptance of customers in usage-based insurance but is also a major consideration of the regulators for the long-term sustainable development of the market. By entering the era of artificial intelligence, the complexity of in-vehicle networks increases exponentially. The slow advancement of the pricing techniques cannot catch up with the contemporary technologies and hinders the expansion of the usage-based insurance market. In fact, insurers face similar issues with operations such as product development, underwriting, claims, and compliance. Chen et al. (2019) pointed out the insufficiency of top-level design and promotion of green insurance investment.

Insufficient Social Acceptance from Different Stakeholders

Social acceptance from all stakeholders is critical for the successful development of the green insurance market. The acceptance from businesses, individuals, insurers, and government is the key factor to the success of the green insurance market. Evidence showed that society is gradually adapting to the green changes, but the process is still slow. Akomea-Frimpong et al. (2022) found reluctance among building owners and construction firms to replace conventional practices by green building and financing practices. Desalegn (2023) addressed the need for the insurance industry to be more active in providing complete green insurance building coverage.

A recent study in Sliwinski and Kurylowicz (2021) found that most of the respondents showed their interests in usage-based insurance, though their acceptance is affected by demographic factors such as age, sex, and place of residence. On the supply side, however, Che et al. (2021) found out that there are no more new insurers adopting the usage-based insurance in the United States since 2016. They pointed out that developing the technologies for usage-based insurance is a long-term investment and it takes years before insurers get the return from the investment, which results in the stagnant growth in the market.

For the growth of the green insurance market, there must be acceptance from both the supply side and the demand side. The demand should be driven by environmental awareness and concerns. On the other hand, insurers should be able to supply up-to-date insurance products in a sustainable manner.

REINFORCING THREE INSTITUTIONAL PILLARS: GREEN INSURANCE MARKET TO THRIVE THROUGH REFORM AND INNOVATION

In this section, we apply the institutional framework to provide a systematic analysis that aims to shed light on the green market's need for reform to maintain its long-term growth. Institutional theory was first proposed by Meyer and Rowan (1977) to study organizations from the sociology point of view. North (1990) suggested to view the institutional framework at a macro-level as the "rules of the game" in the society and perceive organizations as players in the game. The theory was later developed and further extended to investigate "the deeper and more resilient aspects of social structure" (Scott, 2004). The theory has been used to systematically analyze the trend of a newly emerging economy or market. (e.g., Bruton et al., 2010; Dubey et al., 2019; Street, 1987).

Scott (2013) defined institutions in a broad sense that "comprise regulative, normative, and cultural-cognitive elements that, together with associated activities and resources, provide stability and meaning to social life". This definition conceptualizes the three pillars supporting institutions, which are the regulative pillar, the normative pillar, and the cultural-cognitive pillar. The perspective of three institutional pillars has been adopted in the literature to study the challenges faced by a new market. For instance, Javernick-Will and Scott (2010) identified the institutional knowledge gaps when developers, contractors, and engineers work on international projects. Kshetri (2020) investigated how the three institutional pillars are shaping the rapidly growing cyber-insurance market. While we are going to explore and reveal how the reinforcement of the regulative pillar, the normative pillar, and the cultural-cognitive pillar can bring a reform to the green insurance market, it is worth mentioning that the three distinctive pillars are interrelated, and they act on each other in real practice.

Regulative Pillar

Scott (2013) indicated that the regulative pillar is supported by explicit regulatory processes, which "involve the capacity to establish rules, inspect others' conformity to them, and, as necessary, manipulate sanctions–rewards or punishments–in an attempt to influence future behavior". Regulations and rules shape the landscape of the financial market. For example, Mateo-Marquez et al. (2021) demonstrated that regulative pressure is a significant factor that influence the probability of a firm's voluntary carbon disclosure, and in particular, climate-related rules and rewards have a positive correlation with the quality of the disclosure. However, there has been no academic literature that specifically focuses on the reform of the green insurance market from the regulative perspective. In the sequel, we shall discuss the policy implications and limitations on the green insurance market development.

Improve legal system

Pollution liability insurance is where green insurance first emerged, which can be dated back to mid-1970s (Brockett et al., 1990). The green insurance market continuously evolved and there have been different products addressing single or multiple green risks. After half-century of development and practices, an international agreement of the future direction of green insurance market has been set up. The groundbreaking framework, the United Nations principles for sustainable insurance, was established in 2012. ESG factors in the insurance industry were formally considered in this framework. Until 2022, there are 125 insurers/reinsurers in 38 countries, which have become signatories for the principles. Although it is voluntary to follow the principles, more and more insurance institutions are adopting them in their businesses. At the same time, governments have been bringing forward policies and regulating authorities have been setting up regulations for the sustainable growth of the market. Given that these laws and policies are yet to be comprehensive and coordinated, particularly during the developing and maturation stage, advancement in the legal or policymaking aspect is essentially suggested to have a crucial role to play, at least in the following three areas.

