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Green Premium: Evaluating and Diminishing the Environmental Surcharge

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Abstract

In light of significant climate changes, Bill Gates introduced a concept known as the green premium to measure the difference between clean technologies and those that emit greenhouse gases as a way of measuring progress towards reducing carbon emissions. However, the challenge remains in calculating and reducing the green premium. In this paper, we propose a new paradigm that incentivize companies and individuals to adopt environmentally-friendly practices based on the green premium. The proposed paradigm first employs an algorithm to rank products based on their estimated green premium during production and transportation. Subsequently, a persuasive AI system is developed targeting both companies and individuals. The system encourages companies with high green premiums to invest in clean-energy technologies, and individuals to make purchasing decisions that prioritize environmentally conscious products.

Keywords: Green Premium, Persuasive AI.

I. Introduction

The past few decades have witnessed significant changes in climate, affecting various aspects of society, including the geopolitics, economies, and migration [17]. Bill Gates introduced the con-

cept of the green premium to measure the additional cost of choosing clean technology over those that emit greenhouse gases [3]. This not only helps to assess the current progress towards reducing carbon emissions but also provides a guide for action [8, 12].

However, two key challenges exist towards the green premium. The first challenge involves the estimation and ranking of items in terms of the green premium. There is no universally accepted definition or methodology for calculating the green premium, which makes it difficult to compare products and services across different industries and sectors. Besides, both complex supply chains and the changing availability of green technologies make it difficult to assess products' environmental impact and corresponding green premium [9]. Also, the current market data contains information of user preferences over items while being limited on user willingness to pay for environmentally-friendly products [11]. Lastly, despite protecting the environment, we need to balance the environmental benefits of a product or service with other performance factors, such as cost or durability. The second challenge is how to reduce the green premium for environmental protection [14]. It requires either lowering the cost of zero-carbon alternatives or charging for the hidden costs of pollution. Companies and individuals are more likely to pay extra for the protection of the environment only if the green premium is low enough.

Environmental, Social and Governance (ESG) [4, 7] is a framework for organizations to disclose their impact on the environment and showcase their social responsibility (Figure 1). ESG covers a wide range of topics, including environmental protection, social responsibility, and corporate governance, and affect various aspects of an organization's operations, such as its reputation, risk profile, and financial performance. By prioritizing ESG issues, organizations can improve their long-term sustainability and the well-being of the communities and environments in which they operate. An organization is typically evaluated by third-party evaluators on how well they

have satisfied ESG objectives. Prominent rating agencies are KLD (MSCI Stats), Sustainalytics, Vigeo Eiris (Moody's), RobecoSAM (SP Global), Asset4 (Refinitiv), and MSCI. A form of green investment known as ESG investing [13, 18], where individuals making investment decisions based on an organization's ESG scores and reports, is rapidly gaining popularity and has been extraordinarily successful in attracting institutional investors from both advanced and emerging markets [2]. ESG investing can be seen as a form of green premium paid by the investor to choose a green organization with positive impact on the environment and society over another organization driven mainly by financial gains.

An organization's ESG performance has become a key consideration for investors, consumers,

