Green Products*

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Abstract

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Keywords: green marks; green terms; green products; USPTO trademarks; product market scope; natural disasters; environmental scandals

JEL classification: G30; G38; O30; O31; O32; O33

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We apply a novel text-based classification procedure to identify green marks in the USPTO trademark dataset and study the development of environmentally friendly products and services in the U.S. economy over the past forty years. Given the "use in commerce" requirement for trademarks, our data are in a unique position to capture newly commercialized green products and, thus, firms' commitment to environmental protection and sustainability. We first show that manufacturing, energy, and services are the top three sectors in developing green products in the U.S. economy. We next show that firms with more green products are associated with higher environmental ratings and lower greenhouse gas emissions. Moreover, more green products are associated with greater future sales growth and higher firm value. Importantly, those associations are more pronounced among firms with broader product market scope and firms facing fewer competitive threats. Leveraging granular textual data in a mark's registration form, we show that green products are significantly more value-enhancing when they are a firm's core business, are not greenfield, or complement other products. As far as we are aware, we are the first to shed light on whether and how green products help increase sales and firm value. Finally, we provide causal evidence that firms launch green products in response to natural disasters in neighboring counties or their peers' environmental scandals. We conclude that firms' development of green products and services is associated with tangible real environmental outcomes and better financial performance.

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"The role of IP in environmental protection has traditionally been studied by focusing on technology and innovation, using patent filings as the principal indicator of innovative activity in this sphere…. However, to date virtually no studies have considered trademark filings as an indicator of innovation related to environmental protection."

- The European Union Intellectual Property Office (2021, p. 5)

1. Introduction

How to curb pollution and combat climate change is an increasingly important issue faced by businesses, governments, and international organizations. Many have argued that green technology and innovation are key to decarbonizing the global economy and mitigating/adapting to climate change (see, for example, the Organisation for Economic Co-operation and Development 2011; the United Nations 2015; Acemoglu, Aghion, Bursztyn, and Hemous 2012; Nordhaus 2021). Economists tend to agree, as shown in recent studies examining the link between a firm's green patenting and real and financial outcomes (see, for example, Bolton, Kacperczyk, and Wiedemann 2023; Hege, Pouget, and Zhang 2023; Sautner, van Lent, Vilkov, and Zhang 2023a, 2023b; Cohen, Gurun, and Nguyen 2024; Hege, Li, and Zhang 2024; Reza and Wu 2024). However, as the opening quote suggests, green innovation is not limited to patents and includes trademarks. For instance, Home Depot launched its "Eco Options" website in 2021 (with its corresponding trademark registered in 2019) to offer sustainable products to its environmentally conscious customers.

In this paper, we conduct the first large-sample study of the development of environmentally friendly products and services in the U.S. economy over the past forty years. Applying a novel text-based classification procedure to identify green trademarks ("green marks" henceforth) registered with the United States Patent and Trademark Office (USPTO) over the period 1981-2020, we aim to address the following research questions: 1) Which firms are the active developers of green products? 2) Are a firm's green products associated with its environmental and financial performance? If so, what are the channels? And 3) why do firms introduce green products? Answering these questions will improve our understanding of the

nexus of corporate innovation, environmental performance, firm value, and government policy-making.

To motivate our study, we begin by showing a time series plot of new trademarks in general, and new green marks in particular, registered by U.S. public firms over the period 1981-2020 (see Figure 1). It is clear that despite a declining trend in new product development by U.S. publicly listed firms in recent decades (partially driven by a continued drop in the number of listed firms in the U.S. economy), there is a sustained rise in the number of new green products developed by public firms over the same period. In fact, such a surge in green products is even more apparent than the growth of green patents documented in Cohen, Gurun, and Nguyen (2024), which calls for an empirical investigation of the effectiveness, value relevance, and drivers of green products.

We identify green products by applying the newly released green trademark taxonomy from the European Union Intellectual Property Office (EUIPO) (2021) to a mark's goods and services identification (i.e., the description of products and services covered by a mark) in its registration form. To develop the taxonomy, the EUIPO employs an algorithm that combines machine learning with human interventions by its experts. The algorithm generates 375 green expressions to help identify green products. The algorithm further assigns these green expressions into 35 categories (for example, solar energy, biofuels, and wind energy), which are combined into nine groups (for example, energy production and energy conservation). We modify these green expressions by manually checking and making use of the British-American-English conversion when applying the taxonomy to marks registered at the USPTO.

Our green mark dataset offers a number of advantages in data availability, legal implications, and scope of coverage to measure green products. Unlike surveys that tend to be small and selective in sampling, the USPTO trademark data are updated frequently and freely available to the public. In addition, unlike advertisements or news releases, green marks (and their goods and services identifications) are verified, approved, and regulated by an official third party

(the USPTO), which mitigates concerns about corporate greenwashing. Finally, unlike patents subject to patentability requirement, trademarks cover all goods and services (Hall, Helmers, Rogers, and Sena 2014); therefore, our green mark dataset allows us to study the full landscape of green products in the U.S.

After constructing our green mark dataset for U.S. public firms over the period 1981-2020, we first present the sectoral and corporate leaders in green marking. We find that the manufacturing and energy sectors are the clear leaders, followed by the services sector. Out of the top ten producers of green marks, seven are in the energy sector (that includes utilities, following Cohen, Gurun, and Nguyen 2024): NextEra Energy Inc., Xcel Energy Inc., Constellation Energy Group Inc., Exelon Corp., Dominion Energy Inc., Pepco Holdings Inc., and the Southern Co., and two are waste management companies: the Republic Services Inc., and Waste Connections Inc.

In terms of green product groups, we show that energy production, energy conservation, and pollution control are the top three green groups, whereas reusable, environmental awareness, and transportation fall among the bottom three green groups (leaving out the very small agriculture group of green products). Within the leading energy production group, the top two dominant green product categories are other energy and solar energy. In the second-ranked energy conversation group, the top three green product categories are energy saving, storage of electricity, and energy management.

Next, we explore whether a firm's green products are associated with its environmental scores and emissions. Using environmental ratings from three leading rating agencies—MSCI, Sustainalytics, and Refinitiv—along with greenhouse gas (GHG) emissions data from Trucost, we find a robust and significant association between a firm's green products and its environmental performance as measured by ratings and emissions.

We then examine the value relevance of green products. We show that firms with more green products are associated with higher future sales growth and firm value, controlling for their non-green products and green patents. Further tests show that green products are value-enhancing

only for firms with broader product market scope (Hoberg and Phillips 2024) or firms facing fewer product market threats (Hoberg, Phillips, and Prabhala 2014). The former finding suggests that the value of green products hinges on synergies derived from sharing a firm's existing manufacturing, marketing, and research capabilities. The latter finding suggests that the value of green products also relies on a firm's ability to appropriate returns from its green products, which is more likely when it faces fewer competitive threats from rivals.

Additionally, we exploit granular textual information contained in goods and services identification of a mark's registration to categorize a firm's green products by their degree of centrality, their timing of introduction, and their degree of complementarity with other products. We first show that green products are significantly more value-enhancing when they are in a firm's core product lines or when the firm has prior experience in developing green products (i.e., they are not greenfield innovations). Furthermore, we show that only green products introduced together with other non-green products in the same goods (services) class are significantly value-enhancing. As far as we are aware, we are the first to point out that there are multiple sources of value creation through green product innovation – there are substantial synergies for firms to extend/transform their existing (core) products and markets into green innovation and products. Moreover, green product innovation enhances value even more when it complements non-green products in the same product space.

Finally, we explore some potential drivers of a firm's green product introduction. We capture managers' increased awareness of climate risk using natural disasters that did not affect a firm's headquarters county but took place in its neighboring counties. In addition, we approximate regulators' and stakeholders' increased concerns about environmental protection and sustainability using environmental scandals within an industry (measured by negative environmental news). We find that a firm's green products go up significantly with its managers' heightened attention to climate change and its stakeholders' increased concerns about the environment, suggesting that firms' transition to producing environmentally friendly goods and

services is motivated by both their management teams' and stakeholders' environmental awareness and potential opportunities to differentiate themselves from industry peers. Moreover, we measure environmental awareness in general using the Wall Street Journal (WSJ) Climate Change News Index developed by Engle et al. (2020) and show that over time, heightened media discourse on climate issues leads to increases in public firms' green products.

We conclude that green products are associated with tangible real environmental outcomes and better financial performance, consistent with the notion of doing well by doing good in the environmental dimension. More future work is called for to understand what prevents sectors and firms from being more active in green product development.

Our study contributes to four strands of the literature. First, we contribute to the growing literature on measuring green technology and innovation. Recent studies employ patent-based measures to examine how technological progress and government policies facilitate the transition from dirty technology to clean technology (Acemoglu, Akcigit, Hanley, and Kerr 2016; Aghion et al. 2016; Bolton, Kacperczyk, and Wiedemann 2023; Aghion, Bénabou, Martin, and Roulet 2023; Sautner, van Lent, Vilkov, and Zhang 2023a, 2023b; Cohen, Gurun, and Nguyen 2024); none of these studies consider green marks that cover a much wider spectrum of environmentally friendly green goods and services. Our green mark dataset is a timely addition to this literature and offers practical solutions for corporations, stakeholders, government agencies, and international organizations seeking to achieve sustainable economic growth. A noteworthy advantage of our dataset is that we highlight "users" instead of "producers" of green technology – the former is a much larger set of firms than the latter in the economy.

Second, our study adds to the literature on whether firms do well by doing good in general and in their environmental performance in particular. On the one hand, a large number of papers show that corporate social responsibility (CSR) improves firms' financial performance and stakeholder welfare (Edmans 2011; Deng, Kang, and Low 2013; Servaes and Tamayo 2013; Dimson, Karakas, and Li 2015; Flammer 2015; Lins, Servaes, and Tamayo 2017; Albuquerque,

Koskinen, and Zhang 2019). On the other hand, a couple of studies uncover agency problems behind corporate doing goodness (Di Giuli and Kostovetsky 2014; Masulis and Reza 2015; Cheng, Hong, and Shue 2023). Focusing on corporate environmental performance, Chava (2014) finds that firms' costs of capital go up when facing environmental concerns. Fernando, Sharfman, and Uysal (2017) show that firms adopting policies that reduce their exposure to environmental risks create shareholder value. However, Bartram, Hou, and Kim (2022) and Duchin, Gao, and Xu (2024) uncover evidence suggesting that firms engage in green-washing when facing regulatory/shareholder pressure. In light of the mixed evidence on doing well by doing good, our paper establishes a novel positive association between a firm's number of commercialized green products and its future sales growth and firm value. Importantly, leveraging granular textual data on goods and services identification in a mark's registration form, we shed light on what green products and services help contribute to superior firm performance.

Third, we add to the long-standing economics literature on the interplay between product life cycle, innovation, and scope pioneered by Panzar and Willig (1977), Abernathy and Utterback (1978), Teece (1980), Panzar and Willig (1981), and Klepper (1996), that is brought to the fore by Hoberg, Phillips, and Prabhala (2014) and Hoberg and Phillips (2024). Applying textual analysis to annual reports, Hoberg and Phillips (2024) uncover new types of firms in the 21st century as multi-product companies. They further show that these firms are highly valued by the market. We add to this literature by highlighting firms' capabilities, measured by broader product market scope, and firms' abilities to appropriate returns from innovation, which decrease with competitive threats, as boundary conditions for them to benefit from investment in CSR in general and green innovation in particular.

Finally, our use of climate-related natural disasters in counties adjacent to a focal firm's headquarters helps establish the causal effect of managerial environmental awareness on green innovation. This identification strategy adds to the literature on determinants of corporate environmental performance, spanning legal, political, and institutional drivers (Di Giuli and

Kostovetsky 2014; Akey and Appel 2021; Bisetti, Lewellen, Sarkar, and Zhao 2022; Tomar 2023; Bellon 2024), external stakeholder pressure (Schiller 2018; Aghion, Bénabou, Martin, and Roulet 2023; Bisetti, She, and Zaldokas 2024), and financial and governance drivers including shareholder preferences (Shive and Forster 2020; Azar, Duro, Kadach, and Ormazabal 2021; Barber, Morse, and Yasuda 2021; Xu and Kim 2022; Dyck et al. 2023).

2. Literature Review

Prior studies on firms' green investment and innovation focus on pollution abatement activities and green patenting. At a global level, Lanjouw and Mody (1996) and Aghion et al. (2016) show that firm-level green patents increase with environmental regulations and fuel prices, respectively. Brown, Martinsson, and Thomann (2022) find that higher pollution taxes lead to higher R&D expenditures but not necessarily more green patents. Bolton, Kacperczyk, and Wiedemann (2023) find innovative companies with higher carbon emissions tend to engage more in brown R&D and less in green R&D, suggesting the path dependence of innovation. Moreover, despite a consistent rise in the share of green R&D over time, they find little effect of green innovation on future carbon emissions. Sautner, van Lent, Vilkov, and Zhang (2023a) find that firm-level exposure to climate change predicts green patenting and green hires.

Using the U.S. patent data, Hege, Pouget, and Zhang (2023) establish a causal effect of climate-related patents on firm value and reducing future direct carbon emissions. Hege, Li, and Zhang (2024) show that climate innovation at supplier firms reduces carbon emissions at customer firms. Sautner, van Lent, Vilkov, and Zhang (2023b) show that the risk premiums for firm-level climate change decrease with these firms' number of green patents. Cohen, Gurun, and Nguyen (2024) uncover a startling ESG-innovation disconnect whereby energy firms with low ESG scores are key innovators using the green patent metric. They further show that these firms not only generate more green patents but also are first movers and produce high-quality green innovation. Using two regulatory shocks associated with the amendments of the Clean Air Act in

the U.S. that make pollution more costly, Reza and Wu (2024) show that green patents become more valuable, suggesting that green innovation has the potential to increase shareholder value.

Studies based on green patents, however, miss green innovation that may not be patentable, or firms choose to keep as trade secrets (without patenting).[1] One advantage of trademarks over patents is that firms can utilize trademarks to describe the desirable features of their green innovation without disclosing any technical details. Moreover, even for patentable green innovation, firms may still file trademark registrations to protect themselves for two key reasons. First, the protection granted from registered trademarks has no expiration date – many famous trademarks are more than 100 years old. Second, trademark protection can be extended to cover marks' unique product and service features, known as "trade dress," and thus offers permanent barriers to deter potential imitators. Coca-Cola's contour bottle shape and BMW's kidney grille design are two well-known examples.[2]

After surveying the economic literature, both theoretical and empirical, on the choice of intellectual property protection made by firms, Hall et al. (2014) conclude that trademarks are the most commonly used approach to protect intellectual property and cover most of the goods and services categories. Moreover, given the requirements of goods and services identification and "use in commerce" for mark registration, our green mark data are in a unique position to capture firms' *actual* green investment and *commercialized* innovation. Two illustrative examples in our data are Nike's Space Hippie shoes, launched in 2020, made from 90% recycled materials like water bottles, t-shirts, and yarn, and Pela Case mobile phone cases, launched by Open Mind Developments in 2011, made from compostable bio-plastics materials.

3. Identifying Green Products

[1] For example, the legal protection using patents is either infeasible or not meaningful in some industries such as financial and other service industries.
[2] See Coca Cola and BMW for details.

We are the first study to apply the EUIPO green trademark taxonomy to identify green marks registered with the USPTO. In this section, we summarize our procedure and provide a detailed description in the Online Appendix Section OA1.

When a firm prepares to launch a new product or service, it will first apply a trademark at the USPTO for marketing that product or service. In its application, the firm must provide an "identification" to describe the good(s) or service(s) covered by the mark in a precise and understandable way, which defines the scope of protection and is reviewed and approved by the USPTO attorney.[3] A mark application may cover one or more Nice classes, with each Nice class requiring its own goods and services (G&S) identification.[4] Given the "use in commerce" requirement by the U.S. trademark law,[5] the firm has to provide evidence for the commercialization of the good(s)/service(s) in order to register the mark. A mark's registration indicates that new products or services have been introduced to the market, contributing to a firm's sales and consumer welfare.[6]

In 2019, the European Commission issued the European Great Deal, promising to achieve net-zero emissions of greenhouse gases by 2050.[7] The Commission recognized that both intellectual property and financial resources are key to achieving its goals. To keep track of new products and services brought to market relating to environmental protection and sustainability, the EUIPO (2021) developed a green trademark taxonomy for identifying green products.

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[3] According to the Trademark Manual of Examining Procedure (TMEP), a mark's identification should not include extra or unnecessary information and must describe goods or services in ways that general readers can easily understand the goods or services themselves.

[4] The Nice Classification, administered by the World Intellectual Property Organization, is a system of classifying goods and services for trademark applications. There are 45 classes, 34 of which cover goods and 11 services. A mark can fall into multiple Nice classes if it covers products/services in those classes.

[5] The term "use in commerce" is legally defined as the bona fide use of a mark in the ordinary course of trade, and not made merely to reserve a right in a mark. See Section 45 (15 U.S.C. §1127) of the Trademark Act.

[6] In our sample, the average gap between a mark's application and its registration is 1.4 years, and 80% of the mark applications are registered within two years from their application date.

[7] See the European Green Deal for details.