First, a sound legal framework to be built for green insurance should be coordinated, coherent and adaptive to the existing one for the whole insurance industry, with tailor-made and specific government policies and regulations aiming at sufficiently promoting and improving the green insurance market from both the supply side and the demand side.

Second, the legal framework should be accompanied by an unambiguous and strategic formulation of each party's rights and obligations, including those of market players in green insurance, the government, and environmental agencies, as well as the protection of each party's individual interests. Amongst others, all the market activities of the market players, including innovative product design could fall within the ambit of legal protection. This can prevent the market players from withdrawing from the emerging green market because of the restrictive impartial regulations. Of course, it is equally important to establish reporting and disclosure standards. Yu et al. (2020) presented evidence that such scrutiny from the public sector can deter greenwashing practices.

Third, a comprehensive legal system should be able to enhance sustainability and vitality, and maintain certain flexibility, of the green insurance market. It should be capable to cope with the ongoing development and improvements in green insurance and relevant industries, with the aim that the ongoing social and industry consensus as well as social expectations on green policies could be met and that increased or maximized overall social benefits could be realized. Such a favorable legal environment is conducive to the fundamental incentives in green insurance market participation.

Normative Pillar

Understanding the necessary elements for a reform of the green insurance market through the lens of its regulatory pillar is beneficial. However, the regulative aspect only is not enough for a booming and sustainable market. The normative notion is also prominent as it "specifies how things should be done, including adopting socially accepted practices and processes" (Javernick-Will & Scott, 2010). From Scott (2013), normative systems establish goals or objectives and the appropriate ways to achieve them. The basis of legitimacy is morally governed instead of legal. Constructing a solid normative pillar enables us to build the capacity to deploy green insurance on a larger scale.

Establish guidelines and standards

The professional associations of the insurance industry play an important role to advocate green insurance by self-regulation. For example, guidelines for underwriting can be established to minimize greenwashing, and financial reporting standards on the green business lines can be set up. Stricker et al. (2022) assured the importance of active engagement by insurance and actuarial associations in standardizing sustainability definitions and consolidating reporting standards and metrics, and in particular, the green businesses of smaller insurers will be stimulated. The industry guidelines and standards promote effective inter-industry interaction and provides a blueprint for the future policy framework and regulatory reform.

In recent years, various international and local associations have been set up for the purpose of fostering green insurance. Lv et al. (2021) looked at the green finance market in China, including the green insurance market, and found out that the numbers of green finance professional associations, research institutions, and training activities are important development indicators.

Nurture ESG professionals

There is a strong demand for ESG experts specializing in the insurance sector. Insurers need professionals to identify the environmental risks and develop new products to turn the risks into business opportunities, to underwrite and settle claims with the use of ESG data, and to comply with ESG regulations and meet new reporting standards. Pinney et al. (2019) described the competition from capital markets for interdisciplinary and strategic professionals as having a "talent war", and pointed out that the skills needed are from both theoretical and practical sides. Ho and Huang (2018) carried out a survey about ESG strategies taken by the insurers and showed that talent management is the third most important factor affecting industrial relations.

As ESG is still a young fi eld, the pool of talented ESG professionals is limited. To meet the rising need of talent, insurers should develop and broaden a diversified talent pool with the necessary education and experience. In the best interests of the talent building for insurance industry, the professional associations should connect with the academia to provide systematic training and frontier ESG knowledge. The workforce will be upskilled, and the industry will be enlightened by the green transformation through education.

Insurers can also partner with the information technology sector to develop InsurTech. For example, artificial intelligence can be used to enhance the storage, analysis, and application of a big set of climate and insurance data.

Enhance information transparency

Currently, there are no specific guidelines for the insurers to disclose the information related to their green lines of businesses and there are no auditing requirements to confirm the accuracy of the data. The disclosure now is on a voluntary basis by the insurers. However, selective disclosure practices are not sufficient to provide consistent and comparable information to the customers. For example, customers cannot recognize the differences between the pricing factors of traditional and green insurances, or they find it hard to compare green products across insurance companies. Making product information transparent is important for the customers to understand better about green insurance and to build customers' confidence in the new product. Information transparency also reduces the chance of greenwashing, where insurers cannot abuse the green concept and provide misleading products.

As outlined in Li and Li (2012), information transparency drives a sound social framework for green growth, including trust and consensus building, as well as social learning. Greater availability of data is beneficial to verify the effectiveness of green insurance products on fulfilling the climate change mitigation and adaptation objectives. To achieve a higher level of transparency, government authorities should take the lead to discuss with various stakeholders and explore the appropriate extent of mandatory information disclosure.