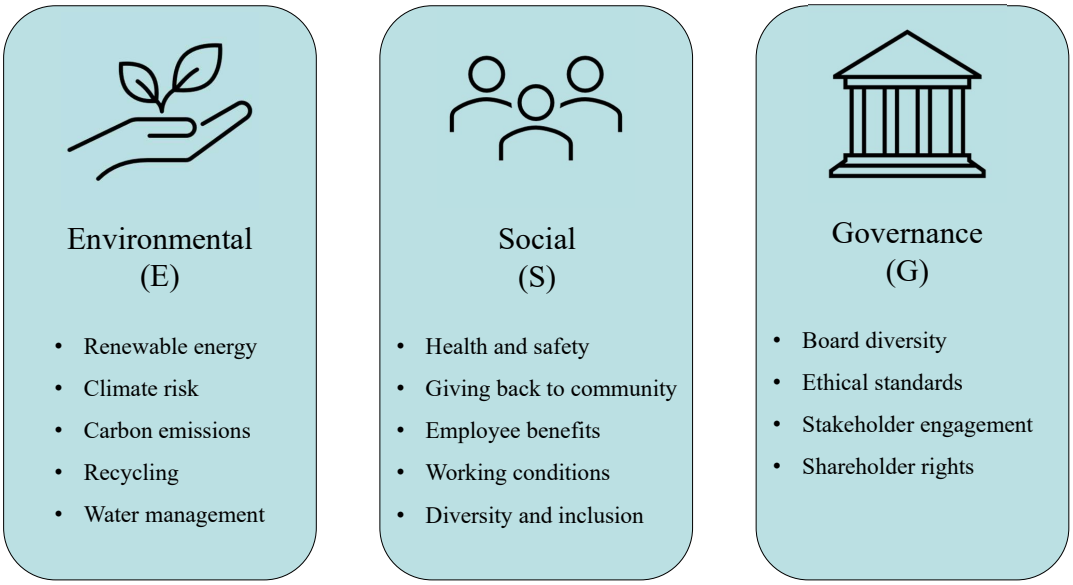

Fig 1 Overview of ESG

regulators, and other stakeholders, who are increasingly demanding greater transparency and accountability from organizations for their actions. According to the World Economic Forum [1], ESG reporting is moving from optional to mandatory for businesses in Europe, North America and worldwide. However, many organizations are finding it challenging to keep up with the ever-evolving ESG standards. Third-party ESG rating agencies adopt very different formats and metrics due to different objectives. The low correlation among different ESG metrics has long been documented [5]. As a result, there is a lack of incentive for individual investors to pay a green premium since their main source of information are ESG reports are currently plagued with many issues such as lack of standardized metrics, subjective evaluation criteria, and lack of transparency. Individual investors might not trust the sustainability commitment made by the firms and may worry about the firms conducting greenwashing [16]; Greenwashing means that organizations advertise their actions or products as environmentally friendly and sustainable, but in fact they do not significantly help or even harm the environment. Investing in organizations with a superficial approach to ESG targets will inevitably lead to lower investment returns as a cost.

To address these challenges, we aim to pioneer a new paradigm for the green premium that can persuade companies and individuals to adopt environmentally-friendly practices (*e.g.*, reduce the green premium and purchase green products). To estimate and rank items in terms of their green premium, we propose a green premium ranking system that considers the environmental costs during production and transportation. With such rankings, the product with the lowest green premium can act as the benchmark for companies to understand its current level of sustainability. To reduce the green premium, we propose to build a persuasive AI system to encourage companies to develop clean-energy technologies and individuals to purchase zero-carbon products. We also tackle the subjective evaluation of ESG scores and the lack of transparency by building a knowl-

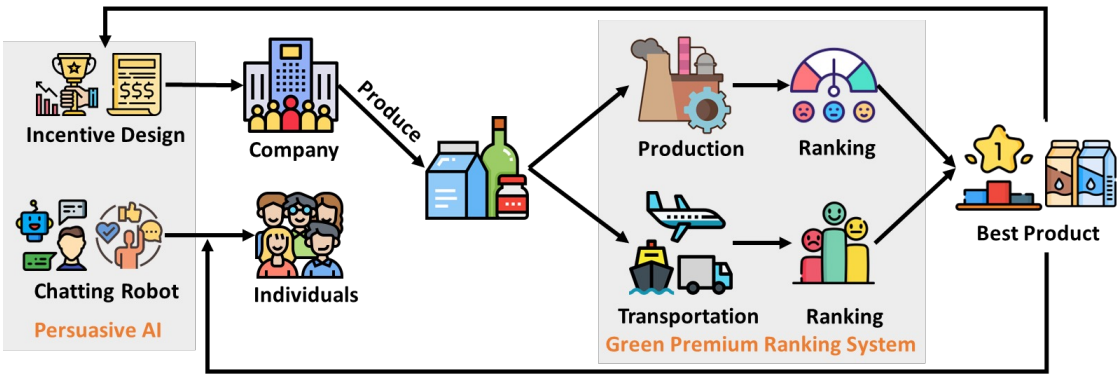

Fig 2 Overview of the proposed paradigm for the green premium.

edge graph that can represent and organize the documents and data sources used in ESG reporting in a structured and coherent manner.

II. Methods

The overview of our proposed paradigm is presented in Figure 2 for the green premium. It consists of a green premium ranking system and a persuasive AI system.

A. Green premium ranking system

The challenge of accurately determining the green premium is due to various factors, such as trade secret concerns, converting environmental factors into numerical values, etc. To address this challenge, we propose to build a green premium ranking system. The system evaluates products through two dimensions: production and transportation. For production, the system aims to quantify the environmental impacts of the production process, which could involve analysis of energy consumption, water usage, and waste generation of the production process. In addition, it determines the environmental benefits of the final product, which may involve assessing the energy efficiency, durability, and recyclability of the product. For transportation, the system analyses the energy consumption, greenhouse gas emissions, and air pollution associated with different

modes of transportation. The green premium ranking system represents a significant advancement in determining the true value of the green premium and promoting environmentally responsible production and transportation practices.