The EUIPO first searches through entries at the EUIPO's Harmonized Database (HDB) (introduced in 1996) for the presence of phrases relating to environmental protection and sustainability and ends up with 904 green phrases (for example, fuel-saving preparations, organic composts, and biofuel). The full list of those green phrases is provided in Annex 1 of the EUIPO study (2021). Once this Harmonized Green Terms inventory is established, to ensure both older marks and future new marks can be assessed for green products, the EUIPO employs an algorithm that combines machine learning with human intervention by its experts to generate 375 green expressions that can be used to identify green products. The full list of the EUIPO green trademark taxonomy is provided in Annex 2 of the EUIPO study (2021). To fit our context of studying green marks applied in the U.S., we modify the EUIPO green expressions by making use of the British-American-English conversion. A term in a mark's G&S identification is classified as green if it matches any of these green expressions.[8] A mark is considered a green mark if its G&S identification contains at least one green term.

In order to analyze the distribution of green marks among different goods and services, the algorithm further assigns the green expressions into 35 categories, grouped into nine broader groups. The nine groups and its corresponding categories are (1) agriculture (fertilizer alternatives, other agriculture, and pesticide alternatives); (2) climate change (carbon brokerage, carbon monitor, and environmental services); (3) energy production (biofuels, other energy, solar energy, and wind energy); (4) energy conservation (energy management, energy saving, low energy lighting, and storage of electricity); (5) environmental awareness (ecology and sustainability); (6) pollution control (air purification, biodegradable, pollution general, and water

[8] For example, one of the green expressions (Ref. 13) is:

+battery +chargeable −acidulated −telephone −computer −fire.extinguisher −game −cigarette −cutters −cell.phone −mobile.phone −smartphone −wireless

It means: A term is green if it contains the word "battery" and the word "chargeable," and does *not* contain the words "acidulated," "telephone," "computer," "fire extinguisher" (together, and in that order), "game," "cigarette," "cutters," "cell phone" (together, and in that order), "smartphone," or "wireless." In this example, the expression (Ref. 13) is assigned to the group "energy conservation" and the category "storage of electricity."

purification); (7) reusable (other reusable, recycling, refilling cartridge, reusable bags, and reusable bottles); (8) transportation (electric bike, electric car, electric engines, electric motor, general transport, hybrid vehicle, hydrogen vehicle, and other vehicles); and (9) waste management (process waste and waste disposal).

To identify a green mark, we start with a mark's G&S identification and parse the textual information at the *term*-level. A "term" is a basic unit of G&S identification that contains a Nice class and words or phrases to delineate the product (service).[9] For example, Tesla Inc.'s mark, Registration Number 6251645 and Mark Word "T," fall into the Nice class 9, electrical and scientific apparatus. Its G&S identification states, "solar energy equipment, namely, photo-voltaic solar modules in the shape of panels or roofing tiles for converting electromagnetic radiation into electrical energy; equipment for use in connection with collecting and converting solar energy into electricity, namely, inverters." In this description, the semicolon demarcates the two terms associated with the mark, with the first term [solar energy … electrical energy] and the second term [equipment for … namely, inverters].

A term in a mark's G&S identification is a "green term" if it matches one of the established green expressions.[10] In this example, the Tesla Inc. mark's two terms are both green terms, with the first term matched to the green expression Ref. 162: "+photovoltaic," and the second term matched to the green expression Ref. 224: "+solar +energy." Both green terms belong to the category of "solar energy." In another example, Tesla Inc.'s mark "MODEL Y" falls into the Nice class 12. Its G&S identification states, "Electric vehicles." This term matches the green expression Ref. 73: "+electric +vehicle −cigarette −door −horn −lock −sunroof

[9] A "term" in G&S identification is "green" or not, depending on its Nice class. For example, the term "carbon dioxide monitors" is not a green term if it falls into the Nice class 10 (medical instruments), but is a green term if it falls outside the Nice class 10.

[10] We perform the same preprocessing step—removing stop words and punctuations and stemming—to terms to be classified as well as the 375 green expressions in the EUIPO green trademark taxonomy.

−alternator −alarm −temperature −theft −antitheft −washers −7 −37." We thus code this mark as a green mark. The green term belongs to the category of "general transport."

At the firm-year level, we count the number of green terms in a firm's newly registered green marks to measure a firm's green product *capacity*. As shown in the above two examples, a mark may contain multiple green terms belonging to different categories. We utilize such granular data to capture a firm's scope in green innovation. At the firm-year level, we count the number of unique categories associated with green terms in a firm's newly registered green marks to measure a firm's green product *scope*.

Arguably, there are other ways to identify green products and services, such as searching for environment-related keywords in a company's disclosed information (e.g., advertisements, websites, financial reports, or earnings calls). However, our green marks have the following advantages over alternative measures. First, as discussed earlier, like all trademarks, green marks are approved when firms provide evidence of their actual commercialization. Second, a trademark's registration will be invalidated if its identification is misleading. Third, we identify green marks based on a mark's identification that is directly related to its legal protection and has been examined and verified by the USPTO attorney. With all these features, we argue that green marks cannot be simply attributed to firms' self-promotion or greenwashing. An important feature of a trademark is its mark words that provide a direct message/image to consumers. For example, "Model X," "Model Y," and "CYBERTRUCK" are mark words. Clearly, these mark words do not contain "green words" (such as green, eco, and environment). In fact, the World Intellectual Property Office (WIPO) warns that applications for trademarks that include certain environmental claims, such as calling a product green, sustainable or eco-friendly, are likely to face a refusal, and the basis for such refusal is most often because the mark words are too general or may be deceptive.[11] Ceteris paribus, such a marketing gimmick, is more likely to play out when a firm's

[11] See this article for details. In addition, the USPTO has rejected applications for marks such as GREEN CEMENT for a type of cement that is not damaging the environment, GREEN-KEY for environmentally

green mark contains "green words." Overall, green marks in our sample are not intended to potentially mislead consumers or engage in greenwashing. Finally, green marks are public information and allow us to measure green innovation across firms in different sectors.

4. An Overview of Green Products in the U.S. Economy

4.1. Sample formation

We download the *case file* of all registered trademarks from the USPTO,[12] including a mark's identification, mark words, filing date, registration date, Nice class(es), owner name, and owner address. The raw sample comprises 5,084,151 unique trademarks registered by firms around the world with the USPTO over the period 1981-2020.[13] Our sample period starts in 1981 because we require a mark's Nice class(es) to identify green marks. The USPTO adopted the Nice classification for trademark filing after September 1973, and only since 1981 have we observed that most marks filled by the U.S. firms have their Nice classes in the case file. After requiring registered marks with corporate owners whose headquarters are located in the U.S., we are left with 3,334,855 unique marks. To match trademark owners in the USPTO trademark dataset with the unique firm identifiers in the CRSP-Compustat dataset, we first harmonize the names of mark owners, and then manually match those owners to U.S. public firms (removing financial firms in SIC 6000-6999 given their very low trademarking activity) in CRSP-Compustat based on name, location, and industry.[14] Table OA1 in the Online Appendix lists the steps taken to form our sample. Our final trademarking sample (i.e., firms with at least one mark registration over the

friendly key cards, CARBON NEGATIVE FIBER for natural fibers used in composite materials for manufacturing, and ZERO WASTE TEE for clothing.

[12] Here is the link for the dataset.

[13] We drop trademarks whose owners are *individuals*. In a *case file*, owner information is in the item "own_entity_cd," coded as 1 for individuals, and 2, 3, 9, 10, 11, 13, 16, or 19 for corporations.

[14] We do not include the financial industry in our sample because the well-known Federal Circuit Court of Appeals decision in the case of State Street Bank v. Signature Financial Group in 1998 effectively improves the patentability of business method patents that are common in the industry, and thus change financial firms' propensity to file patents and seek other intellectual property protection (Lerner 2002).

period 1981-2020) comprises 109,129 firm-year observations associated with 7,865 unique firms and 11,609 green marks (16,389 green terms).

4.2. Time series evidence

Figure 1 Panel A presents the temporal trend in trademarking in general and green marking, in particular, using our full sample over the period 1981-2020. We note a steady increase in trademarking and green marking (in blue and light green bars, respectively) up to 2011, then a decline after, reflecting the fact that the number of public firms declined in the 2010s. Interestingly, by tracking the number of green terms (in dark green bars), which represent distinct product lines within a green mark, we observe a sustained rise in green product lines over time (recall Tesla Inc's mark "T" spans two product lines), as a single green mark can have several green terms. In fact, the growth in green products even outpaces the rise in green patents documented in Cohen, Gurun, and Nguyen (2024, Figure 1). The divergence in temporal trends of green marks and green terms highlights why our unit of measure for green marking is based on a firm's green terms rather than its green marks; the latter fails to capture different green product lines.

Panel B presents the temporal trend in the share of green terms (green marks) out of all new products in a dark green (light green) line. Both shares exhibit an increasing time trend, especially after the 15th session of the Conference of the Parties (COP) – the 2009 Copenhagen Accord. The dark green line capturing the share of green terms – our measure for the capacity of green marking – shows a much steeper rise since 2009, suggesting an accelerated effort by U.S. firms to curb pollution and combat climate change.

Panel C presents green marking by industry sector based on the two-digit SIC codes.[15] We show that both the manufacturing and energy (including oil, gas, and utilities) sectors are the

[15] Our industry sector classification follows Cohen, Gurun, and Nguyen (2024) who extract the SIC codes from the U.S. Department of Labor's website.

clear leaders in the green product space, followed by the services sector. Moreover, both sectors have been industry leaders in green marking long before the term ESG was coined in the 2004 United Nations' global compact leaders summit final report (United Nations 2004).

4.3. Green marking across sectors and firms

Table 1 presents green marking by industry sector and firm. Consistent with the temporal and cross-sector pattern in Figure 1 Panel C, Panel A shows that the manufacturing sector has the highest number of green terms, totaling 6,953, followed by the energy sector with 5,854 green terms, and the services sector with 1,462 green terms. Cohen, Gurun, and Nguyen (2024) highlight that firms in the energy sector are key innovators in the U.S.'s green patent landscape despite their low ESG scores. In terms of the green patenting output, the energy sector, in the second place with 17,276 green patents over the period 1980-2020, is about a tenth of the number of green patents for the first place sector – manufacturing with 187,240 green patents.[16] In contrast, using green products (measured by the number of green terms) as a metric, the energy sector is not that far behind the industry leader, the manufacturing sector.

Table 1 Panel B lists firms in descending order based on the number of green terms. Out of the top 50 green marking firms, 30% are manufacturing firms, 52% are energy firms, and 10% are services firms.[17] Strikingly, out of the top ten producers of green marks, seven are in the

[16] We download patent data from the PatentsView database maintained by the USPTO. After merging with the Kogan, Papanikolaou, Seru, and Stoffman (2017) data repository, we keep utility patents granted to public firms over the period 1981-2020. We determine whether a patent is related to green technology following Haščič and Migotto (2015) whose classification scheme was adopted by the Organisation for Economic Co-operation and Development (OECD). The classification scheme relies on selected International Patent Classification (IPC) and Cooperative Patent Classification (CPC) classes, grouped into technological fields that are important for achieving four major environmental policy objectives: human health impacts of environmental pollution, addressing water scarcity, ecosystem health, and climate change migration.

[17] We note that S&P Global Inc. (which belongs to the services sector) ranks 29th. Its predecessor, McGraw Hill Financial, Inc., was well-known for financial information and data analytics. We manually checked the company's registered green products and found that it was actively engaged in environmentally friendly services. For example, in 2007, its subsidiary JD Power released the Automotive Environmental Index and applied for trademarks with the USPTO with mark words AUTOMOTIVE ENVIRONMENTAL INDEX and AUTOMOTIVE ENVIRONMENTAL INDEX TOP MODELS. We also found several green marks registered by Platts, a division of S&P Global Inc., which is a leading global provider of energy and metals

energy-producing sector (that includes utilities, following Cohen, Gurun, and Nguyen 2024): NextEra Energy Inc., Xcel Energy Inc., Constellation Energy Group Inc., Exelon Corp., Dominion Energy Inc., Pepco Holdings Inc., and the Southern Co., and two are waste management companies: the Republic Services Inc., and Waste Connections Inc. For comparison, the top five U.S. firms in terms of producing green patents are General Electric Co., Ford Motor Co., Dupont De Nemours Inc., United Technologies Group, and General Motors Co. (Cohen, Gurun, and Nguyen 2024). There is only one repeating firm in the top five firm list for producing green patents and that for producing green marks – General Electric Co.

4.4. Green marking by group

One unique feature of the EUIPO green trademark taxonomy is that it assigns the 375 green expressions into 35 categories and nine groups. Table 2 presents the frequency distribution of these nine groups and 35 categories in descending order by the number of green terms.[18] We note that green products concentrate in the group "energy production" (23.5%), followed by "energy conservation" (19.1%) and "pollution control" (14.9%). The bottom three groups are "agriculture" (0.4%), "transportation" (5.6%), and "environmental awareness" (6.0%).

Table 2 also presents the frequency distribution of the 35 categories under the nine groups (the share of each category is within its own group). We note that the category with the greatest number of green products is "other energy" (2,089 green terms), followed by "environmental services" (1,977 green terms), "process waste" (1,370 green terms), and "water purification" (1,288 green terms).

Figure 1 Panel D presents green marking by group following the EUIPO's classification. We make two observations. First, the top three green groups with the greatest number of green

information. S&P Global Inc.'s acquisition of Bentek Energy in 2011 also broadened its analytical services in natural gas and related power markets.

[18] Figure OA1 in the Online Appendix presents word clouds for the nine groups.

terms are energy production, energy conservation, and climate change. Second, these top three groups also experienced the most drastic increase since 2000.

5. Green Marking and Environmental and Firm Performance

5.1. Sample overview

Our trademarking sample (i.e., firms with at least one trademark registration from 1981 to 2020) comprises 109,129 firm-year observations associated with 7,865 unique trademarking firms over the period 1981-2020. There are 298,806 marks registered by the sample firms, out of which 9,547 are green marks (corresponding to 16,389 green terms). Table 3 presents summary statistics. Panel A focuses on the trademarking sample. We show that a third of the trademarking firms are green marking firms, i.e., firms with at least one new green product over the sample period. On average, the number of green terms registered per firm-year (#Green Term) is 0.13. To mitigate the skewness in this variable, we use the logarithmic value of #Green Term plus one to measure a firm's green product capacity, which is denoted as *Green Term*. The average number of unique categories with green terms of trademarks registered per firm-year (*Green Category*) is 0.059, which is used to measure a firm's green product scope and is bounded between 0 and 35. The sample firms, on average, register 2.74 marks and 0.08 green marks. Interestingly, among the trademarking sample, a fifth of the firms have produced at least one green patent over the sample period. The sample firms, on average, register 12.90 patents and 0.51 green patents.

Panel B presents the summary statistics for the green marking sample and its subsample of firm-year observations in which a firm registers at least one green mark. The green marking sample comprises 33,774 firm-year observations associated with 1,506 unique firms. Conditional on firm-year observations with at least one green mark registration (the right part of Panel B), we show that, on average, green marking firms register 3.23 green terms in 1.43 unique categories. These firms, on average, register 12.76 marks, with 1.88 being green marks. Commensurate with

their trademarking output, these firms are also highly productive in patenting, with an average of 80.6 patents including 5.21 green patents.

5.2. Green products and environmental performance

Given the mixed evidence on doing well by doing good in general and doing well in environmental performance in particular (e.g., Edmans 2011; Deng, Kang, and Low 2013; Servaes and Tamayo 2013; Dimson, Karakas, and Li 2015; Flammer 2015; Lins, Servaes, and Tamayo 2017; Albuquerque, Koskinen, and Zhang 2019 on the one hand, and Di Giuli and Kostovetsky 2014; Masulis and Reza 2015; Cheng, Hong, and Shue 2023 on the other hand), it begs the question of whether a firm's commitment to green product development is associated with any financial and real outcomes. To explore whether a firm's green products are associated with its environmental scores and emissions, we employ a number of measures. The first is from MSCI (formerly KLD; MSCI acquired KLD in 2010). The MSCI E-score is the difference between the number of strengths normalized by the total number of strengths and the number of concerns normalized by the total number of concerns, available from 1991 to 2019. The second is from Sustainalytics' Environmental Ratings, available from 2009-2019. Sustainalytics captures how well companies proactively manage the environmental issues that are the most material to their business, using three metrics: preparedness, disclosure, and performance. We use the average of these three metrics to measure a firm's environmental performance.[19] The third is from Refinitiv, available from 2002-2020. It has three environmental component scores: innovation score, resource use score, and emission reduction score. Innovation score captures a firm's capability to create "new market opportunities through new environmental technologies

[19] Preparedness refers to a firm's management systems and policies designed to manage material environmental risks. Disclosure refers to whether a firm meets international best practice standards and is transparent with respect to the most material environmental concerns. Performance refers to a firm's environmental performance based on quantitative metrics and whether it has been involved with any controversial environmental incidents. We divide the average of these three scores by 100 so that the average is between 0 and 1, consistent with other environmental scores used in our analysis.

and processes, or eco-designed products," and, therefore is directly linked to green products. Therefore, we use Refinitiv's innovation score in our analysis. We match the rating data with our green mark dataset by a mark's filing year to better capture the timing when green products are developed.