Cultural-Cognitive Pillar

The cultural-cognitive dimension depicts common perception, social knowledge and understanding. The

regulatory focus is on following the rules, while the normative notion uncovers the morals under the rules. For the cultural-cognitive pillar, it describes the "preconscious, taken-for-granted understandings that represent the nature of social reality" (Javernick-Will & Scott, 2010). Alexander (2012) further explained the taken-for-granted beliefs in the context of innovation in technology alliances as "how individuals in a society understand and deal with risk, uncertainty … and affects orientations towards change, innovation". This explanation pointed out that social understanding directly affects the success of innovation, which is also applicable to our analysis here on the emerging market. The key to building a mature green insurance market is to increase social understanding on the objectives and benefits behind the green insurance products, which will gradually lead to greater acceptance of green insurance on climate risk management.

Offer incentives and build trust

The most direct way to encourage the customers to go green is to provide premium discount. For example, some insurers provide discounts on coverage of LEED-certified green homes. Some auto insurance providers off er premium discount to the drivers who choose to enroll in pay-as-you-drive insurance plan and drive less than 7,500 miles per year. These drivers are usually considered as low-mileage drivers both in the academic literature (Redelbach et al., 2014) and in the industry. Few insurers provide discounts for green insurance products, though. Insurance companies are not motivated to off er special discounts on green products, which would reduce their profit margins. To drive the green transition, the government must take a lead to subsidize the insurers, which offer green products or to provide tax rebates to the individuals and firms that purchase green insurance. There have been different studies showing that the financial support from the government is effective to boost the supply and demand of green products (see e.g., Nie et al., 2016; Shao et al., 2017).

To enhance the market acceptance of green insurance, rate discount alone is not enough. The green insurance market is relatively young, and this may lead to a lack of confidence by the customers. For instance, usage-based insurance is yet to be the mainstream in the auto insurance market, and this is because it needs to collect the driver's data with the use of telematics. Zhou et al. (2019) identified that protecting personal data privacy is one of the biggest obstacles to promote usage-based insurance. This security problem may be resolved later with technological advancement. Therefore, a long-term and impactful green insurance market must be sustained by building trust in society.

Transition towards green growth

It is important for the public to understand the importance of green growth and recognize that it is a pressing issue. The government should continue to make greater efforts to raise public awareness of the environmental concerns affecting consumer behavior and push businesses to make green decisions. Society should reach an agreement on the necessary transition towards green growth. This common understanding is necessary for building a long-term green economy. The green insurance market, being part of the economy, will also be mobilized.

CASE STUDY: GREEN INSURANCE MARKET IN CHINA

Methodology

In this section, we provide a case study by considering the green insurance market in China. The instance of the Chinese market merits investigation for two reasons. First, the insurance market in China is expanding. Second, the progressive pilot programs in the pollution liability insurance market in China provide insights on exploring the optimal government and market participation in the emerging green market.

This case study examines the development of the pollution liability insurance market in China through qualitative analysis and review of relevant data from official and industry sources. Given that pollution liability insurance involves both the insurance, and the environmental aspects, data and information is searched from related official sources. In addition to official reports and publications, statistics are also searched from industry associations and reports published by insurance companies. To ensure comprehensive coverage, the study also searches for relevant academic publications that focus on pollution liability insurance in China. This gives insights on the current state of the market and identifying any trends.

The case study looks into the growth of China's pollution liability insurance market by carefully analyzing and synthesizing data from credible sources such as official publications, industry reports, and academic research. It focuses on the three institutional pillars that have contributed to the development of this market. Through the case of pollution liability insurance in China, it highlights how regulation, industry initiatives, and collaboration from the insurance industry, can facilitate the growth of a sustainable market.

Overview and Development of Green Market

Being the largest developing country in the world, the economy in China has grown rapidly. Since 2008, the amount of annual insurance premiums in China has shown an increasing trend. The demand for insurance in Chinese market remains strong and China has become the second largest insurance market in the world in terms of the amount of annual premiums starting from 2017[4]. The latest data from the National Bureau of Statistics shows that the annual premium in China amounts to 4.49 trillion RMB in 2021[5].