B. Persuasive AI for both companies and individuals

Global e-commerce giants like Alibaba are responsible for guiding sub-suppliers towards cost-effective and green production processes. To this end, we propose an approach that leverages a knowledge graph-based method [15] and a Contract Theory-based incentive design. The knowledge graph-based method is developed to evaluate the green premium level of sub-suppliers. The Contract Theory-based incentive design is implemented to motivate and persuade sub-suppliers, especially those with high estimated green premiums, to invest in zero-carbon production research and utilize green energy. Furthermore, we recognize the important role that individual consumers play in shaping the market [6]. As more individuals prioritize zero-carbon products, despite the additional cost, service providers and investors are more willing to make investments towards zero-carbon initiatives. Therefore, we plan to develop a persuasive chatting robot to recommend and educate individuals to adopt zero-carbon lives. These individual changes will subsequently influence a green transformation at the organizational level.

C. ESG Knowledge Graph

There is a large amount of information that organizations will use when carrying out ESG reporting. Environmental factors that are commonly evaluated include a company's carbon footprint, energy efficiency, and water usage. Social factors include labour practices, community engagement, and human rights. Governance factors include a company's leadership structure, transparency, and

ethical practices. ESG data and metrics are collected from a variety of sources, including company financial reports, sustainability reports, and publicly available data from organizations such as the Carbon Disclosure Project and the Global Reporting Initiative. We will utilize natural language processing (NLP) technologies, such as named entity recognition (NER) and relation extraction, as well as coreference resolution, to extract and organize relevant information from the documents. We will then construct a knowledge graph using the extracted information.

A knowledge graph is a type of data structure that allows for the representation and organization of data in a structured and interconnected manner, allowing for the identification of relationships and patterns within the data. This provides a comprehensive and multi-dimensional understanding of an organization's ESG issues. The knowledge graphs can be used by investors and analysts to evaluate a company's overall sustainability and identify potential risks and opportunities.

Graph representation learning can also be used to infer additional insights (e.g., an overall ESG score). One approach is to use techniques such as graph convolutional networks (GCNs) [10] to learn representations of the entities and relationships in the knowledge graph. These representations can then be used for tasks such as link prediction or node classification.

After the construction of the ESG knowledge graph, ESG performance evaluation systems can be used to assess the sustainability and societal impact of individuals and organizations. These systems typically involve analysing a range of data and metrics related to a company's environmental impact, labour practices, community engagement, and governance structure, among other factors. The results of this analysis are often used by investors, consumers, and other stakeholders to assess the overall performance of a company in terms of its social and environmental impact. Some organizations also use ESG performance evaluations to identify areas for improvement and to set sustainability targets for the future.

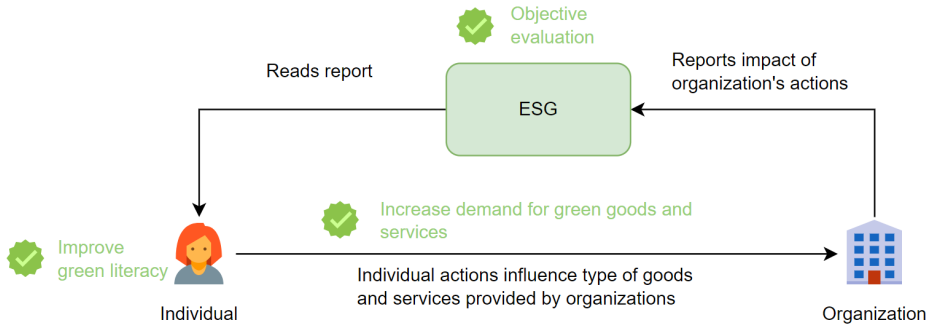

Fig 3 Impact of transparent and objective ESG evaluation

The improvement in ESG reporting could potentially lead to a positive feedback loop of sustainability at both individual and organizational level (Figure 3). Transparent and objective ESG reporting will increase demand for green investments and thereby incentivize individuals to improve their green literacy (i.e., understanding of how our actions impact the environment). This would hopefully permeate to their daily lifestyles and drive greater demand for green goods. Organizations will in turn supply more green goods and services to meet the demand.

III. Conclusion

In this paper, we introduce a paradigm for calculating and reducing the green premium, which consists of a green premium ranking system and a persuasive AI system. The green premium ranking system evaluates products' green premium from the perspective of production and transportation. The persuasive AI system guides companies towards zero-carbon production methods by leveraging a knowledge graph-based method and a Contract Theory-based incentive design framework, and influences individuals to adopt zero-carbon lifestyles through a persuasive chatting robot. In addition, we looked at the green premium from an investor's perspective by paying more for organizations with good ESG performance. We propose an ESG Knowledge Graph as a solution to more transparent and objective ESG evaluation. We hope our proposed paradigm can drive the

market towards a more environmentally-friendly future.

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