Our final environmental performance measure is from Trucost, available from 2002-2020. Trucost collects firm-level carbon and other greenhouse gas emissions with different scopes. Scope 1 emissions are direct emissions from operations of affiliates that are owned or controlled by a firm. Scope 2 emissions come from the generation of purchased heat, steam, and electricity used by a firm. Scope 3 emissions are indirect emissions caused by a firm's operations and the use of its products. These include emissions from the production of purchased materials, product use, waste disposal, and outsourced activities. However, the data quality for Scope 3 emissions is poor. For our purpose, we focus on total and Scope 1 emissions scaled by sales. Panel C presents the summary statistics for different samples with data available from three different ESG rating agencies – MSCI, Sustainalytics, Refinitiv, or greenhouse gas (GHG) emissions from Trucost.

We examine the relation between a firm's green products and its environmental performance. We estimate the following ordinary least squares (OLS) regression:

$$Environmental\ Score_{i,t} = \alpha + \beta_1 Green\ Product_{i,t} + Controls_{i,t} + Firm\ FE + Industry \times Year\ FE + \varepsilon_{i,t}, \quad (1)$$

where the dependent variable, $Environmental\ Score_{i,t}$, denotes three different environmental scores from MSCI, Sustainalytics, and Refinitiv. The variable of interest, $Green\ Product_{i,t}$, denotes the number of green terms and the number of unique green categories associated with green terms filed by firm *i* in year *t*. We control for a firm's number of non-green marks, number of green patents, firm size, firm age, return on assets, capital expenditure, R&D expenditure, cash holdings, and leverage. Moreover, we also include firm fixed effects to capture time-invariant firm characteristics (such as firm culture and managerial preferences) as well as SIC3-by-year

fixed effects to capture all time-varying industry-specific factors (such as federal environmental regulation, industry peer pressure, and market opportunities). Standard errors are clustered at the firm level.

Table 4 presents the results. In Panel A, using three different environmental scores as the dependent variables, we show that both our measures of green product capacity (*Green Term*) and scope (*Green Category*) are positively and significantly related to all three different measures of a firm's environmental performance. Such a positive association is also of economic significance: when a firm's *Green Term* (*Green Category*) increases by one standard deviation, its MSCI, Sustainalytics, and Refinitiv innovation scores will increase by 14.4%, 0.5%, and 3.2% (13.2%, 0.5%, and 2.6%), respectively, relative to the sample mean.[20] The findings in Panel A suggest that a firm's green products are recognized and incorporated into its environmental score produced by ESG rating agencies.

Next, we examine whether a firm's green products help reduce its future GHG emissions. We replace the dependent variable in Equation (1) with the GHG emissions variables, and estimate the following OLS regression:

$$GHG\ emissions_{i,t+2} = \alpha + \beta_1 Green\ Product_{i,t} + Controls_{i,t} + Firm\ FE + Industry \times Year\ FE + \varepsilon_{i,t+2}, \quad (2)$$

where the dependent variable, $GHG\ emissions_{i,t+2}$, denotes the Trucost's total emissions and Scope 1 emissions in the next two years.

Panel B reports the results and shows that both our measures of green product capacity (*Green Term*) and scope (*Green Category)* are negatively and significantly related to these two different measures of a firm's future environmental performance. Such a negative association is

[20] The standard deviations of *Green Term* (*Green Category*) are 0.40, 0.53, and 0.45 (0.55, 0.76, and 0.64), respectively, for the MSCI, Sustainalytics, and Refinitiv samples. The averages of *MSCI E-score*, *Sustainalytics E-score*, and *Refinitiv Innovation Score* are 0.025, 0.328, and 0.183, respectively. In comparison, when a firm's *Green Patent* increases by one standard deviation, *MSCI E-score*, *Sustainalytics E-score*, and *Refinitiv Innovation Score* will increase by 72.9%, 2.5%, and 7.4%, respectively. The coefficients on *Non-Green Mark* are negative but not statistically different from zero.

also of economic significance: When a firm's *Green Term* (*Green Category*) increases by one standard deviation, its total emissions and Scope 1 emissions will decrease by 8.7% and 11.7% (9.5% and 12.8%), respectively, relative to the sample mean.[21] The findings in Panel B suggest that a firm's green products are associated with real tangible environmental outcomes. This finding also confirms that our data on green marks indeed reflect firms' real efforts in accordance with trademark laws and are not simply capturing firms' strategic greenwashing attempts.

To show that green marking is far more common than green patenting, as well as that these significant associations between green marking and environmental performance are not driven by green patents, we employ a subsample of green marking firms that do not have any green patents over the sample period (i.e., the sample of non-green patenting firms). This sample comprises 86,950 firm-year observations associated with 6,908 unique firms. Table OA2 Panel A in the Online Appendix presents the summary statistics for this sample. Panels B and C repeat the analysis in Table 4. We show that the positive associations between green marking and environmental performance remain, suggesting that in the absence of patentable green technology, green marking firms are associated with superior environmental performance.

Table 4 thus has the following two implications. First, green products have unique explanatory power for firms' environmental performance that cannot be superseded by green patents and non-green products. Second, our use of environmental scores from three ESG rating agencies and Trucost's emission data enables us to establish a robust association between a firm's green products and its environmental performance.

5.3. Green products and firm performance

[21] The standard deviations of *Green Term* and *Green Category* are 0.48 and 0.67, respectively, for the Trucost sample. The averages of *GHG Total Emission* and *GHG Scope 1 Emission* are 5.6% and 3.2%, respectively. We note that the coefficients on *Green Patent* and *Non-Green Mark* are negative but not statistically different from zero.

The CSR literature argues that firms act socially responsible because they anticipate benefits and profits from launching green products to cater to customers' preferences (see, for example, Luo and Bhattacharya 2006; Albuquerque, Koskinen and Zhang 2019). However, commercializing green innovation into products and services can be an expensive and risky endeavour and harms a firm's operating performance and/or market value. It is thus an empirical question whether a firm's green products/services lead to sales growth and eventually contribute to firm value.

To begin with, we examine the relation between a firm's green products and its performance using the following OLS regression:

$$Performance_{i,t+2} = \alpha + \beta_1 Green\ Product_{i,t} + Controls_{i,t} + Firm\ FE + Industry \times Year\ FE + \varepsilon_{i,t+2}, \quad (3)$$

where the dependent variable, $Performance_{i,t+2}$, denotes average sales growth, Total Q, and Tobin's Q over the next two years. Total Q is the market value of assets divided by the sum of tangible and intangible assets (Peters and Taylor 2017). Conceptually, green products are the output of intangible investments, which makes Total Q a more suitable measure of firm value than the traditional Tobin's Q. The variable of interest, $Green\ Product_{i,t}$, denotes green product capacity (*Green Term*) and scope (*Green Category*). The regression includes an extensive list of firm characteristics (including a firm's number of non-green marks and the number of green patents), firm fixed effects, and SIC3-by-year fixed effects.

Table 5 reports the results. We find that both our measures of green product capacity (*Green Term*) and scope (*Green Category)* are positively and significantly related to all three different measures of firm performance over the next two years. This positive association is also of economic significance: when a firm's *Green Term* (*Green Category*) increases by one standard deviation, its sales growth, *Total Q*, and *Tobin's Q* will increase by 2.2%, 0.6%, and 0.8% (2.3%,

0.6%, and 0.7%), respectively, relative to the sample mean.[22] We note that non-green marks are also positively and significantly associated with sales growth and firm value, consistent with the intuition that new products grab market attention and seize new customers (Hsu et al. 2022).

Table OA2 Panel D repeats the analysis in Table 5 using a sample of non-green patenting firms. We continue to find that a firm's green marking activities positively and significantly predict its sales growth and Tobin's Q. This is a noteworthy finding as it demonstrates that in a sample of firms without any green patenting, there remains a significant and positive association between green marking and future firm performance and value. More importantly, the coefficients on *Green Term* and *Green Category* are actually quite close to those in Table 5 using the baseline sample, which suggests that the role of green marks in firm performance and value is unaffected by firms' need or choice to patent green innovation.

Table 5 thus has the following three implications. First, green products play a distinct role from green patents in predicting sales growth and firm value. Second, if we only use green patents to capture a firm's environmental effort, we may miss the full picture of its green investment. Third, the benefits of a firm's environmental engagement may come from its product market presence and marketing. In summary, as far as we are aware, we are one of the first in the literature to establish the value implications of green products and extending green innovation beyond green patents.

5.4. Product market scope and threats

In this section, we explore whether there is any boundary condition for the positive association between green products and firm performance established earlier. Our first analysis is

[22] The standard deviations of *Green Term* and *Green Category* are 0.26 and 0.34, respectively, in the sample. The averages of sales growth, *Total Q*, and *Tobin's Q* are 0.17, 1.70, and 6.92, respectively, in the sample. In comparison, when a firm's *Green Patent* increases by one standard deviation, its sales growth will increase by 1.9% relative to the sample mean. The coefficients on *Green Patent* are statistically insignificant for *Total Q* and *Tobin's Q*. In addition, the coefficients on *Non-Green Mark* are positive and significant.

motivated by the theories of economies of scope and scale pioneered by Panzar and Willig (1977, 1981) and Teece (1980), who argue that multi-product firms are more likely to emerge if economies of scope are based on shared proprietary know-how. Using a novel text-based measure of a firm's product market scope, Hoberg and Phillips (2024) find that U.S. firms have significantly expanded their scope of product offerings over the past 30 years, and those expansions significantly increase firm value. We thus posit that green innovation will be value-enhancing if firms that undertake it have the organizational capabilities to utilize existing production, marketing, and research facilities. To test this conjecture, we use the product market scope measure developed by Hoberg and Phillips (2024) as our proxy for a firm's scope-expanding capabilities.[23] We create an indicator variable, *High Product Market Scope*, that takes the value of one if a firm's product market scope in a year is above the top tercile of its three-digit SIC industry peers, and zero otherwise. We estimate Equation (3) by replacing *Green Product* with *Green Product* × *High Product Market Scope* and *Green Product*× *(1 – High Product Market Scope)*. These interaction terms help delineate the boundary condition for green products to be value-enhancing.

Our second analysis is motivated by the industrial organization literature on product life cycle and innovation (Abernathy and Utterback 1978; Klepper 1996). One takeaway from this literature is that firms should be more willing to develop green products when their product portfolios have reached a stable point. We thus posit that green innovation will be value-enhancing if firms that undertake it face fewer competitive threats from rivals. To test this conjecture, we use the product market fluidity measure developed by Hoberg, Phillips, and Prabhala (2014). The measure captures changes in rival firms' products relative to a focal firm's products; a lower value indicates a firm facing fewer competitive threats in the product market space. We create an indicator variable, *Low Product Market Threats*, that takes the value of one if

[23] The data are available from 1988 to 2020 and can be downloaded from the Hoberg and Phillips data library.

a firm's product market fluidity in a year is below the bottom tercile of its three-digit SIC industry peers, and zero otherwise. Table 6 presents the results.

Panel A reports the OLS regression results involving the product market scope measure. We find that the estimated coefficient on *Green Product × High Product Market Scope* is positive and significant at the 5% or higher level when the dependent variables are sales growth, Total Q, and Tobin's Q; however, the estimated coefficient on *Green Product × (1 – High Product Market Scope)* is not significant when the dependent variables are Total Q or Tobin's Q.[24] In other words, while sales growth increases with green products in both groups of firms, only firms with higher product market scope benefit from green product development in firm value. These results are intuitive; while firms can apply their green innovation to more product lines and increase sales, such extension may be costly and thus reduce firm value (Maksimovic and Phillips 2002; Hoberg and Phillips 2024). Only firms with high product market scope enjoy more synergies or bear lower costs in their transformation of green innovation to product lines, leading to higher market value. For other firms, such product extension may be costly and even hurt firm value. In addition, when comparing the results in Panel A to the baseline results in Table 5, the estimated coefficient on *Green Product × High Product Market Scope* is between 1.3 and 1.6 times more than that in the baseline regression. These results indicate that the value of a firm's green innovation increases with its scope-expanding capabilities, supporting our conjecture.

Table 6 Panel B reports the OLS regression results involving the product market fluidity measure. We find that the estimated coefficient on *Green Product × Low Product Market Threats* is positive and significant at the 1% level when the dependent variables are sales growth, Total Q, and Tobin's Q; however, the estimated coefficient on *Green Product × (1 – Low Product Market*

[24] When the dependent variable is sales growth, we find significant and positive coefficients on the interaction terms *Green Product × High Product Market Scope* and *Green Product × (1 – High Product Market Scope)*. Nevertheless, the former is larger than the latter, consistent with our conjecture that green product firms benefit more when they have scope-expanding capabilities. We further conduct the t-tests for the difference between the coefficients on those two interaction variables; the p-values are 0.40 and 0.01 when green product variables are green term and green category, respectively.

Threats) is not significant when the dependent variables are Total Q or Tobin's Q.[25] These results suggest that, even though both groups of firms experience higher sales growth, only firms with fewer competitive threats benefit from green products in valuation. This finding is consistent with the prediction from the product life cycle literature (e.g., Klepper 1996): Firms appropriate more profits from new green products when there are fewer rivals who can imitate them. When we compare the results in Panel B to the baseline results in Table 5, we note that the estimated coefficient on *Green Product × Low Product Market Threats* is about 1.5 times those coefficients in different baseline specifications, supporting the notion that green innovation is more valuable when firms producing it face fewer product market threats.

In summary, we find that the benefits from green products/services are not evenly distributed, depending on firms' product market scope and competitive threats. The results in Table 6 establish some novel boundary conditions for firms to benefit from green innovation – shared capabilities in production, marketing, and research facilities and/or they face fewer competitive peers in the product space.

6. Heterogeneity in Green Products

In this section, we leverage the rich, granular textual data in a mark's registration form to shed light on the contributions of different green products and services to revenue growth and firm value. Specifically, we dissect a firm's product development in three aspects. First, we focus on the centrality of a firm's green marks by determining whether green marks are filed in its core business areas or peripheral domains. Next, we examine whether and how the timing and sequence of green term introduction lead to different firm outcomes. Lastly, we assess whether

[25] When the dependent variable is sales growth, we find significant and positive coefficients on the interaction terms *Green Product × Low Product Market Threats* and *Green Product × (1 – Low Product Market Threats)*. We further conduct the t-tests for the difference between the coefficients on those two interaction coefficients; the p-values of the tests are 0.58 and 0.93 when green product variables are green term and green category, respectively.

there is potential complementarity between green and non-green terms if they belong to the same product or service categories.

6.1. Core-business and non-greenfield green products

To capture cross-sectional and temporal heterogeneities in a firm's green marks, we utilize its trademarking history over the past five years to separate green products into two paired groups. First, we are interested in whether green marks belong to its owner's core business or not and their value implications. We identify a firm's core business using the top three Nice classes with the most number of products (services) over the past five years. *Core-Business Green Term* refers to a green term in the focal firm's top three Nice classes, and *Non-Core-Business Green Term* refers to a green term, not in the focal firm's top three Nice classes.

Moreover, we are interested in whether there are differential value implications for greenfield green products compared to non-greenfield ones. We identify a firm's greenfield green products if a green term is registered for the first time over the past five years. *Greenfield Green Term* refers to a green term for a firm that has not registered any green marks over the past five years, and *Follow-up Green Term* refers to a green term for a firm that has registered some green marks over the past five years. The summary statistics are provided in Table OA3 in the Online Appendix.

In Table 7, we repeat the analysis in Table 5 except that we replace *Green Term* with its paired components as defined above. In Panel A, when we divide green terms by whether those green terms are related to a firm's core business, we find that the positive association between green terms and sales growth, as well as firm value, largely comes from green products in the firm's core business.

In Panel B, when we divide green terms by whether a firm had green products over the past five years, we find that both follow-up and greenfield green terms are positively and significantly associated with sales growth. Nevertheless, only follow-up ones are significantly

related to future firm value. This finding may be attributed to the risk and uncertainty associated with greenfield green products – even though they may boost short-term revenue, they are also more likely to fail. On the other hand, follow-up green products reflect a firm's success in its prior green innovation and/or that a firm strengthens its existing advantage and market position; thus, these follow-up green products are more likely to succeed in the future.

6.2. Shared goods (service) class

Next, we explore whether complementarity between green and non-green terms in the same goods (service) class would contribute to revenue growth and firm value. Recall that a mark is a green mark if it contains a green term, and that a green mark can be associated with multiple green and non-green terms. These green and non-green terms could be in the same or different Nice classes. The variation in term composition across Nice classes is informative of a firm's green innovation strategy.

To motivate our measures, we present examples in Section OA1.4 in the Online Appendix. In one example, Tesla Inc.'s mark "MODEL Y" is a green mark in the Nice class 12, with only one single green term, and no other non-green term associated with this mark. In another example, Waste Management Inc.'s mark "WM" is a green mark in the Nice classes 40 and 42. There are two green terms (in the Nice classes 40 and 42) and two non-green terms in the Nice classes 37 and 39. As a third example, NextEra Energy Inc.'s green mark "NEXTERA ENERGY" spans three Nice classes (35, 36, and 41). There are three green terms, one in the Nice class 35, and the other two in the Nice class 36.