In recent years, China has put forth green development and the government have published a series of policies on sustainability. In the 19th National Congress of the Communist Party of China, it was proposed to "speed up reform to develop

[4] Insurance Information Institute. Top-10 countries by life and nonlife direct premiums written. https://www.iii.org/table-archive/21209
[5] National Bureau Statistics of China. https://data.stats.gov.cn/english/

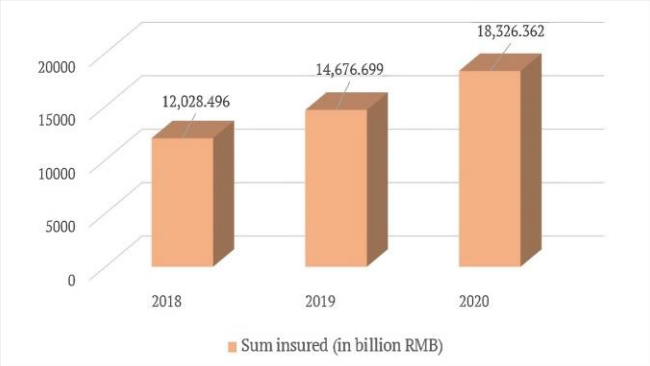

Figure 1. Total sum insured in green insurance market in China from 2018 to 2020 (Insurance Association of China, 2021)

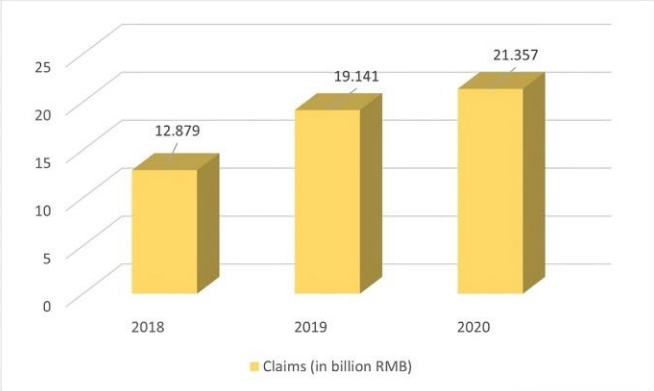

Figure 2. Total claims in green insurance market in China from 2018 to 2020 (Insurance Association of China, 2021)

sound systems for building an ecological civilization", including the strategic directions to "promote green development", "solve prominent environmental problems", "intensify the protection of ecosystems", and "reform the environmental regulation system". China has mapped out clearly its carbon peaking and carbon neutrality goals, respectively by 2030 and 2060. Green policies together with the large insurance market size, there is a huge potential for the development of green insurance market in China.

According to the insurance industry focuses on carbon peak and carbon neutrality goal boosts green development blue book published by the Insurance Association of China (2021), the total sum insured in the green insurance market in China from 2018 to 2020 amounted to 45.03 trillion RMB, which shows an increasing trend, as depicted in **Figure 1**. The claims arising from these green insurance policies totaling 53.377 billion RMB, which also shows an increasing trend, as in **Figure 2**.

Figure 2 shows that the green insurance market in China is expanding. The market for green insurance still has a lot of room to grow, though, when compared to the entire insurance industry.

The concept of green insurance is evolving, and the content is enriched over time. In China, pollution liability insurance is the most representative type of green insurance. Its development has the longest history in China since the reform and opening up. The legal framework for pollution liability insurance is more well-established than other emerging green insurances. For an in-depth study, we will next focus the discussion on one particular type of green insurance, i.e., pollution liability insurance.

Pollution Liability Insurance Market

Progressive pilot programs

In the 1990s, the local environmental protection bureaus and the insurance companies worked together to launch the first batch of pollution liability insurance products in some cities in China such as Dalian, Jilin, Shenyang, Changchun (Feng et al., 2014b). The penetration rate of pollution liability insurance appeared to be rather low in this round of trial. The next milestone was in 2007, when China started a new round of pilot work and issued guidelines on environmental pollution liability insurance. The Guidelines pointed out the roles of different parties for effective market promotion. First, the local environmental and insurance authorities jointly facilitate the implementation of the pollution liability insurance system and propose the insurance coverage and claims standard. Second, the regulatory bodies for insurance strengthen industry oversight and management. Third, insurers develop new pollution liability products, and fulfill their responsibilities according to the market laws and regulations. Lastly, the businesses that are insured should continue to manage their risks and disclose relevant information to the insurers.

In 2013, the Ministry of Environmental Protection (currently known as Ministry of Ecology and Environment) and the China Insurance Regulatory Commission (currently known as China Banking and Insurance Regulatory Commission) reviewed the pilot program and jointly issued a new guidance about carrying out the pilot work of mandatory environmental pollution liability insurance. Heavy metal polluting sectors like mining for heavy metals, making lead batteries, processing leather, and manufacturing chemicals were selected as the pilot industries for making pollution liability insurance mandatory for the first time [6].Different provinces and cities promote and implement the pilot program according to the characteristics of the respective regions, such as the economic and industrial factors, and the geographic locations. Examples of different model modes to promote pollution liability insurance in different provinces are shown in **Table 2**. Up till 2021, the mandatory pollution insurance pilot project has been expanded to 31 provinces, autonomous regions and municipalities in China, covering 20 high environmental risk industries such as heavy metals, petrochemicals, medical waste disposal [7]. Cumulative pollution insurance coverage has reached 160 billion RMB [8]. Now, a mixed mode of mandatory and voluntary on pollution liability insurance is adopted in China.