Motivated by the different composition within goods (service) class associated with a green mark as illustrated by the above examples, we separate *Green Term* into two groups: *Common-Class Green Term*, i.e., a mark's green terms fall into the same Nice class(es) as its non-green terms, and *Unique-Class Green Term*, i.e., a mark's green terms fall into different Nice class(es) from its non-green terms. Going back to NextEra Energy Inc.'s green mark "NEXTERA

ENERGY," its green term ("Charitable services, namely, promoting public awareness of environmental issues and initiatives") is in the same Nice class 35 as one of its non-green terms ("Charitable services, namely, organizing and conducting volunteer programs and community service projects") and thus is a common-class green term. In the case of Waste Management Inc.'s green mark "WM," its green term ("Recycling") is the only term in the Nice class 40 and thus is a unique-class green term. This way of categorization enables us to examine if there is complementarity between green terms and non-green terms (which reflect green and non-green technologies or products). In other words, it allows us to examine if green products are of higher value when combined with non-green products in the same product space. Table 8 repeats the analysis in Table 5 except that we replace *Green Term* with its paired components of *Common-Class Green Term* and *Unique-Class Green Term*.

In Table 8, we show that the positive association between green products and sales growth and firm value largely comes from green terms that share the same Nice class(es) with non-green terms under the green marks. This indicates that green products (services) complementary to non-green products (services) generate the most value for their owners.

We conclude that green products are significantly more value-enhancing when they are in a firm's core product lines, are not greenfield, or are introduced together with other non-green products in the same goods (service) class. As far as we are aware, we are the first in the literature to shed light on the sources of value creation from green products.

7. Why Do Firms Develop Green Products?

In this section, we explore a number of possible motivating factors behind firms' development of green products. They include intrinsic factors, such as managers' mindsets and awareness shaped by experiences like natural disasters, and extrinsic factors, such as elevated regulatory scrutiny and stakeholders' attention prompted by industry peers mired in environmental scandals. We begin by analyzing the impact of natural disasters—an intrinsic

motivator—on firms' green mark production. We then explore the role of environmental scandals in an industry, an extrinsic motivator that prods firms' green initiatives. We also explore the temporal association between public awareness of climate issues and public firms' green products.

7.1. Natural disasters

Natural disasters are an increasingly salient global phenomenon. Prior research shows that such events can significantly affect firms' operations (Barrot and Sauvagnat 2016), disrupt credit supply (Cortés and Strahan 2017), and change managers' behavior (Bernile, Bhagwat, and Rau, 2017). Climate-related disasters such as floods, hurricanes, tornadoes, and wildfires often serve as wake-up calls, highlighting the urgent need for sustainable solutions to mitigate environmental degradation. We hypothesize that firms exposed to these events, either directly or indirectly, may respond by developing greener products and services, reflecting their environmental awareness and a desire to contribute to sustainability efforts.

To explore this conjecture, we utilize data on major natural disasters from the Spatial Hazard and Loss Database for the United States (SHELDUS), maintained by Arizona State University. The database provides detailed records of hazardous events at the county level across the U.S.

We define a "disaster-affected county" as one experiencing disasters whose total estimated property and crop damages exceed $1 million in 2021 constant dollars in a given year. In our robustness checks, we also explore alternative definitions of a disaster. We exclude firms located in disaster-affected counties to ensure that our focal firms' operations are not directly impacted by disasters.

The key assumption in our analysis is that firms located in counties adjacent to disaster-affected counties are indirectly exposed to the environmental repercussions of these events. While these firms are not physically impacted by the disasters—meaning that they do not experience

significant property damages themselves—their proximity to the affected areas makes the impact of natural disasters highly salient to their managers. This heightened awareness is reinforced by extensive media coverage and increased public concerns. Such salience may prompt these firms' managers to engage in the development of green products, responding proactively to the visible environmental challenges faced by their neighboring communities. It is worth noting that, for these firms, their customers and facilities are much more geographically spread-out than their top management team. Thus, if a firm's green products increase after the occurrence of natural disasters in its adjacent counties, it is more likely attributed to changes in managers' mindset and awareness. In other words, the incidence of natural disasters in adjacent counties serves as a proxy for increased managerial environmental awareness. This approach allows us to isolate the awareness effect of natural disasters on firms' product market strategies that are indirectly affected, ensuring that we do not confound the results with the direct economic impact of the disaster itself, such as physical damages or operational disruptions.

To quantify the impact of natural disasters in adjacent counties on a firm's green product development, we estimate the following Poisson regression model:

$$E[Green\ Product_{i,t+n}|\mathcal{X}] = \exp\ (\alpha + \beta_1 Adjacent\ to\ Natural\ Disaster_{i,t} + Controls_{i,t} + Firm\ FE + Industry \times Year\ FE), \quad (4)$$

where the dependent variable, $Green\ Product_{i,t+n}$, denotes the number of green terms (*Green Term*) and the number of unique green categories (*Green Category*) associated with green terms filed by firm *i* in year *t+1* or years *t+1* and *t+2*. The variable of interest, $Adjacent\ to\ Natural\ Disaster_{i,t}$, is an indicator variable that takes the value of one if a firm's headquarters is located in a county adjacent to any disaster-affected county in that year, and zero otherwise.[26] For our analysis, we focus on the period after 2000, as both green

[26] For the Poisson regression sample, firms or industry-year observations with identical outcome variables (such as zero green terms) will be dropped. In this sample, the average of *Adjacent to Natural Disaster* is 0.502.

technology/innovation and the incidence of major natural disasters became more prominent during this period. We also include control variables, firm size, firm age, return on assets, capital expenditure, R&D expenditure, cash holdings, and leverage, to account for confounding factors that might influence green product innovation. Firm fixed effects and SIC3-by-year fixed effects are included to control for unobserved heterogeneity at the firm level and industry-wide shocks, respectively. Standard errors are clustered at the firm level. Table 9 presents the results.

In Panel A, we show that firms located in counties adjacent to disaster-affected areas significantly increase their green products in the years following the disaster. Specifically, both green product capacity (*Green Term*) and green product scope (*Green Category*) improve after managers are exposed to natural disasters. In terms of economic significance, in column (1), the coefficient estimate on *Adjacent to Natural Disaster* is 0.521 and significant at the 1% level, suggesting that, after adjacent counties experience natural disasters, firms will increase their number of new green terms by 68.4% (exp(0.521) − 1) in the next year. This translates into an average increase of 0.84 new green terms given the average number of new green terms for the Poisson regression sample at 1.227 terms per year. In column (3), the coefficient estimate on *Adjacent to Natural Disaster* is 0.352 and significant at the 1% level, suggesting a 42.2% increase in green product scope, corresponding to an average increase of 0.20 unique green categories, relative to the average number of 0.48 unique green categories produced per year. These results suggest that managers' environmental awareness triggered by their firms' proximity to climate-related disasters prompts these firms to develop more new green products.

In Panel B, we expand the regressors in our model by adding three new variables to validate the parallel trend assumption. The dependent variable in columns (1) and (2) is the number of green terms filed in the next year, and in columns (3) and (4) is the number of unique green categories filed in the next year. The newly added independent variables, "Adj to Natural Disaster (-1/-2/-3)," equal one if a firm-year observation is one, two, or three years prior to the

event of adjacency to a natural disaster. The results show that the coefficients on *Adj to Natural Disaster (-1/-2/-3)* are insignificant across all columns, suggesting no differential trends in green marking activities between the control and treatment groups prior to the disaster. Conversely, the estimated coefficients on the main variable of interest, *Adjacent to Natural Disaster*, remain positive and significant across all specifications.

To ensure the robustness of our findings, we conduct several additional tests. First, we explore alternative thresholds for defining natural disasters, such as using only far more damaging disasters as defined in Barrot and Sauvagnat (2016), or reducing the damage threshold to $500 thousand (see Table OA4 in the Online Appendix). Second, we refine our sample by excluding firms located in counties with minor disaster impacts (i.e., total estimated damages less than $50 thousand), ensuring that our results are not driven by firms in marginally affected areas (see Table OA5). Third, we estimate the model with standard errors clustered by county, rather than by firm, to account for potential spatial correlations among firms in their disaster exposure (see Table OA6). Across all alternative specifications, we continue to show that firms' indirect exposure to natural disasters is associated with a significant increase in both their green product capacity and scope. These results demonstrate that managers' environmental awareness, an intrinsic motivation, significantly influences their firms' development of green products, underscoring its importance as a key driver of firms' adoption of sustainable practices.

7.2. Environmental scandals in an industry

As we explore different reasons behind firms' development of green products, it is crucial to also consider any external factors that might influence this decision. In this part of our study, we examine whether and how environmental scandals in an industry shape firms' commitment to green products.

We hypothesize that when a firm is caught in environment-related scandals, it raises awareness among regulators, stakeholders, and industry peers. This heightened awareness and

peer pressure might lead peer firms to increase their investment in green products, responding to both stakeholders' expectations and their own realization of the importance of being green.[27]

To test this conjecture, we first construct industry-level negative environmental news using data from RepRisk, a global provider of business intelligence focusing on environmental, social, and governance (ESG) risks (Gantchev, Giannetti, and Li 2022; Derrien, Krueger, Landier, and Yao 2023; Akey, Lewellen, Liskovich, and Schiller 2024). RepRisk sources news events from the media as well as regulatory and commercial documents and categorizes them into 29 distinct ESG issues.[28] We present two examples of RepRisk incidents in the Online Appendix Section OA2: the Dan River coal ash spill from Duke Energy's facilities in 2014, and the news about Halliburton Co.'s responsibility in the Deepwater Horizon oil spill in 2010.

To classify a news event as a negative environmental incident, we require its severity score to be of medium to high severity (2 to 3) and be labelled as violating at least one of the following three environment-related United Nations Global Compact (UNGC) principles: Principle 7 (Businesses should support a precautionary approach to environmental challenges), Principle 8 (Undertake initiatives to promote greater environmental responsibility), and Principle 9 (Encourage the development and diffusion of environmentally friendly technologies). In robustness checks, we also consider an alternative definition of negative environmental news using RepRisk's own classification of environmental issues. We aggregate firm-level severe negative environmental news events in a year to the SIC3-year level. To avoid endogeneity concerns, we exclude firms featured in any negative environmental news themselves, as both the news and a firm's response could be influenced by the firm's prior activities and characteristics.

[27] Prior studies show that customers respond to firms' ESG scandals by reducing their demand (e.g., Duan, Li, Michaely 2023; Meier, Servaes, Wei, and Xiao 2024). Therefore, it is also possible that peer firms seize the opportunity to expand their market share by producing more green products (Albuquerque, Koskinen, and Zhang 2019; Aghion, Bénabou, Martin, and Roulet 2023).
[28] See RepRisk Research Scope: ESG Issues for details.

We estimate the following Poisson regression relating peer firms' environmental scandals to a firm's response in terms of developing green products:

$$E[Green\ Product_{i,t+n}|\mathcal{X}] = \exp\ (\alpha + \beta_1 Peer\ Scandal_{j,t} + Controls_{i,t} + Firm\ FE + Year\ FE), \quad (5)$$

where the dependent variable $Green\ Product_{i,t+n}$ denotes the number of green terms (*Green Term*) and the number of unique green categories (*Green Category*) associated with green terms filed by firm *i* in year *t+1* or years *t+1* and *t+2*. The variable of interest, $Peer\ Scandal_{j,t}$, is an indicator variable that takes the value of one if firm *i* belongs to an SIC3 industry *j* that is reported to have severe negative environmental news in year *t*, and zero otherwise.[29] The sample period is 2007-2020 due to the data availability of RepRisk.

Similar to our main specification, we include the same set of firm characteristics that might influence their green products. We do not include SIC3-by-year fixed effects because our variable of interest, $Peer\ Scandal_{j,t}$, is an industry-year level variable. Standard errors are clustered at the industry level because our variable of interest is the negative environmental news within an industry. Table 10 presents the Poisson regression results.

In Panel A, across all specifications, we show a positive and significant association between firms whose industry peers are hit with environmental scandals and their development of green products. In terms of economic significance, in column (1), the coefficient estimate on *Peer Scandal* is 0.325 and significant at the 1% level, suggesting that, facing industry peers' negative environmental news, firms will increase their number of new green terms by 38.4% (exp(0.325) – 1) in the next year. Given the average number of new green terms for the Poisson regression sample at 0.753 terms per year, this translates to an average increase of 0.289 green terms. In column (3), the coefficient estimate on *Peer Scandal* is 0.137 and significant at the 5% level, suggesting a 14.7% increase in the number of unique green categories in the next year. Our

[29] For the Poisson regression sample, firms with identical outcome variables (such as zero green terms) will be dropped. In this sample, the average of *Peer Scandal* is 0.403.

findings suggest that external pressure and stakeholder scrutiny might prompt firms to introduce green products to differentiate themselves.

Following a similar approach as in the natural disaster analysis, Panel B expands our model by including three new variables. To examine the existence of any pre-trends, we add three independent variables "Peer Scandal (-1/-2/-3)" into the regression, which equal one if a firm-year observation is one, two, or three years prior to the event of experiencing peer scandals. The dependent variable in columns (1) and (2) is the number of green terms filed in the next year, while in columns (3) and (4), it is the number of unique green categories filed in the next year. The results indicate that the coefficients for *Peer Scandal (-1/-2/-3)* are insignificant across all columns, suggesting that green marking activities are similar for both the control and treatment groups before peer scandals happen. By contrast, the primary variable of interest, *Peer Scandal*, continues to show positive and significant effects across all specifications. These findings provide support for the parallel trend assumption being satisfied.

In robustness tests, we use an alternative definition of negative environmental news based on RepRisk's own classification of environment-related issues that cover climate change, GHG emissions, global pollution, impacts on landscapes and bioscope, local pollution, other ESG issues, overuse and wasting of resources, product-related health and environmental issues, and waste issues (see Table OA7 in the Online Appendix). We find consistent results when we use this alternative measure.

In summary, Tables 9 and 10 provide clean causal evidence that both internal forces such as management's awareness of climate risk prompted by their firms' proximity to natural disasters and external forces such as environmental scandals of industry peers that result in heightened scrutiny from regulators and stakeholders, could be behind firms' development of green products. Our findings indicate that while both natural disasters and industry scandals increase firms' green product output, the impact of natural disasters appears to be more substantial. Specifically, firms adjacent to disaster-affected areas increase their green product

capacity by approximately 68.4%, compared to a 38.4% increase in response to industry scandals. This suggests that direct environmental impacts may have a stronger influence on firms' decisions to introduce green products than external pressures from scandals within their industry.

7.3. The environmental awareness in general

In this section, we provide some suggestive evidence on how public awareness of environmental issues motivates firms' development of green products by examining the relationship between media coverage of such issues and public firms' production of green marks. Specifically, we employ the WSJ Climate Change News Index, developed by Engle et al. (2020), as a proxy for the intensity of climate change discussions in the media.[30] Higher index values indicate a heightened public attention to climate change topics.

We examine the association between the six-month trailing average of the WSJ Climate Change News Index (t-6 to t-1) and the six-month forward average of the number of green terms filed by public firms (t+1 to t+6) in each month t.

Figure 2 Panel A presents the binned scatter plot. The monthly data is grouped into 40 bins, with the solid line indicating the linear fit using the underlying raw data. The plot reveals a positive association: As the WSJ index increases, the number of green products rises in subsequent months. This suggests that heightened media focus on climate issues positively correlates with subsequent corporate investment in green products.

Panel B presents the temporal trends in the lagged WSJ index (red line) and forward green products by public firms (blue line). Both variables exhibit an upward trend over time, with noticeable spikes during certain periods. These spikes often align, as increases in the WSJ index

[30] The WSJ Climate Change News Index ("WSJ index") captures the intensity of climate change discourse relevant to investors by analyzing WSJ articles using a predefined vocabulary compiled from authoritative climate documents. The index looks at the textual similarity between WSJ articles and this vocabulary using a cosine similarity metric.

are followed by corresponding rises in green products. The synchronization of trends suggests that firms react to more environmental discourse in the media by increasing their green products.

Figure OA2 in the Online Appendix repeats the analysis by green group. Across all groups, the trends in green products generally rise over time, with notable peaks aligning with spikes in the WSJ index, particularly during key climate-related events. Some groups, such as energy conservation, reusable, transportation and waste management, exhibit stronger alignment between public awareness and green product development, indicating possibly these green products' stronger sensitivity to heightened climate discourse.

Taken together, we establish a strong positive association between stakeholders' environmental awareness and firms' efforts to develop green products and services.

8. Conclusions

Applying a newly released green trademark taxonomy from the European Union Intellectual Property Office (EUIPO) (2021) to the USPTO trademark dataset, we compile a novel dataset of environmentally friendly products and services deployed in the U.S. economy over the past forty years. Given the "use in commerce" requirement as well as legal protection and regulation of trademarks, our data are in a unique position to capture newly commercialized green products and, thus, firms' commitment to environmental protection and sustainability. Moreover, our data cover a wide range of industries and firms because we focus on "users" instead of "producers" of green technology.

We first show that the manufacturing, energy, and services sectors top the green products in the U.S. economy. We further show that firms with more green products are associated with higher environmental ratings and lower greenhouse gas emissions, which confirms the significance and reveals the real effects of our measures. In addition, firms' green products are shown to be associated with greater future revenue growth and higher firm value, supporting the

notion of doing well by doing good. Moreover, the value relevance of firms' green products is limited to firms with greater product market scope and facing fewer product market threats.

Importantly, leveraging the granular textual data in a mark's application, we show that green products are significantly more value-enhancing when they are in a firm's core product lines, are not greenfield, or are introduced together with other non-green products in the same product space. As far as we are aware, we are the first to shed light on whether and how green products help increase sales and firm value. Finally, we provide causal evidence that firms launch green products in response to natural disasters in neighboring countries or their peers' environmental scandals.

Appendix
Variable definitions

All continuous variables are winsorized at the 1st and 99th percentiles.

Variable	Definition
Trademark Variables	
#Green Term	The sum of green terms in newly registered green marks by a firm in a year. A green term is identified according to the (modified) EUIPO green trademark taxonomy. See the detailed description of steps involved to identify green marks in the Online Appendix Section OA1.
Green Term	Natural logarithm of #Green Term plus one.
#Green Category	The sum of unique green categories associated with green terms in newly registered green marks by a firm in a year. The EUIPO green trademark taxonomy assigns a green term into 35 categories and nine groups. The following list shows each group together with its categories: (1) agriculture (fertilizer alternatives, other agriculture, and pesticide alternatives); (2) climate change (carbon brokerage, carbon monitor, and environmental services); (3) energy production (biofuels, other energy, solar energy, and wind energy); (4) energy conservation (energy management, energy saving, low energy lighting, and storage of electricity); (5) environmental awareness (ecology and sustainability); (6) pollution control (air purification, biodegradable, pollution general, and water purification); (7) reusable (other reusable, recycling, refilling cartridge, reusable bags, and reusable bottles); (8) transportation (electric bike, electric car, electric engines, electric motor, general transport, hybrid vehicle, hydrogen vehicle, and other vehicles); and (9) waste management (process waste and waste disposal).
#Green Mark	The sum of newly registered green marks by a firm in a year. A mark is a green mark if its identification contains at least one green term according to the (modified) EUIPO green trademark taxonomy.
Green Mark	Natural logarithm of #Green Mark plus one.
#All Mark	The sum of newly registered marks by a firm in a year.
#Non-Green Mark	The sum of newly registered non-green marks by a firm in a year.
Non-Green Mark	Natural logarithm of #Non-Green Mark plus one.
Green Marking Firm	An indicator variable that takes the value of one if a firm has at least one newly registered green mark during 1981-2020, and zero otherwise.
#Core-Business Green Term	The sum of green terms in newly registered green marks by a firm in a year, where the new marks' Nice classes belong to the firm's core business. A firm's core-business refers to its top three Nice classes with the most number of terms over the past five years.
Core-Business Green Term	Natural logarithm of #Core-Business Green Term plus one.
#Non-Core-Business Green Term	The sum of green terms in newly registered green marks by a firm in a year, where the new marks' Nice classes do not belong to the firm's core business.
Non-Core-Business Green Term	Natural logarithm of #Non-Core-Business Green Term plus one.

#Follow-up Green Term	The sum of green terms in newly registered green marks by a firm in a year, where the firm has registered some green marks over the past five years.
Follow-up Green Term	Natural logarithm of #Follow-Up Green Term plus one.
#Greenfield Green Term	The sum of green terms in newly registered green marks by a firm in a year, where the firm has not registered any green marks over the past five years.
Greenfield Green Term	Natural logarithm of #Greenfield Green Term plus one.
#Common-Class Green Term	The sum of green terms in newly registered green marks by a firm in a year, where within a green mark, these green terms have the same Nice class(es) as the mark's non-green terms.
Common-Class Green Term	Natural logarithm of #Common-Class Green Term plus one.
#Unique-Class Green Term	The sum of green terms in newly registered green marks by a firm in a year, where within a green mark, these green terms are not paired with non-green terms, or they do not have the same Nice class(es) as the mark's non-green terms.
Unique-Class Green Term	Natural logarithm of #Unique-Class Green Term plus one.
Patent Variables	
#Green Patent	The sum of newly granted green patents to a firm in a year. A patent is a green patent if its Cooperative Patent Classification (CPC) and/or International Patent Classification (IPC) falls within the Organisation for Economic Co-operation and Development green patent taxonomy (Haščič-Migotto 2015, pp. 46-58).
Green Patent	Natural logarithm of #Green Patent plus one.
#Patent	The sum of newly granted patents to a firm in a year.
Green Patenting Firm	An indicator variable that takes the value of one if a firm has at least one newly granted green patent during 1981-2020, and zero otherwise.
Environmental Performance Variables	
MSCI E-Score	The score is calculated as the difference between the number of strengths normalized by the total number of strengths and the number of concerns normalized by the total number of concerns. Data is from MSCI, available from 1991 to 2019.
Sustainalytics E-Score	The score is the average of three metrics: preparedness, disclosure, and performance, and divided by 100 to have the score range between 0 and 1. Preparedness refers to a firm's management systems and policies designed to manage material environmental risks. Disclosure refers to whether a firm meets international best practice standards and is transparent with respect to the most material environmental concerns. Performance refers to a firm's environmental performance based on quantitative metrics and whether it has been involved with any controversial environmental incidents. Data is from Sustainalytics, available from 2009 to 2019.
Refinitiv Innovation Score	The score captures a firm's capability to create new market opportunities through new environmental technologies and processes, or eco-designed products, and, therefore is directly linked to green products. Data is from Refinitiv, available from 2002 to 2020.
GHG Total Emission	The sum of Scope 1, 2, and 3 greenhouse gas emissions in units of tons of CO2 equivalent by a firm in a year divided by its sales (in percentage points). Data is from Trucost, available from 2002 to 2020.

GHG Scope1 Emission	Direct emissions from the operation of affiliates that are owned or controlled by a firm in a year divided by its sales (in percentage points). Data is from Trucost, available from 2002 to 2020.
WSJ Climate Change News Index	Monthly index of media discourse on climate issues, developed by Engle et al. (2020).
Firm-level Variables	
Firm Size	Natural logarithm of total assets. (Compustat: at)
Firm Age	Firm age since its IPO year.
ROA	Income before extraordinary items divided by total assets. (Compustat: ib / at)
Capex	Capital expenditure divided by total assets. (Compustat: capx / at)
RD	R&D expenditure divided by total assets. We replace missing value with zero. (Compustat: xrd / at)
Cash Holdings	Cash divided by total assets. (Compustat: che / at)
Leverage	Book debt divided by total assets. (Compustat: (dlc + dltt) / at)
Sales Growth	Sales growth. (Compustat: (sale – lagged sale) / (lagged sale))
Total Q	Market value of assets divided by the sum of tangible and intangible assets. A firm's market value is the sum of the market value of outstanding equity (Compustat: prcc_f × csho) and the book value of debt (Compustat: dltt + dlc), net of cash and liquid securities (Compustat: che). A firm's tangible assets is the book value of property, plant, and equipment (Compustat: ppegt). A firm's intangible assets is the sum of its externally purchased (Compustat: intano + gdwl) and internally created intangible assets (i.e., the estimated off-balance-sheet intangible assets). Data for the off-balance-sheet intangible assets is from Peters and Taylor (2017).
Tobin's Q	Market value of assets divided by tangible assets. (Compustat: (prcc_f × csho + dltt + dlc – che) / ppegt)
High Product Market Scope	An indicator variable that takes the value of one if a firm's product market scope in a year is above the top tercile of its three-digit SIC industry peers, and zero otherwise. Data is from the Hoberg and Phillips data website. See Hoberg and Phillips (2024) for details.
Low Product Market Threats	An indicator variable that takes the value of one if a firm's product market fluidity in a year is below the bottom tercile of its three-digit SIC industry peers, and zero otherwise. Data is from the Hoberg and Phillips data website. See Hoberg, Phillips, and Prabhala (2014) for details.
Adjacent to Natural Disaster	An indicator variable that takes the value of one, if a firm's headquarters is located in a county whose adjacent counties experience natural disasters with total estimated property and crop damages exceeding $1 million in 2021 constant dollars in a year, and zero otherwise. Natural disaster data is from SHELDUS.
Peer Scandal	An indicator variable that takes the value of one if a firm's SIC3 industry peers have negative environmental news in a year, and zero otherwise. Negative environmental news refers to environmental news (of medium to high severity) featuring the violation of at least one of the following three UNGC principles: Principle 7: Businesses should support a precautionary approach to environmental challenges; Principle 8: Undertake initiatives to promote greater environmental responsibility; and Principle 9: Encourage the development and diffusion of environmentally friendly technologies. Environmental news data is from RepRisk.

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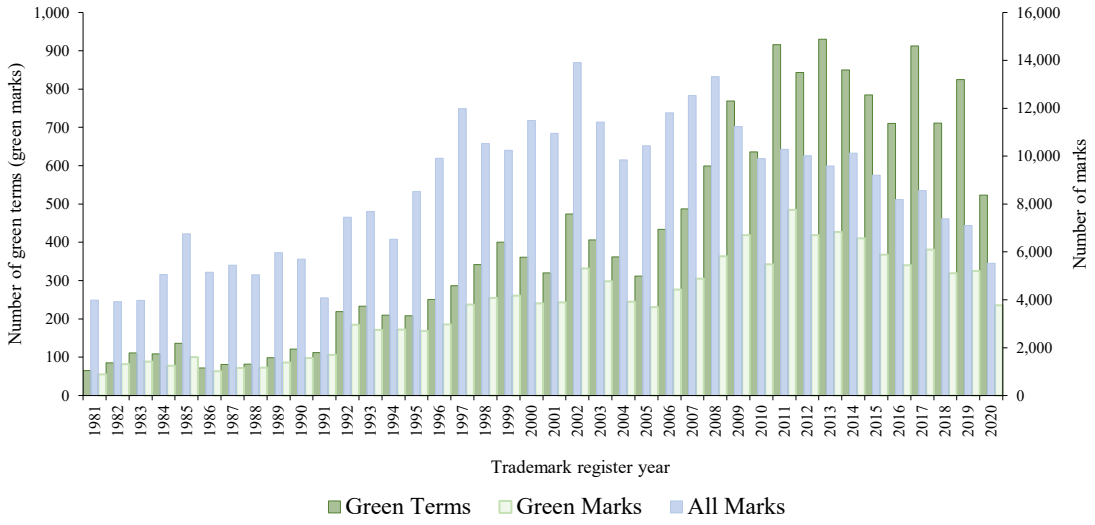
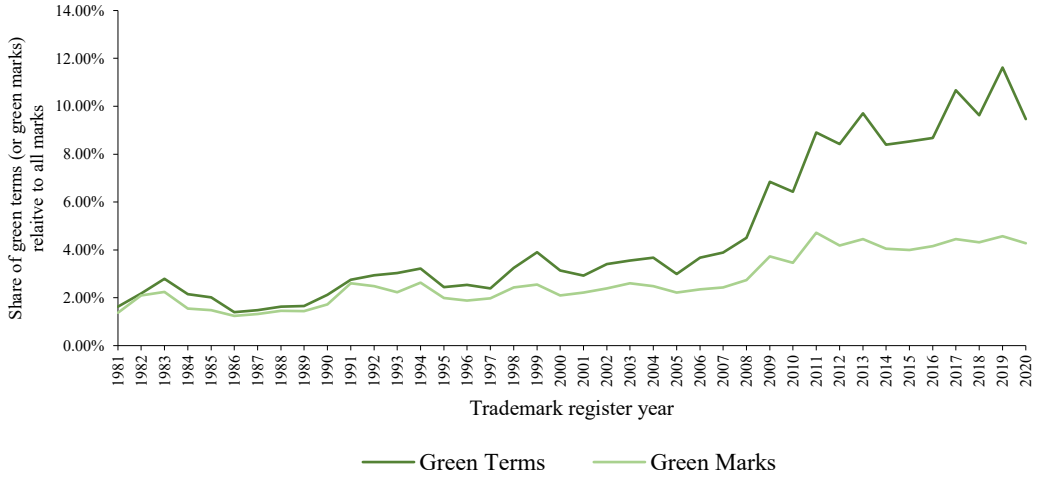
Figure 1
Green products over time by industry and green group

The sample comprises 16,389 green terms associated with 9,547 green marks registered at the USPTO by U.S. public firms over the period 1981-2020.

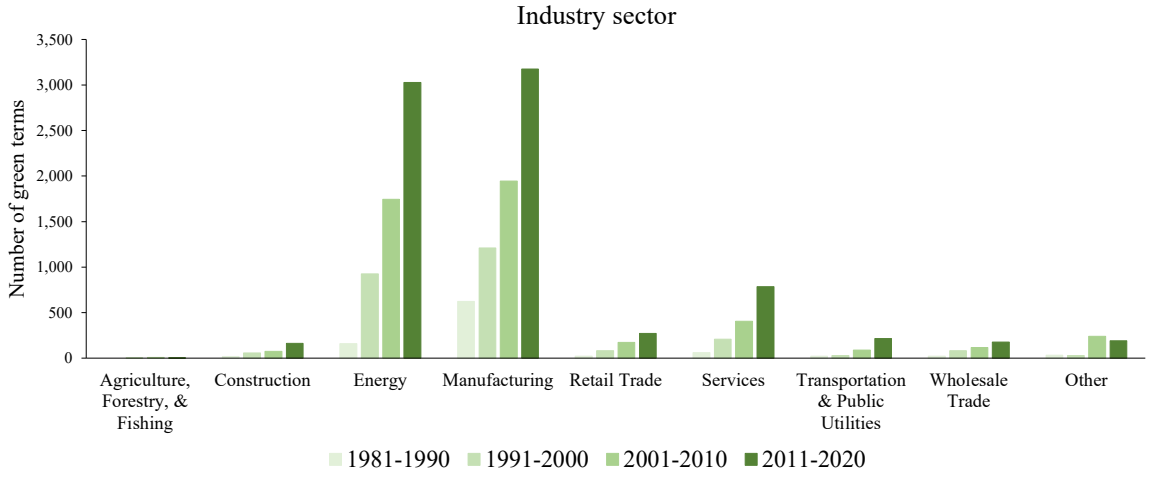
Panel A: Green terms, green marks, and marks registered by U.S. public firms over time



Panel B: Share of green terms (marks) to marks registered by U.S. public firms over time



Panel C: Green products by industry sector



Panel D: Green products by green group

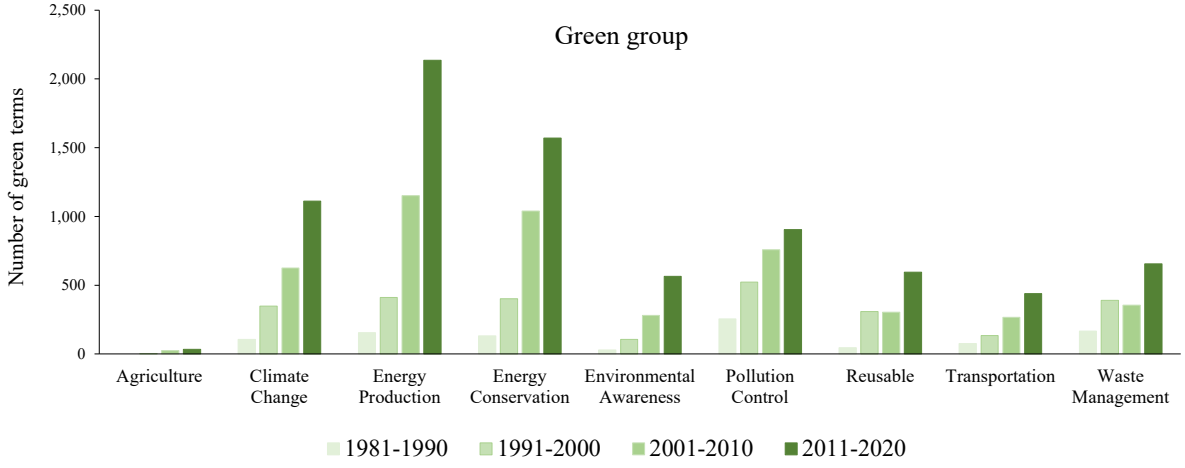
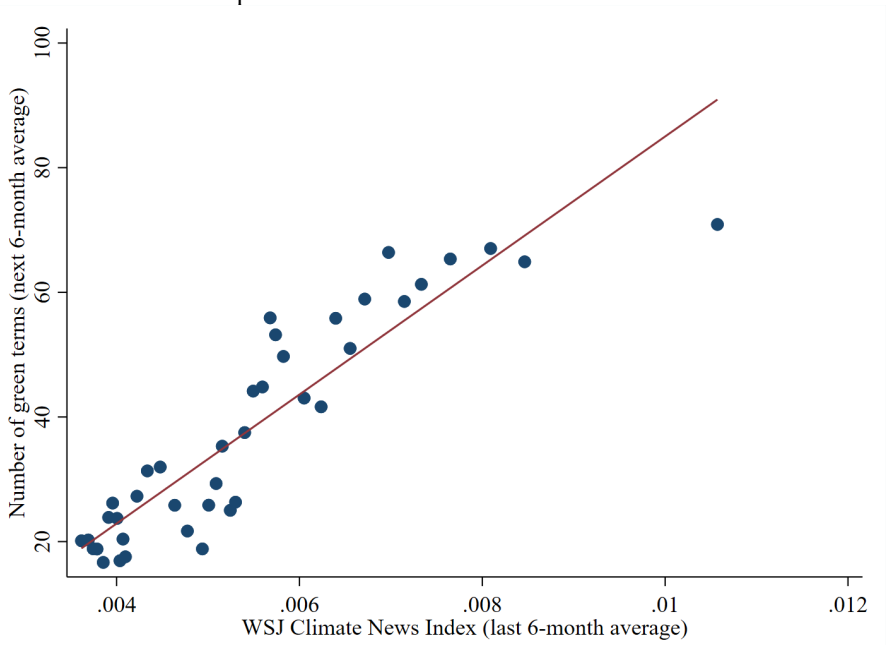


Figure 2
WSJ Climate Change News Index and green products

This figure shows the temporal correlation between the WSJ Climate Change News Index (Engle et al. 2020) and green products. Panel A presents the binned scatter plot between the six-month trailing average of the WSJ Climate Change News Index (x-axis) and the six-month forward average of green terms (y-axis), with aggregated data points and a linear fit line using underlying observations. Panel B presents the monthly trends in the six-month trailing average of the WSJ Climate Change News Index (red line) and the six-month forward average of green terms (blue line) over the period 1984.1–2017.6. The sample comprises 14,897 green terms associated with 8,713 green marks filed by 1,625 U.S. public firms.