[6] https://www.mee.gov.cn/gkml/hbb/bwj/201302/t20130221 248320.htm
[7] http://www.gov.cn/xinwen/2021-07/15/content 5625778.htm
[8] https://sthjt.hubei.gov.cn/fbjd/zc/zcjd/202112/t20211213 3911006.shtml

Table 2. Pollution liability insurance models in different provinces (Guo, 2016b)

Province	Model	Incentive policy measures
Hubei	Premium subsidy model	Local government offered premium subsidy to insured companies & tax incentives to insurance companies.
Suzhou	Collective insured, professional hosting, & CO underwriting model	Insured companies were collectively insured by several insurance companies. Insurance brokers are also engaged for interests of insured companies.
Guangdong	Coinsurance model	Special reserve fund was set up by a group of insurance companies to cover excessive claims.

Table 3. Progress & needs for development in pollution liability insurance market in China

	Progress	Needs for development
Regulative	Pilot work is making good development. Provinces implement pollution liability insurance pilot program on their own characteristics.	Insufficient coordination between insurance laws & environmental laws.
Normative	Industry standards are gradually developing on risk assessment underwriting, claims, reporting, & disclosure.	Lack of ESD professionals specializing in insurance sector. Application of contemporary technology such as blockchain & artificial intelligence is still green.
Cultural-cognitive	Insurance companies have taken initiatives to develop more pollution liability insurance products & provide more coverage.	Lack of initiative on part of businesses to acquire pollution liability insurance, which is not required.

Reinforcement of institutional pillars

For the long-term development of the market, it is crucial to establish and enhance the legal framework and enforcement tools. The insurance law and the environmental protection law are closely related in developing the green insurance market, and therefore overall coordination between the laws needs to be strengthened. While the government will provide the imperative policy support and coordination, it is also important for the insurers to increase their underwriting capabilities for the green insurance products. This includes developing the talent pool for the green product development and management such as assessing risks with environmental and pollution data with contemporary technologies. Take Ping An as an example, which is the first insurance company in Mainland China to sign the United Nations environment program finance initiative's principles for sustainable insurance. It collaborated with institutions like Tsinghua University to create cloud service platforms for risk prevention, underwriting, and claims. The platforms focus on different aspects of environmental liability insurance such as risk monitoring, early warning management and environmental contamination sensitivity mapping. Up till the first half of 2021, Ping An has developed 439 sustainable insurance products including environment and ecosystem related ones [9]. Government can work with the insurance industry to raise the awareness of enterprises of pollution issues, and off er financial incentives to the enterprises in purchasing green insurance. The goal is to increase the enterprises' incentives to purchase pollution liability insurance even if their industries are not under the official mandatory lists. The government should collaborate with the insurance sector to make the businesses more aware of environmental issues and provide financial incentives for them to get green insurance. The objective is to boost the incentives for businesses to buy pollution liability insurance, even if their sectors are not included in the official mandated lists. **Table 3** shows progress and needs for development from the perspective of the three institutional pillars.

In summary, coordination between the public and business sectors is important to foster the expansion of the pollution liability insurance market in China. Coordinated and coherent laws and regulations by the regulators, implementation of the laws and regulations by different levels of government, supply-side improvements by the insurance companies, as well as demand-led growth are the key factors for the sustainable growth of the mandatory and voluntary pollution liability markets.

CONCLUSIONS

The objective of this research is to provide a comprehensive analysis of the green insurance market, with a particular focus on climate change mitigation products. The green insurance market has been evolving and expanding fast. However, there is a lack of academic literature that provides a systematic analysis on the current landscape of the international green insurance market. The research aims to identify the challenges faced by the market and suggest reforms needed in different pillars of the institutional framework to foster sustainable growth.

To achieve this objective, the research methodology follows a systematic, comprehensive, and empirical approach. First, the research categorizes green insurance products by their nature and studies the development of different green insurance products. This allows for an understanding of the landscape of the market and the different types of products available.

Second, the research identifies and analyzes the challenges faced by the market, including the lack of a universal definition of green insurance, the need for an

[9] 2020 climate risk management report. Ping An insurance (group) company of China. https://group.pingan.com/resource/pingan/ESG/Report/pingan-climate-risk-management-tcfd-report-2020.pdf

optimal regulatory system, technological advancements, talent nurturing, and increasing social acceptance.

Third, the research applies an institutional framework to discuss the future direction of market reform. This framework helps to identify the reforms needed in different aspects of the regulative, normative, and cultural-cognitive pillars to foster sustainable growth in the market.

Finally, the research investigates the pollution liability insurance market in China as an empirical case study to gain insights into the role of the government and supply and demand influences on the market. This case study provides practical insights for improving the effectiveness of green insurance initiatives.

The limitation of the research is that this study focuses on the market of one category of green insurance products, which is aimed at climate change mitigation. While this was chosen as a starting point due to the presence of pollution liability insurance, the first type of green insurance, it must be noted that there are two additional categories of green insurance products. In the future, it would be beneficial to explore these categories in more detail. This includes the category of green insurance products designed for climate change adaptation, which primarily deals with adapting to extreme events and significant losses. Additionally, the category of green insurance products under the carbon initiative, which is a newer form of green insurance that aids in achieving carbon neutrality, should also be examined more thoroughly.

Author contributions: All co-authors have involved in all stages of this study while preparing the final version. They all agree with the results and conclusions.

Funding: No funding source is reported for this study.

Acknowledgements: The authors would like to thank the anonymous reviewers for the suggestions and comments.

Declaration of interest: No conflict of interest is declared by the authors.

Ethical statement: Authors stated that ethics committee approval was not required as it is a review of existing literature.

Data sharing statement: Data supporting the findings and conclusions are available upon request from corresponding author.

REFERENCES

Akomea-Frimpong, I., Kukah, A. S., Jin, X., Osei-Kyei, R., & Pariafsai, F. (2022). Green finance for green buildings: A systematic review and conceptual foundation. *Journal of Cleaner Production, 356*, 131869. https://doi.org/10.1016/j.jclepro.2022.131869

Alexander, E. A. (2012). The effects of legal, normative, and cultural-cognitive institutions on innovation in technology alliances. *Management International Review, 52*(6), 791-815.https://doi.org/10.1007/s11575-011-0123-y

Allied Market Research. (2021). *Renewable energy market by type (hydro-electric power, wind power, bioenergy, solar energy, and geothermal energy) and end use (residential, commercial, industrial, and others): Global opportunity analysis and industry forecast, 2021-2030*. Allied Market Research.

Baerenklau, K. A. (2005). Some simulation results for a green insurance mechanism. *Journal of Agricultural and Resource Economics, 30*(1), 94-108.

Bian, Y., Yang, C., Zhao, J. L., & Liang, L. (2018). Good drivers pay less: A study of usage-based vehicle insurance models. *Transportation Research Part A, 107*, 20-34. https://doi.org/10.1016/j.tra.2017.10.018

Brockett, P. L., Golden, L. L., & Aird, P. R. (1990). How public policy can define the market-place: The case of pollution liability insurance in the 1980s. *Journal of Public Policy and Marketing, 9*(1), 211-226. https://doi.org/10.1177/074391569000900115

Bruton, G. D., Ahlstorm, D., & Li, H.-L. (2010). Institutional theory and entrepreneurship: Where are we now and where do we need to move in the future? *Entrepreneurship Theory and Practice, 34*(3), 421-440. https://doi.org/10.1111/j.1540-6520.2010.00390.x

Che, X., Liebenberg, A., & Xu, J. (2021). Usage-based insurance–Impact on insurers and potential implications for InsurTech. *North American Actuarial Journal, 26*(3), 428-455. https://doi.org/10.1080/10920277.2021.1953536

Chen, H., Yao, M., & Chong, D. (2019). Research on institutional innovation of China's green insurance investment. *Journal of Industrial Integration and Management, 4(01)*, 1950003. https://doi.org/10.1142/S2424862219500039

Chen, S., Ding, X., Lou, P., & Song, H. (2022). New evidence of moral hazard: Environmental liability insurance and firms' environmental performance. *Journal of Risk and Insurance, 89*(3), 581-613. https://doi.org/10.1111/jori.12380

Desalegn, G. (2023). Insuring a greener future: How green insurance drives investment in sustainable projects in developing countries? *Green Finance, 5(2)*, 195-210. https://doi.org/10.3934/GF.2023008

DeVuyst, E. A., & Ipe, V. C. (1999). A group incentive contract to promote adoption of best management practices. *Journal of Agricultural and Resource Economics, 24*(2), 367-382.