Panel A: Binned scatter plot



Panel B: Time-series plot

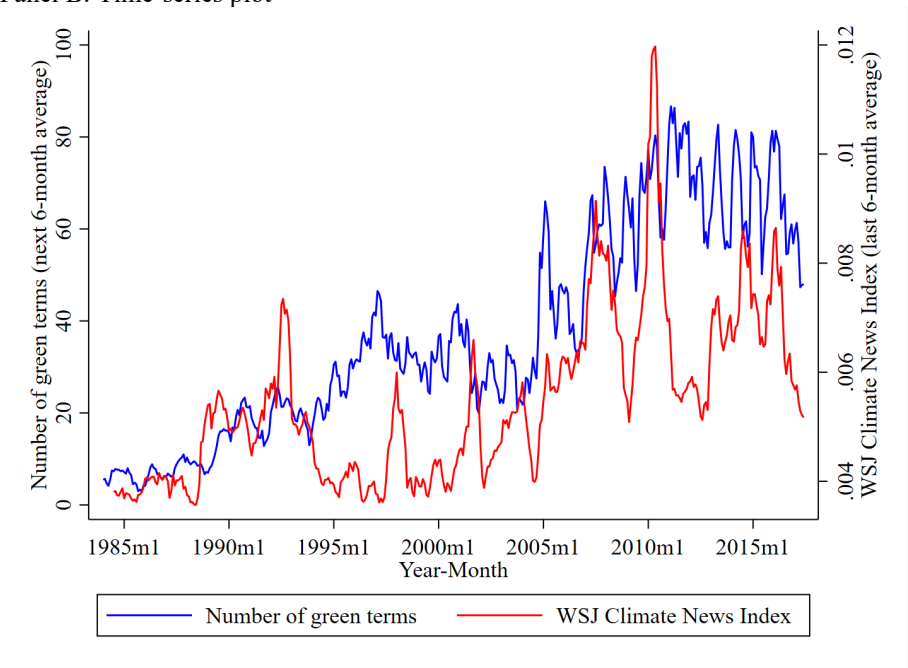


Table 1
Green products by industry sector and firm

This table presents the distribution of green products. The sample comprises 16,389 green terms in 9,547 newly registered green marks at the USPTO by U.S. public firms over the period 1981-2020. The green terms are identified using the (modified) EUIPO green trademark taxonomy. Panel A presents the frequency distribution by industry sector. Following Cohen et al. (2024), we use a firm's two-digit Standard Industrial Classification (SIC) to classify nine industry sectors. Different from Cohen et al. (2024), we exclude the Finance, Insurance, & Real Estate sector. Panel B lists the top 50 U.S. public firms by their green products.

Panel A: Green products by industry sector

Industry sector	#Green Terms
Manufacturing	6,953
Energy	5,854
Services	1,462
Retail Trade	548
Other	495
Wholesale Trade	398
Transportation & Public Utilities	355
Construction	310
Agriculture, Forestry, & Fishing	14

Panel B: Green products by U.S. public companies

Company	#Green Terms	Rank
NextEra Energy Inc	366	1
Republic Services Inc	293	2
General Electric Co	291	3
Xcel Energy Inc	280	4
Constellation Energy Group Inc	259	5
Exelon Corp	247	6
Dominion Energy Inc	202	7
Waste Connections Inc	191	8
Pepco Holdings Inc	187	9
Southern Co (The)	158	10
Waste Management Inc	155	11
Johnson Controls International Plc	141	12
Edison International	139	13
Honeywell International Inc	125	14
CenterPoint Energy Inc	123	15
Ford Motor Co	117	16
SunPower Corp	109	17
Alliant Energy Corp	105	18
NRG Energy Inc	103	19
Ecolab Inc	103	20
Raytheon Technologies Corp	99	21
Dover Corp	95	22
Emerson Electric Co	94	23
FirstEnergy Corp	86	24
Trane Technologies plc	85	25
International Business Machines Corp	83	26
Casella Waste Systems Inc	79	27
Halliburton Co	78	28
S&P Global Inc	77	29
Baker Hughes Inc	75	30
Clean Harbors Inc	75	31
Thermo Fisher Scientific Inc	74	32
Anadarko Petroleum Corp	72	33
Public Service Enterprise Group Inc	70	34
Pinnacle West Capital Corp	70	35
Eversource Energy	68	36
Quaker Chemical Corp	64	37
Berkshire Hathaway Inc	63	38
Cummins Inc	63	39
United Rentals Inc	63	40
URS Corp	62	41
Versar Inc	61	42
PPG Industries Inc	59	43
E. I. du Pont de Nemours and Co	58	44
Stanley Black & Decker Inc	58	45
Walmart Inc	54	46
Calgon Carbon Corp	54	47
American Electric Power Co Inc	53	48
Arch Chemicals Inc	52	49
Chevron Corp	52	50

Table 2
Green products by green group and category

This table reports the number and frequency distribution of green terms by green group and category (in descending order). The sample comprises 16,389 green terms in 9,547 newly registered green marks at the USPTO by U.S. public firms over the period 1981-2020. The green terms are identified using the (modified) EUIPO green trademark taxonomy. There are nine groups: agriculture, climate change, energy production, energy conservation, environmental awareness, pollution control, reusable, transportation, and waste management, and 35 categories (as listed below).

Group	#Green Terms	%Group	Category	#Green Terms	%Category within a group
Energy Production	3,853	23.51%	Other Energy	2,089	54.22%
			Solar Energy	1,287	33.40%
			Biofuels	285	7.40%
			Wind Energy	192	4.98%
Energy Conservation	3,140	19.16%	Energy Saving	1,110	35.35%
			Storage of Electricity	971	30.92%
			Energy Management	964	30.70%
			Low Energy Lighting	95	3.03%
Pollution Control	2,439	14.88%	Water Purification	1,288	52.81%
			Pollution General	733	30.05%
			Air Purification	341	13.98%
			Biodegradable	77	3.16%
Climate Change	2,190	13.36%	Environmental Services	1,977	90.27%
			Carbon Monitor	122	5.57%
			Carbon Brokerage	91	4.16%
Waste Management	1,566	9.56%	Process Waste	1,370	87.48%
			Waste Disposal	196	12.52%
Reusable	1,251	7.63%	Recycling	1,053	84.17%
			Other Reusable	74	5.92%
			Reusable Bags	54	4.32%
			Reusable Bottles	49	3.92%
			Refilling Cartridge	21	1.68%
Environmental Awareness	977	5.96%	Ecology	519	53.12%
			Sustainability	458	46.88%
Transportation	912	5.56%	General Transport	412	45.18%
			Electric Engines	358	39.25%
			Other Vehicles	101	11.07%
			Electric Motor	20	2.19%
			Hydrogen Vehicle	7	0.77%
			Hybrid Vehicle	5	0.55%
			Electric Car	5	0.55%
			Electric Bike	4	0.44%
Agriculture	61	0.37%	Fertilizer Alternatives	35	57.38%
			Pesticide Alternatives	25	40.98%
			Other Agriculture	1	1.64%

Table 3
Summary statistics

This table presents the summary statistics for different samples used in our regression analyses. Panel A presents the summary statistics for the baseline sample of trademarking firms. The trademarking sample comprises 109,129 firm-year observations associated with 7,865 unique public firms with at least one trademark registration over the period 1981-2020. Panel B presents the summary statistics for the sample of firms with at least one green mark registration over the period 1981-2020 (i.e., green marking firms) and for a subset of that sample with at least one current year green mark registration. The green marking sample comprises 33,774 firm-year observations associated with 1,506 unique firms. The subsample comprises 4,503 firm-year observations. Panel C presents the summary statistics for the different samples used in the analysis of the relation between a firm's green products and its environmental performance. The MSCI sample comprises 27,481 firm-year observations associated with 2,653 unique firms over the period 1991-2019. The Sustainalytics sample comprises 8,154 firm-year observations associated with 1,800 unique firms over the period 2009-2019. The Refinitiv sample comprises 15,837 firm-year observations associated with 2,048 unique firms over the period 2002-2020. The Trucost sample comprises 14,795 firm-year observations associated with 1,925 unique firms over the period 2002-2020. Variable definitions are provided in the Appendix.

Panel A: The trademarking sample

	Mean	Std. Dev.	P1	P25	P50	P75	P99
Green Marking Firm	0.309	0.462	0	0	0	1	1
#Green Term	0.133	1.502	0	0	0	0	3
Green Term	0.047	0.260	0	0	0	0	1.386
Green Category	0.059	0.344	0	0	0	0	2
#All Mark	2.738	9.560	0	0	0	2	36
All Mark	0.672	0.916	0	0	0	1.099	3.611
#Green Mark	0.077	0.558	0	0	0	0	2
Green Mark	0.039	0.205	0	0	0	0	1.099
#Non-Green Mark	2.661	9.451	0	0	0	2	35
Non-Green Mark	0.656	0.909	0	0	0	1.099	3.584
Green Patenting Firm	0.203	0.402	0	0	0	0	1
#Patent	12.895	116.129	0	0	0	1	259
#Green Patent	0.508	8.685	0	0	0	0	8
Green Patent	0.078	0.400	0	0	0	0	2.197
Total Assets (in $million)	3,093	17,429	2.637	51	232	1,202	47,889
Firm Size	5.553	2.191	0.97	3.938	5.448	7.092	10.777
Firm Age	20.451	14.817	3	9	16	29	64
ROA	-0.024	0.220	-1.214	-0.023	0.035	0.074	0.242
Capex	0.058	0.056	0	0.020	0.041	0.075	0.311
RD	0.049	0.096	0	0.000	0.002	0.058	0.563
Cash Holdings	0.167	0.197	0	0.024	0.086	0.240	0.851
Leverage	0.234	0.207	0	0.046	0.206	0.359	0.941
Sales Growth	0.166	0.472	-0.62	-0.021	0.079	0.218	3.149
Total Q	1.701	2.095	0.101	0.636	1.023	1.836	13.584
Tobin's Q	6.923	13.278	0.271	1.166	2.513	6.232	90.925

Panel B: The green marking sample and the subsample of firms with a current year green mark registration

	Green marking firms			Firms with a current year green mark		
	Mean	Std. Dev.	P50	Mean	Std. Dev.	P50
#Green Term	0.431	2.676	0	3.231	6.683	2
Green Term	0.153	0.45	0	1.146	0.614	1.099
Green Category	0.191	0.598	0	1.429	0.955	1
#All Mark	5.681	15.736	1	12.764	23.263	5
All Mark	1.068	1.138	0.693	2.021	1.015	1.792
#Green Mark	0.25	0.981	0	1.875	2.044	1
Green Mark	0.127	0.354	0	0.949	0.398	0.693
#Non-Green Mark	5.431	15.569	1	10.889	22.92	4
Non-Green Mark	1.015	1.136	0.693	1.62	1.273	1.609
Green Patenting Firm	0.416	0.493	0	0.521	0.5	1
#Patent	32.639	202.785	0	80.554	425.545	1
#Green Patent	1.418	15.181	0	5.212	34.993	0
Green Patent	0.199	0.638	0	0.435	1.008	0

Panel C: Samples with available data for environmental performance

	MSCI			Sustainalytics			Refinitiv			Trucost		
	Mean	Std. Dev.	P50	Mean	Std. Dev.	P50	Mean	Std. Dev.	P50	Mean	Std. Dev.	P50
MSCI E-score	0.025	0.136	0									
Sustainalytics E-score				0.328	0.108	0.296						
Refinitiv Innovation Score							0.183	0.279	0			
GHG Total Emission (%)										5.635	12.984	2.120
GHG Scope1 Emission (%)										3.162	12.081	0.209
Green Marking Firm	0.466	0.499	0	0.577	0.494	1	0.531	0.499	1	0.551	0.497	1
#Green Term	0.335	2.594	0	0.640	4.274	0	0.449	3.392	0	0.505	3.563	0
Green Term	0.104	0.4	0	0.173	0.527	0	0.130	0.452	0	0.147	0.477	0
Green Category	0.132	0.549	0	0.224	0.762	0	0.167	0.64	0	0.187	0.668	0
#All Mark	5.401	16.203	1	7.144	18.098	2	6.185	18.362	1	6.819	18.966	2
All Mark	1.027	1.116	0.693	1.256	1.187	1.099	1.084	1.17	0.693	1.183	1.187	1.099
#Green Mark	0.172	0.864	0	0.289	1.249	0	0.219	1.057	0	0.242	1.077	0
Green Mark	0.083	0.303	0	0.133	0.384	0	0.102	0.339	0	0.115	0.355	0
#Non-Green Mark	5.228	16.044	1	6.855	17.854	2	5.965	18.164	1	6.576	18.786	1
Non-Green Mark	0.996	1.11	0.693	1.211	1.184	1.099	1.049	1.164	0.693	1.143	1.183	0.693
Green Patenting Firm	0.314	0.464	0	0.391	0.488	0	0.356	0.479	0	0.378	0.485	0
All Patent	35.418	219.776	0	57.762	303.607	0	47.292	268.008	0	50.62	273.442	0
#Green Patent	1.448	15.901	0	3.126	27.702	0	2.124	21.302	0	2.074	18.174	0
Green Patent	0.178	0.628	0	0.284	0.828	0	0.218	0.716	0	0.248	0.749	0

Table 4
Green products and environmental performance

The table reports the OLS regression results examining the relation between a firm's green products and its environmental performance and greenhouse gas (GHG) emissions. Panel A reports the contemporaneous relation between a firm's green products and its environmental scores. The dependent variable in columns (1) and (2) is *MSCI E-Score*. The dependent variable in columns (3) and (4) is *Sustainalytics E-Score*. The dependent variable in columns (5) and (6) is *Refinitiv Innovation Score*. Panel B reports the relation between a firm's green products and its future GHG emissions using Trucost data. The dependent variable in columns (1) and (2) is *GHG Total Emission*. The dependent variable in columns (3) and (4) is *GHG Scope 1 Emission*. Variable definitions are provided in the Appendix. All model specifications include firm fixed effects and SIC3-by-year fixed effects. Robust standard errors clustered at the firm level are reported in parentheses. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Green products and environmental scores

	MSCI E-Score		Sustainalytics E-Score		Refinitiv Innovation Score	
	(1)	(2)	(3)	(4)	(5)	(6)
Green Term	0.009***		0.003**		0.013**	
	(0.003)		(0.002)		(0.005)	
Green Category		0.006***		0.002**		0.007**
		(0.002)		(0.001)		(0.004)
Non-Green Mark	-0.001	-0.001	-0.001	-0.001	-0.005	-0.005
	(0.002)	(0.002)	(0.001)	(0.001)	(0.003)	(0.003)
Green Patent	0.029***	0.029***	0.010***	0.010***	0.019**	0.019**
	(0.006)	(0.006)	(0.003)	(0.003)	(0.008)	(0.008)
Firm Size	-0.023***	-0.023***	0.009**	0.009**	0.001	0.001
	(0.004)	(0.004)	(0.004)	(0.004)	(0.009)	(0.009)
Firm Age	-0.008***	-0.008***	0.001*	0.001*	-0.002	-0.002
	(0.002)	(0.002)	(0.001)	(0.001)	(0.004)	(0.004)
ROA	-0.015*	-0.015*	-0.024**	-0.024**	0.011	0.011
	(0.008)	(0.008)	(0.010)	(0.010)	(0.020)	(0.020)
Capex	0.046	0.046	-0.055	-0.055	0.096	0.096
	(0.038)	(0.038)	(0.041)	(0.041)	(0.102)	(0.102)
RD	-0.125***	-0.125***	-0.075	-0.075	0.070	0.07
	(0.028)	(0.028)	(0.058)	(0.058)	(0.062)	(0.062)
Cash Holdings	0.030***	0.030***	0.024*	0.024	-0.038	-0.038
	(0.011)	(0.011)	(0.015)	(0.015)	(0.032)	(0.032)
Leverage	0.028***	0.028***	0.020*	0.020*	-0.035	-0.035
	(0.010)	(0.010)	(0.012)	(0.012)	(0.024)	(0.024)
Firm FE	Y	Y	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y	Y	Y
Adjusted R-squared	0.503	0.502	0.863	0.863	0.72	0.72
Observations	26,012	26,012	6,695	6,695	14,906	14,906