Dubey, R., Gunasekaran, A., Childe, S. J., Blome, C., & Papadopoulos, T. (2019). Big data and predictive analytics and manufacturing performance: Integrating institutional theory, resource-based view and big data culture. *British Journal of Management, 30*(2), 341-361. https://doi.org/10.1111/1467-8551.12355

Feng, Y., Mol, A. P. J., Lu, Y., He, G., & van Koppen, C. S. A. (2014b). Environmental pollution liability insurance in China: In need of strong government backing. *Ambio, 43*(5), 687-702.https://doi.org/10.1007/s13280-013-0436-0

Feng, Y., Mol, A. P. J., Lu, Y., He, G., & van Koppen, C. S. A. (2014a). Environmental pollution liability insurance in China: Compulsory or voluntary. *Journal of Cleaner Production, 70*, 211-219. https://doi.org/10.1016/j.jclepro.2014.02.027

Foggan, L. A., & Gridley, M. J. (2014). Issues in coverage for preexisting pollution conditions under pollution liability insurance policies. *Environmental Claims Journal, 26(2)*, 91-106. https://doi.org/10.1080/10406026.2014.899806

Gatzert, N., & Kosub, T. (2016). Risks and risk management of renewable energy projects: The case of onshore and offshore wind parks. *Renewable and Sustainable Energy Reviews, 60*, 982-998. https://doi.org/10.1016/j.rser.2016.01.103

Gatzert, N., Reichel, P., & Zitzmann, A. (2020). Sustainability risks & opportunities in the insurance industry. *Zeitschrift für die Gesamte Versicherungswissenschaft* [*Journal for the Entire Insurance Science*]*, 109*, 311-331. https://doi.org/10.1007/s12297-020-00482-w

Golnaraghi, M. (2018). Climate change and insurance industry: Taking action as risk managers and investors. Perspectives from C-level executives in the insurance industry. *Geneva Association*. https://www.genevaassociation.org/publication/climate-change-and-environment/climate-change-and-insurance-industry-taking-action-risk

Guo, H. (2016a). International experience of environmental pollution liability insurance. *Journal of Management and Strategy, 7(1)*, 59-64. https://doi.org/10.5430/jms.v7n1p59

Guo, H. (2016b). Research on the way of promoting environmental pollution liability insurance in China. *International Journal of Business Administration, 7(1)*, 26-32. https://doi.org/10.5430/ijba.v7n1p26

Ho, C.-C., & Huang, C.-Y. O. (2018). Analysis of the factors influencing sustainable development in the insurance industry. *Corporate Social Responsibility and Environmental Management, 25*(4), 391-410. https://doi.org/10.1002/csr.1467

Huang, Y., & Meng, S. (2019). Automobile insurance classification ratemaking based on telematics driving data. *Decision Support Systems, 127*, 113156. https://doi.org/10.1016/j.dss.2019.113156

Insurance Association of China. (2021). *Insurance industry focuses on carbon peak and carbon neutrality goal boosts green development blue book*. http://www.iachina.cn/art/2021/6/12/art 22 105126.html

IPCC Sixth Assessment Report. (2022). *Climate change 2022: Impacts, adaptation and vulnerability*. https://www.ipcc.ch/report/ar6/wg2/

IPCC. (2018). *Global warming of 1.5 °C. An IPCC special report on the impacts of global warming of 1.5° °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*. https://www.ipcc.ch/sr15/

Javernick-Will, A. N., & Scott, W. R. (2010). Who needs to know what? Institutional knowledge and global projects. *Journal of Construction Engineering and Management, 136(5)*, 546-557. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000035

Kirillova, N., Pukala, R., & Janowicz-Lomott, M. (2021). Insurance programs in the renewable energy sources projects. *Energies, 14(20)*, 6802. https://doi.org/10.3390/en14206802

Kshetri, N. (2020). The evolution of cyber-insurance industry and market: An institutional analysis. *Telecommunications Policy, 44*, 102007. https://doi.org/10.1016/j.telpol.2020.102007

Li, W., & Li, D. (2012). Environmental information transparency and implications for green growth in China. *Public Administration and Development, 32(3)*, 324-334. https://doi.org/10.1002/pad.1626

Li, X., Ozturk, I., Ullah, S., Andlib, Z., & Hafeez, M. (2022). Can top-pollutant economies shift some burden through insurance sector development for sustainable development? *Economic Analysis and Policy, 74*, 326-336. https://doi.org/10.1016/j.eap.2022.02.006

Lv, C., Bian, B., Lee, C.-C., & He, Z. (2021). Regional gap and the trend of green finance development in China. *Energy Economics, 102*, 105476. https://doi.org/10.1016/j.eneco.2021.105476

Mateo-Marquez, A. J., Gonzalez-Gonzalez, J. M., & Zamora-Ramirez, C. (2021). Components of countries' regulative dimensions and voluntary carbon disclosures. *Sustainability, 13*, 1914. https://doi.org/10.3390/su13041914

Meyer, J., & Rowan, B. (1977). Institutionalized organizations: Formal structure as myth and ceremony. *American Journal of Sociology, 83*, 340-363. https://doi.org/10.1086/226550

Nie, P.-Y., Chen, Y.-H., Yang, Y.-C., & Wang, H. (2016). Subsidies in carbon finance for promoting renewable energy development. *Journal of Cleaner Production, 139*, 677-684. https://doi.org/10.1016/j.jclepro.2016.08.083

North, D. C. (1990). *Institutions, institutional change and economic performance*. Cambridge University Press. https://doi.org/10.1017/CBO9780511808678

Olubunmi, O. A., Xia, P. B., & Skitmore, M. (2016). Green building incentives: A review. *Renewable and Sustainable Energy Reviews, 59*, 1611-1621. https://doi.org/10.1016/j.rser.2016.01.028

Pinney, C., Lawrence, S., & Lau, S. (2019). Sustainability and capital markets–Are we there yet? *Journal of Applied Corporate Finance, 31(2)*, 86-91. https://doi.org/10.1111/jacf.12350

PSI. (2012). Principles for sustainable insurance. *UNEP Finance Initiative*. https://www.unepfi.org/psi/wp-content/uploads/2012/06/PSI-document.pdf

Redelbach, M., Ozdemir, E. D., & Friedrich, H. E. (2014). Optimizing battery sizes of plug-in hybrid and extended range electric vehicles for different user types. *Energy Policy, 73*, 158-168. https://doi.org/10.1016/j.enpol.2014.05.052

Richardson, B. J. (2002). Mandating environmental liability insurance. *Duke Environmental Law and Policy Forum, 12(2)*, 293-329.

Scott, W. R. (2004). Institutional theory: Contributing to a theoretical research program. In K. G. Smith, & M. A. Hitt (Eds.), *Great minds in management: The process of theory development* (pp. 460-484). Oxford University Press.

Scott, W. R. (2013). *Institutions and organizations: Ideas, interests, and identities*. SAGE.

Shao, L., Yang, J., & Zhang, M. (2017). Subsidy scheme or price discount scheme? Mass adoption of electric vehicles under different market structures. *European Journal of Operational Research, 262(3)*, 1181-1195. https://doi.org/10.1016/j.ejor.2017.04.030

Sliwinski, A., & Kurylowicz, L. (2021). Usage-based insurance and its acceptance: An empirical approach. *Risk Management and Insurance Review, 24*, 71-91. https://doi.org/10.1111/rmir.12165

Street, J. H. (1987). The institutionalist theory of economic development. *Journal of Economic Issues, 21(4)*, 1861-1887. https://doi.org/10.1080/00213624.1987.11504725

Stricker, L., Pugnetti, C., Wagner, J., & Roschmann, A. Z. (2022). Green insurance: A roadmap for executive management. *Journal of Risk and Financial Management, 15(5)*, 221. https://doi.org/10.3390/jrfm15050221

Tselentis, D. I., Yannis, G., & Vlahogianni, E. I. (2017). Innovative motor insurance schemes: A review of current practices and emerging challenges. *Accident Analysis and Prevention, 98*, 139-148. https://doi.org/10.1016/j.aap.2016.10.006

United Nations. (2020). *UNEP's principles for sustainable insurance initiative*. https://www.unepfi.org/psi/underwriting-esg-risks/

Wang, C., Nie, P.-Y., Peng, D.-H., & Li, Z.-H. (2017). Green insurance subsidy for promoting clean production innovation. *Journal of Cleaner Production, 148*, 111-117. https://doi.org/10.1016/j.jclepro.2017.01.145

Wang, J., Guo, Q., Wang, F., Aviso, K. B., Tan, R. R., & Jia, X. (2021a). System dynamics simulation for park-wide environmental pollution liability insurance. *Resources, Conservation and Recycling, 170*, 105578. https://doi.org/10.1016/j.resconrec.2021.105578

Wang, W., Tian, Z. Xi, W., Tan, Y. R., & Deng, Y. (2021b). The influencing factors of China's green building development: An analysis using RBF-WINGS method. *Building and Environment, 188*, 107425. https://doi.org/10.1016/j.buildenv.2020.107425

Yi, Y., Liu, H., Guo, Q., & Jia, X. (2020). Environmental pollution liability insurance to promote environmental risk management in chemical industrial parks. *Resources, Conservation and Recycling, 152*, 104511. https://doi.org/10.1016/j.resconrec.2019.104511

Yu, E. P.-Y., Luu, B. V., & Chen, C. H. (2020). Greenwashing in environmental, social and governance disclosures. *Research in International Business and Finance, 52*, 101192. https://doi.org/10.1016/j.ribaf.2020.101192

Zhou, L., Du, S., Zhu, H., Chen, C., Ota, K., & Dong, M. (2019). Location privacy in usage-based automotive insurance: Attacks and countermeasures. *IEEE Transactions on Information Forensics and Security, 14(1)*, 196-211. https://doi.org/10.1109/TIFS.2018.2848227