Panel B: Green products and GHG emissions

	GHG Total Emission (next 2 years)		GHG Scope1 Emission (next 2 years)	
	(1)	(2)	(3)	(4)
Green Term	-1.030**		-0.777*	
	(0.508)		(0.399)	
Green Category		-0.805**		-0.606**
		(0.332)		(0.255)
Non-Green Mark	2.737	2.745	0.465	0.471
	(1.998)	(1.999)	(0.297)	(0.296)
Green Patent	-0.120	-0.117	-0.026	-0.023
	(0.485)	(0.485)	(0.277)	(0.277)
Firm Size	-6.948	-6.938	-2.453	-2.445
	(5.070)	(5.068)	(1.966)	(1.967)
Firm Age	0.437	0.438	0.153	0.154
	(0.306)	(0.306)	(0.168)	(0.168)
ROA	-8.018	-7.994	-1.007	-0.989
	(11.349)	(11.346)	(1.883)	(1.882)
Capex	123.158	123.191	1.751	1.776
	(116.565)	(116.570)	(20.298)	(20.298)
RD	34.703	34.832	-0.783	-0.686
	(65.129)	(65.122)	(9.035)	(9.032)
Cash Holdings	2.004	2.022	-0.239	-0.224
	(14.645)	(14.643)	(2.194)	(2.194)
Leverage	-14.471	-14.467	-1.420	-1.417
	(13.769)	(13.768)	(2.211)	(2.211)
Firm FE	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y
Adjusted R-squared	0.191	0.191	0.764	0.764
Observations	11,826	11,826	11,826	11,826

Table 5
Green products, sales growth, and firm value

This table reports the OLS regression results examining the relation between a firm's green products and its future sales growth and firm value. The sample period is 1981-2020. The dependent variable in columns (1) and (2) is the average sales growth over the next two years. The dependent variable in columns (3) and (4) is *Total Q*, measured as the market value of assets divided by the sum of tangible and intangible assets (Peters and Taylor 2017). The dependent variable in columns (5) and (6) is *Tobin's Q*. Variable definitions are provided in the Appendix. All model specifications include firm fixed effects and SIC3-by-year fixed effects. Robust standard errors clustered at the firm level are reported in parentheses. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Sales Growth (next 2 years)		Total Q (next 2 years)		Tobin's Q (next 2 years)	
	(1)	(2)	(3)	(4)	(5)	(6)
Green Term	0.014***		0.041**		0.206**	
	(0.004)		(0.016)		(0.091)	
Green Category		0.011***		0.027**		0.143**
		(0.002)		(0.012)		(0.067)
Non-Green Mark	0.012***	0.012***	0.040***	0.041***	0.172***	0.173***
	(0.002)	(0.002)	(0.010)	(0.010)	(0.057)	(0.057)
Green Patent	0.008*	0.008*	0.062	0.063	-0.115	-0.114
	(0.005)	(0.005)	(0.064)	(0.065)	(0.206)	(0.206)
Firm Size	-0.096***	-0.096***	-0.374***	-0.374***	-1.602***	-1.602***
	(0.004)	(0.004)	(0.024)	(0.024)	(0.142)	(0.142)
Firm Age	-0.001	-0.001	-0.008	-0.008	-0.025	-0.025
	(0.002)	(0.002)	(0.019)	(0.019)	(0.113)	(0.113)
ROA	-0.184***	-0.184***	1.008***	1.008***	3.200***	3.200***
	(0.019)	(0.019)	(0.077)	(0.077)	(0.554)	(0.554)
Capex	0.212***	0.212***	0.525***	0.525***	-8.005***	-8.006***
	(0.044)	(0.044)	(0.171)	(0.171)	(0.853)	(0.853)
RD	-0.105*	-0.105*	-0.542*	-0.542*	2.563	2.559
	(0.064)	(0.064)	(0.300)	(0.300)	(2.256)	(2.256)
Cash Holdings	0.331***	0.331***	1.271***	1.270***	6.621***	6.620***
	(0.018)	(0.018)	(0.106)	(0.106)	(0.736)	(0.736)
Leverage	-0.069***	-0.069***	0.007	0.007	1.366**	1.366**
	(0.016)	(0.016)	(0.079)	(0.079)	(0.557)	(0.557)
Firm FE	Y	Y	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y	Y	Y
Adjusted R-squared	0.305	0.305	0.591	0.591	0.641	0.641
Observations	90,401	90,401	90,401	90,401	90,401	90,401

Table 6
Product market scope and threats

This table reports the OLS regression results examining the role of a firm's product market scope and threats in the relation between a firm's green products and its future sales growth and firm value. The product market data are from the Hoberg and Phillips data library. The sample period is 1988-2020. Variable definitions are provided in the Appendix. All model specifications include firm fixed effects and SIC3-by-year fixed effects. Robust standard errors clustered at the firm level are reported in parentheses. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: The role of product market scope

	Sales Growth (next 2 years)		Total Q (next 2 years)		Tobin's Q (next 2 years)	
	(1)	(2)	(3)	(4)	(5)	(6)
Green Term × High Product Market Scope	0.017***		0.056**		0.308**	
	(0.005)		(0.025)		(0.153)	
Green Term × (1 – High Product Market Scope)	0.012**		0.031		0.139	
	(0.005)		(0.020)		(0.106)	
Green Category × High Product Market Scope		0.013***		0.039**		0.233**
		(0.004)		(0.019)		(0.112)
Green Category × (1 – High Product Market Scope)		0.009***		0.016		0.076
		(0.003)		(0.015)		(0.073)
Non-Green Mark	0.012***	0.012***	0.031***	0.032***	0.179***	0.180***
	(0.002)	(0.002)	(0.011)	(0.011)	(0.063)	(0.063)
Green Patent	0.006	0.006	0.013	0.013	-0.271	-0.270
	(0.005)	(0.005)	(0.073)	(0.073)	(0.246)	(0.246)
Firm Size	-0.100***	-0.100***	-0.413***	-0.413***	-1.840***	-1.841***
	(0.004)	(0.004)	(0.027)	(0.027)	(0.172)	(0.172)
Firm Age	-0.002	-0.002	-0.010	-0.010	-0.020	-0.020
	(0.002)	(0.002)	(0.020)	(0.020)	(0.120)	(0.120)
ROA	-0.178***	-0.178***	1.073***	1.073***	3.749***	3.749***
	(0.020)	(0.020)	(0.080)	(0.080)	(0.607)	(0.607)
Capex	0.136***	0.136***	0.351*	0.350*	-10.006***	-10.008***
	(0.051)	(0.051)	(0.208)	(0.208)	(1.110)	(1.110)
RD	-0.133**	-0.134**	-0.364	-0.365	2.379	2.375
	(0.067)	(0.067)	(0.301)	(0.301)	(2.375)	(2.375)
Cash Holdings	0.330***	0.330***	1.217***	1.216***	6.841***	6.840***
	(0.020)	(0.020)	(0.118)	(0.118)	(0.846)	(0.846)
Leverage	-0.061***	-0.062***	-0.018	-0.018	1.674**	1.674**
	(0.018)	(0.018)	(0.090)	(0.090)	(0.660)	(0.660)
Firm FE	Y	Y	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y	Y	Y
Adjusted R-squared	0.308	0.308	0.594	0.594	0.643	0.643
Observations	73,558	73,558	73,558	73,558	73,558	73,558

Panel B: The role of product market threats

	Sales Growth (next 2 years)		Total Q (next 2 years)		Tobin's Q (next 2 years)	
	(1)	(2)	(3)	(4)	(5)	(6)
Green Term × Low Product Market Threats	0.016***		0.064***		0.321***	
	(0.004)		(0.018)		(0.103)	
Green Term × (1 – Low Product Market Threats)	0.012**		0.009		0.051	
	(0.006)		(0.028)		(0.162)	
Green Category × Low Product Market Threats		0.011***		0.040***		0.205***
		(0.003)		(0.014)		(0.073)
Green Category × (1 – Low Product Market Threats)		0.011***		0.006		0.061
		(0.004)		(0.019)		(0.113)
Non-Green Mark	0.012***	0.012***	0.031***	0.032***	0.179***	0.181***
	(0.002)	(0.002)	(0.011)	(0.011)	(0.063)	(0.063)
Green Patent	0.006	0.006	0.013	0.014	-0.270	-0.269
	(0.005)	(0.005)	(0.073)	(0.073)	(0.245)	(0.245)
Firm Size	-0.099***	-0.099***	-0.412***	-0.413***	-1.838***	-1.838***
	(0.004)	(0.004)	(0.027)	(0.027)	(0.172)	(0.172)
Firm Age	-0.002	-0.002	-0.010	-0.010	-0.020	-0.020
	(0.002)	(0.002)	(0.020)	(0.020)	(0.120)	(0.120)
ROA	-0.178***	-0.178***	1.072***	1.072***	3.747***	3.747***
	(0.020)	(0.020)	(0.080)	(0.080)	(0.607)	(0.607)
Capex	0.136***	0.136***	0.352*	0.352*	-10.000***	-10.003***
	(0.051)	(0.051)	(0.208)	(0.208)	(1.110)	(1.110)
RD	-0.133**	-0.133**	-0.363	-0.363	2.389	2.384
	(0.067)	(0.067)	(0.301)	(0.301)	(2.375)	(2.375)
Cash Holdings	0.330***	0.330***	1.217***	1.217***	6.841***	6.840***
	(0.020)	(0.020)	(0.118)	(0.118)	(0.846)	(0.846)
Leverage	-0.061***	-0.061***	-0.017	-0.017	1.677**	1.677**
	(0.018)	(0.018)	(0.090)	(0.090)	(0.660)	(0.660)
Firm FE	Y	Y	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y	Y	Y
Adjusted R-squared	0.308	0.308	0.594	0.594	0.643	0.643
Observations	73,558	73,558	73,558	73,558	73,558	73,558

Table 7
Dissecting green products: Core-business and follow-up green products

This table reports the OLS regression results examining the role of a firm's green product strategy in the relation between its green products and future sales growth and firm value. The sample period is 1981-2020. Panel A reports the results where we divide green products into two groups: *Core-Business Green Term* (i.e., a green term belongs to a firm's core business; a firm's core business refers to its top three Nice classes with the most number of terms over the past five years), and *Non-Core-Business Green Term* (i.e., a green term does not belong to a firm's core business). Panel B reports the results where we divide green products into two groups: *Follow-up Green Term* (i.e., a green term appears after a firm has registered green terms over the past five years), and *Greenfield Green Term* (i.e., a green term appears for the first time over the past five years). Variable definitions are provided in the Appendix. All model specifications include firm fixed effects and SIC3-by-year fixed effects. Robust standard errors clustered at the firm level are reported in parentheses. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Core-business vs. non-core-business green products

	Sales Growth (next 2 years)	Total Q (next 2 years)	Tobin's Q (next 2 years)
	(1)	(2)	(3)
Core-Business Green Term	0.014***	0.045**	0.209*
	(0.005)	(0.021)	(0.118)
Non-Core-Business Green Term	0.008*	0.016	0.109
	(0.005)	(0.020)	(0.107)
Non-Green Mark	0.012***	0.040***	0.173***
	(0.002)	(0.010)	(0.057)
Green Patent	0.008*	0.062	-0.115
	(0.005)	(0.064)	(0.206)
Firm Size	-0.096***	-0.374***	-1.602***
	(0.004)	(0.024)	(0.142)
Firm Age	-0.001	-0.008	-0.025
	(0.002)	(0.019)	(0.114)
ROA	-0.184***	1.008***	3.201***
	(0.019)	(0.077)	(0.554)
Capex	0.212***	0.525***	-8.004***
	(0.044)	(0.171)	(0.853)
RD	-0.105*	-0.541*	2.565
	(0.064)	(0.300)	(2.256)
Cash Holdings	0.331***	1.271***	6.621***
	(0.018)	(0.106)	(0.736)
Leverage	-0.069***	0.007	1.366**
	(0.016)	(0.079)	(0.557)
Firm FE	Yes	Yes	Yes
SIC3-by-year FE	Yes	Yes	Yes
Adjusted R-squared	0.305	0.591	0.641
Observations	90,401	90,401	90,401

Panel B: Follow-up vs. greenfield green products

	Sales Growth (next 2 years) (1)	Total Q (next 2 years) (2)	Tobin's Q (next 2 years) (3)
Follow-up Green Term	0.011***	0.058***	0.276**
	(0.004)	(0.020)	(0.116)
Greenfield Green Term	0.020***	0.009	0.072
	(0.006)	(0.021)	(0.110)
Non-Green Mark	0.012***	0.040***	0.173***
	(0.002)	(0.010)	(0.057)
Green Patent	0.008*	0.061	-0.120
	(0.005)	(0.065)	(0.206)
Firm Size	-0.096***	-0.374***	-1.602***
	(0.004)	(0.024)	(0.142)
Firm Age	-0.001	-0.008	-0.025
	(0.002)	(0.019)	(0.114)
ROA	-0.184***	1.008***	3.201***
	(0.019)	(0.077)	(0.554)
Capex	0.212***	0.525***	-8.003***
	(0.044)	(0.171)	(0.853)
RD	-0.105*	-0.541*	2.564
	(0.064)	(0.300)	(2.256)
Cash Holdings	0.331***	1.271***	6.620***
	(0.018)	(0.106)	(0.736)
Leverage	-0.069***	0.006	1.364**
	(0.016)	(0.079)	(0.557)
Firm FE	Yes	Yes	Yes
SIC3-by-year FE	Yes	Yes	Yes
Adjusted R-squared	0.305	0.591	0.641
Observations	90,401	90,401	90,401

Table 8
Dissecting green products: Green features in a mark

This table reports the OLS regression results examining the role of a mark's green features in the relation between a firm's green products and future sales growth and firm value. The sample period is 1981-2020. This table reports the results where we divide green products into two groups: *Common-Class Green Term* (i.e., a mark's green terms have the same Nice class(es) as its non-green terms), and *Unique-Class Green Term* (i.e., a mark's green terms do not have the same Nice class(es) as its non-green terms). Variable definitions are provided in the Appendix. All model specifications include firm fixed effects and SIC3-by-year fixed effects. Robust standard errors clustered at the firm level are reported in parentheses. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Sales Growth (next 2 years) (1)	Total Q (next 2 years) (2)	Tobin's Q (next 2 years) (3)
Common-Class Green Term	0.015***	0.047**	0.214*
	(0.005)	(0.022)	(0.127)
Unique-Class Green Term	0.008*	0.015	0.117
	(0.005)	(0.018)	(0.103)
Non-Green Mark	0.012***	0.040***	0.173***
	(0.002)	(0.010)	(0.057)
Green Patent	0.008*	0.062	-0.116
	(0.005)	(0.064)	(0.205)
Firm Size	-0.096***	-0.374***	-1.602***
	(0.004)	(0.024)	(0.142)
Firm Age	-0.001	-0.008	-0.025
	(0.002)	(0.019)	(0.113)
ROA	-0.184***	1.008***	3.201***
	(0.019)	(0.077)	(0.554)
Capex	0.212***	0.526***	-8.003***
	(0.044)	(0.171)	(0.853)
RD	-0.105*	-0.541*	2.564
	(0.064)	(0.300)	(2.256)
Cash Holdings	0.331***	1.271***	6.621***
	(0.018)	(0.106)	(0.736)
Leverage	-0.069***	0.007	1.367**
	(0.016)	(0.079)	(0.557)
Firm FE	Y	Y	Y
SIC3-by-year FE	Y	Y	Y
Adjusted R-squared	0.305	0.591	0.641
Observations	90,401	90,401	90,401

Table 9
Natural disasters and green products

This table reports the Poisson regression results examining the relation between a firm's headquarters adjacent to natural disasters and its green products. The sample period is 2000-2020. Panel A presents the baseline results. The dependent variable in columns (1) and (2) is the number of green terms associated with green marks filed in the next year or over the next two years. The dependent variable in columns (3) and (4) is the number of unique green categories associated with green marks filed in the next year or over the next two years. Panel B validates the parallel trend assumption. The dependent variable in columns (1) and (2) is the number of green terms filed in the next year, and in columns (3) and (4) is the number of unique green categories filed in the next year. Additional independent variables include "Adj to Natural Disaster (-1/-2/-3)", which takes the value of one if a firm-year is 1/2/3 years before being adjacent to a natural disaster, and zero otherwise. Variable definitions are provided in the Appendix. All model specifications include firm fixed effects and SIC3-by-year fixed effects. Robust standard errors clustered at the firm level are reported in parentheses. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Baseline

	Green Term		Green Category	
	(next year)	(next 2 years)	(next year)	(next 2 years)
	(1)	(2)	(3)	(4)
Adjacent to Natural Disaster	0.521***	0.320***	0.352***	0.161***
	(0.140)	(0.089)	(0.089)	(0.057)
Firm Size	-0.021	0.089	0.150	0.140
	(0.150)	(0.121)	(0.110)	(0.090)
Firm Age	0.023	0.089	0.029	0.092
	(0.095)	(0.088)	(0.079)	(0.076)
ROA	1.281***	0.927**	1.219***	0.962**
	(0.484)	(0.407)	(0.455)	(0.380)
Capex	-5.461**	-2.405	-0.865	0.346
	(2.740)	(1.691)	(1.682)	(1.297)
RD	2.498	0.822	3.095*	0.948
	(2.387)	(1.885)	(1.581)	(1.272)
Cash Holdings	-1.309	-0.204	-0.009	0.424
	(0.892)	(0.532)	(0.561)	(0.429)
Leverage	-1.305**	-1.021*	-0.288	-0.115
	(0.654)	(0.607)	(0.452)	(0.394)
Firm FE	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y
Pseudo R-squared	0.565	0.622	0.306	0.332
Observations	3,740	4,681	3,837	4,987

Panel B: Validating the parallel trend assumption

	Green Term (next year)		Green Category (next year)	
	(1)	(2)	(3)	(4)
Adjacent to Natural Disaster	0.552***	0.519***	0.386***	0.362***
	(0.141)	(0.136)	(0.085)	(0.086)
Adj to Natural Disaster (-1)	0.154	0.065	0.085	0.028
	(0.147)	(0.125)	(0.095)	(0.090)
Adj to Natural Disaster (-2)	0.115	0.081	0.041	0.042
	(0.109)	(0.118)	(0.087)	(0.096)
Adj to Natural Disaster (-3)		-0.156		-0.040
		(0.115)		(0.087)
Firm Size	0.060	0.024	0.209	0.214
	(0.172)	(0.182)	(0.134)	(0.142)
Firm Age	0.055	0.107	0.033	0.027
	(0.097)	(0.113)	(0.075)	(0.100)
ROA	1.104**	1.760***	1.239**	1.679***
	(0.527)	(0.659)	(0.544)	(0.600)
Capex	-5.598**	-4.998	-1.318	-1.653
	(2.759)	(3.048)	(1.651)	(1.836)
RD	1.402	2.883	2.120	3.191*
	(3.122)	(3.509)	(1.594)	(1.895)
Cash Holdings	-1.291	-0.935	-0.022	0.123
	(0.934)	(0.931)	(0.556)	(0.568)
Leverage	-1.514**	-1.501**	-0.276	-0.298
	(0.664)	(0.692)	(0.481)	(0.484)
Firm FE	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y
Pseudo R-squared	0.570	0.575	0.310	0.307
Observations	3,497	3,111	3,497	3,111

Table 10
Industry environmental scandals and green products

This table reports the Poisson regression results examining the relation between a firm's industry peers' environmental scandals and its green products. The sample period is 2007-2020. Panel A presents the baseline results. The dependent variable in columns (1) and (2) is the number of green terms associated with green marks filed in the next year or over the next two years. The dependent variable in columns (3) and (4) is the number of unique green categories associated with green marks filed in the next year or over the next two years. Panel B validates the parallel trend assumption. The dependent variable in columns (1) and (2) is the number of green terms filed in the next year, and in columns (3) and (4) is the number of unique green categories filed in the next year. Additional independent variables include "Peer Scandal (-1/-2/-3)", which takes the value of one if a firm-year is 1/2/3 years before experiencing peer scandals, and zero otherwise. Variable definitions are provided in the Appendix. All model specifications include firm fixed effects and year fixed effects. Robust standard errors clustered at the SIC3 level are reported in parentheses. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Baseline

	Green Term		Green Category	
	(next year)	(next 2 years)	(next year)	(next 2 years)
	(1)	(2)	(3)	(4)
Peer Scandal	0.325***	0.186**	0.137**	0.081
	(0.125)	(0.087)	(0.069)	(0.054)
Firm Size	-0.048	-0.073	0.052	0.034
	(0.154)	(0.156)	(0.109)	(0.099)
Firm Age	0.182**	0.219***	0.261***	0.253***
	(0.076)	(0.079)	(0.068)	(0.068)
ROA	0.771**	0.061	0.362	0.067
	(0.352)	(0.282)	(0.285)	(0.228)
Capex	-1.448	-0.516	-0.876	0.820
	(1.569)	(1.718)	(1.127)	(1.168)
RD	1.287	1.082	1.032	0.225
	(1.489)	(1.665)	(1.195)	(1.143)
Cash Holdings	0.192	0.561	0.488	0.362
	(0.522)	(0.383)	(0.515)	(0.465)
Leverage	0.457	0.396	0.306	0.183
	(0.583)	(0.527)	(0.378)	(0.318)
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Pseudo R-squared	0.358	0.441	0.205	0.233
Observations	7,167	6,609	7,421	7,033

Panel B: Validating the parallel trend assumption

	Green Term (next year)		Green Category (next year)	
	(1)	(2)	(3)	(4)
Peer Scandal	0.283***	0.300***	0.180**	0.162**
	(0.108)	(0.101)	(0.076)	(0.076)
Peer Scandal (-1)	-0.061	-0.046	0.018	0.044
	(0.132)	(0.166)	(0.091)	(0.105)
Peer Scandal (-2)	-0.162	-0.124	-0.030	-0.012
	(0.132)	(0.166)	(0.078)	(0.090)
Peer Scandal (-3)		0.014		0.052
		(0.173)		(0.085)
Firm Size	-0.109	-0.073	-0.018	0.031
	(0.157)	(0.190)	(0.128)	(0.155)
Firm Age	0.176	0.198	0.280***	0.319**
	(0.133)	(0.201)	(0.104)	(0.135)
ROA	0.651*	0.625	0.185	0.192
	(0.366)	(0.444)	(0.288)	(0.330)
Capex	-1.420	-1.927	-1.167	-1.785
	(1.480)	(1.534)	(1.243)	(1.308)
RD	0.607	1.016	0.693	1.760
	(1.398)	(1.923)	(1.095)	(1.356)
Cash Holdings	0.459	0.493	0.640	0.698
	(0.536)	(0.585)	(0.508)	(0.531)
Leverage	0.399	0.472	0.401	0.578
	(0.638)	(0.702)	(0.431)	(0.504)
Firm FE	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y
Pseudo R-squared	0.312	0.322	0.185	0.188
Observations	5,777	4,858	5,777	4,858

Online Appendix for
"Green Products"

OA1. Constructing the green trademark dataset

We construct a new green trademark dataset that provides a bird-eye view of green and sustainability-related products and/or services in the U.S. Our green trademark dataset captures green innovation associated with commercialized goods and/or services that is different from green innovation captured by green patents – primarily technologies. Below, we provide a detailed description of how we compile the green trademark dataset.

OA1.1. The EUIPO green trademark taxonomy

Trademarks distinguish the products and/or services of a company from those of its competitors. Trademark applications must contain a representation of the mark (typically words, graphic elements, or a combination of the two) and a list of goods and services (G&S) identification covered by the mark.

In 2019, the European Commission established action on climate change as a priority. In 2021, the European Union Intellectual Property Office (EUIPO) (2021) released its first version of the green trademark taxonomy, reflecting the increasing frequency at which goods and services identification of EU trademarks are related to environmental protection and sustainability.

A trademark application is required to provide G&S identification following the Nice Classification. A "term" is a basic unit of G&S identification that contains a class (classes) from the Nice Classification and words or phrases to describe a product (service). In its online trademark application platform since 1996, the EUIPO adopts the Harmonised Database (HDB) that contains 85,000 terms, from which the EUIPO experts classify 904 as green phrases. Specifically, the EUIPO experts review G&S identification for the presence of any term that could be related to environmental protection and sustainability, such as "solar heating," and "biofuel."[1]

Once this Harmonized Green Terms inventory is established, to ensure both older marks and future new marks can be assessed for green products, the EUIPO employs an algorithm that combines machine learning with human intervention by EUIPO experts to generate 375 green expressions that can be used to identify green products. Each of those green expressions is assigned a reference number ("Ref.") ranging from 1 to 375. In our study, we call this green term classifier the "EUIPO green trademark taxonomy."

Here is an example of a green expression:

Ref.	Green expression
73	+electric +vehicle −cigarette −door −horn −lock −sunroof−alternator −alarm −temperature −theft −antitheft −washers −7 −37

The above expression (Ref. 73) means: A term is green if it contains the word 'electric' and the word 'vehicle,' and does *not* contain the word 'cigarette' or the word 'door' or the word 'horn' or the word 'lock' or the word 'sunroof' or the word 'alternator' or the word 'alarm' or the word

[1] The EUIPO experts identify 904 green phrases. Note that trademarks with terms related to nuclear energy are not classified as green, which is different from Haščič and Migotto's (2015) green patent taxonomy that includes nuclear energy (see page 52; 4.4. NUCLEAR ENERGY; Y02E30).

'temperature' or the word 'theft' or the word 'antitheft' or the word 'washers,' *except* if *Nice Class 7 Machines and Machine Tools, Parts* or *Nice Class 37 Construction, Repair, Cleaning*.

The EUIPO green trademark taxonomy assigns green terms into thirty-five categories by subject, which are then combined into nine groups. In this example, the expression (Ref. 73) is assigned to the group "transportation" and the category "general transport." It is clear that the main product associated with this green term is electric cars and belongs to transportation.

As another example, if we search the keyword "battery" in the taxonomy, four green expressions show up with Ref. 13, 14, 15, and 221 as follows,

Ref.	Green expression
13	+battery +chargeable −acidulated −telephone −computer −fire.extinguisher −game −cigarette −cutters −cell.phone −mobile.phone −smartphone −wireless
14	+battery +charging −acidulated −telephone −computer −fire.extinguisher −game −cigarette −cutters −cell.phone −mobile.phone −smartphone –wireless
15	+battery +electric −acidulated −telephone −computer −fire.extinguisher −game −cigarette −cutters −cell.phone −mobile.phone −smartphone –wireless
221	+solar +battery

The first expression (Ref. 13) means: A term is green if it contains the word 'battery' and the word 'chargeable,' and does *not* contain the words 'acidulated,' 'telephone,' 'computer,' 'fire extinguisher' (together, and in that order), 'game,' 'cigarette,' 'cutters,' 'cell phone' (together, and in that order), 'smartphone,' or 'wireless.' In this example, the expression (Ref. 13) is assigned to the group "energy conservation" and the category "storage of electricity." Ref. 14 and 15 green expressions are assigned to the same category as Ref. 13, and Ref. 221 is assigned to the group "energy production" and the category "solar energy."

OA1.2. Identifying green marks from the USPTO

The EUIPO green trademark taxonomy is developed to identify green trademarks as long as a mark's goods and/or services identification is in English. To account for our context of studying green marks applied in the U.S., we modify the taxonomy and describe our detailed procedure below.

Step 1: We modify the EUIPO green expressions by making use of the British-American-English conversion.[2] We list the entire set of 375 green expressions at the end of this Appendix.

Step 2: We collect detailed trademark data from the USPTO. For our purpose, we extract G&S identification and parse that piece of textual information. Specifically, the textual description for each unique Nice class is separated by semicolons, which gives us the

[2] Some examples of our modifications are as follows: "fertilisers" becomes "fertilizers" (Ref. 209); "refuelling" becomes "refueling" (Ref. 183); "demineralising" becomes "demineralizing" (Ref. 282); "deodorising" becomes "deodorizing" (Ref. 6 and Ref. 107).

basic unit and is called a "term."[3] We then standardize the description by removing stop words, punctuations, and stemming.[4] Finally, we tokenize the textual information.[5]

Step 3: We perform the same preprocessing step for the 375 green expressions in the (modified) EUIPO green trademark taxonomy.

Step 4: We match the term data in Step 2 (at the term level) to each of the expressions in Step 3. A term is a green term if it matches one of the green expressions. Note that a mark could have multiple green terms. A mark is a green mark if it contains at least one green term.

OA1.3. Word clouds by green group

Applying the procedure described in the section above to all marks registered by individuals, U.S. firms, and foreign firms at the USPTO over the period 1981-2020, we end up with 379,590 green terms associated with 186,612 green marks. We note that the top three green groups are energy conservation (with a 21% share), energy production (20%), and pollution control (17%).[6]

Figure OA1 plots the word cloud for each green group using these green terms. The font of each word (phrase) is proportional to its frequency of occurrences in these green terms registered at the USPTO over the period 1981-2020. We note that the top words (phrases) associated with each green group seem to pass face validity. For example, the top five phrases for the group "energy conservation" are electric battery, charger electric, rechargeable battery, apparatus instrument, and battery charger; the top five phrases for the group "transportation" are land vehicle, electric vehicle, electric motor, motor vehicle, and electric bicycle.

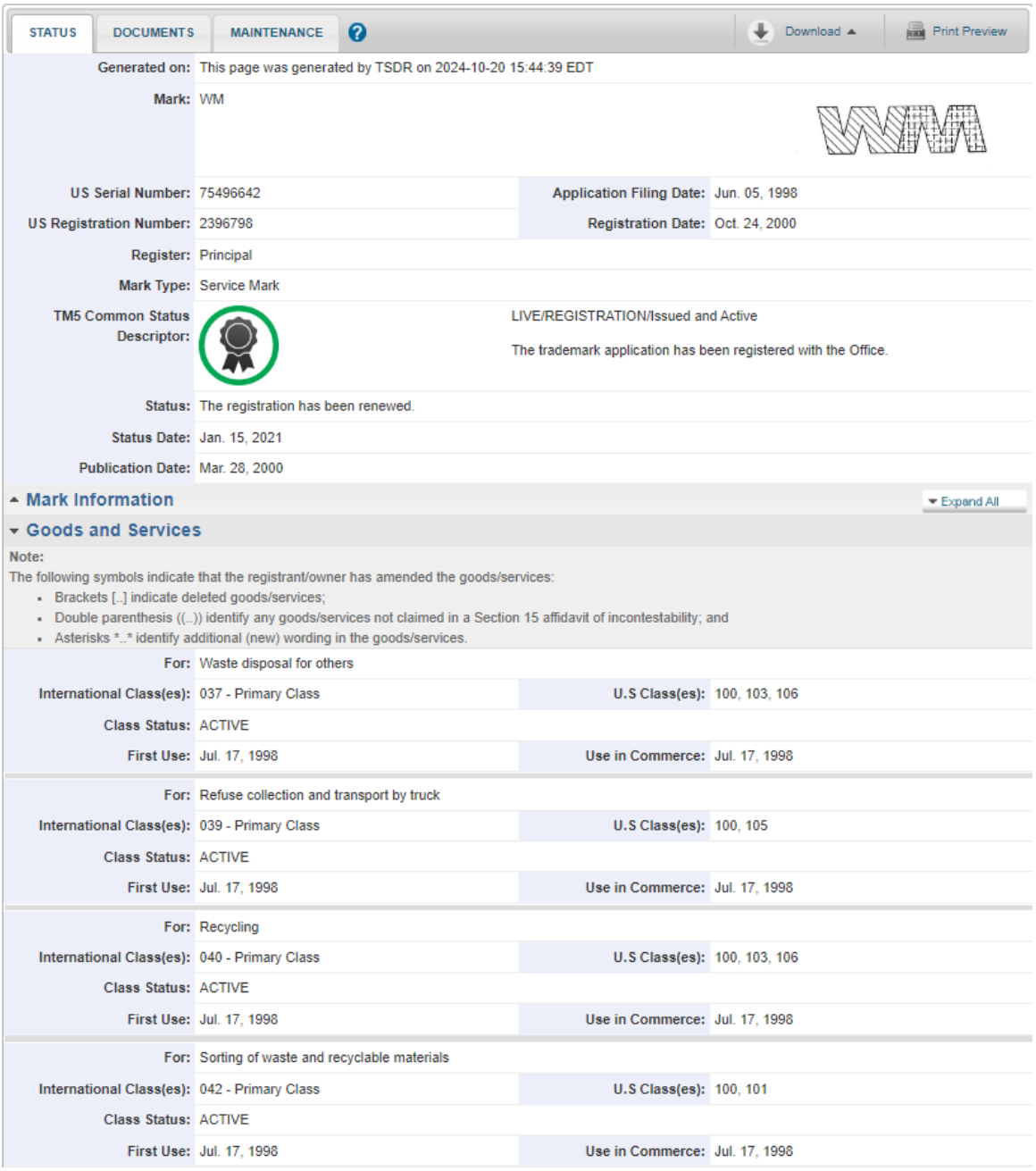
OA1.4. Examples of green marks registered at the USPTO

We manually check the green marks identified using our approach for three companies, Waste Management Inc., Tesla Inc., and NextEra Energy Inc. Some examples are provided below.

Company 1: Waste Management Inc.

Green mark 1
Waste Management Inc. applied for this trademark on June 5, 1998, and registered it on October 24, 2000. The Word Mark is "WM" with the registration number 2396798.

[3] A trademark can apply in multiple Nice classes.
[4] We use Python and its *Stop words package* and *Snowball stemming package*. Stop words are a set of commonly used words in a language. Examples of stop words in English are "a," "the," "is," and "are."
[5] After tokenization, single words are separated. For compound words, we implement tokenization in two ways. The first approach is to remove hyphen; for example, "self-balancing" becomes "selfbalancing," and "eco-friendly" becomes "ecofriendly." The second approach is to replace the hyphen with a space; for example, "electric-motor" becomes "electric" and "motor." All compound words are tokenized using both approaches.
[6] The shares of each green group are as follows: (1) agriculture (0.7%); (2) climate change (11%); (3) energy conservation (21%); (4) energy production (20%); (5) environmental awareness (8%); (6) pollution control (17%); (7) reusable (8%); (8) transportation (7%); and (9) waste management (7%).



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Mark: WM

US Serial Number: 75496642 | Application Filing Date: Jun. 05, 1998

US Registration Number: 2396798 | Registration Date: Oct. 24, 2000

Register: Principal

Mark Type: Service Mark

TM5 Common Status Descriptor: LIVE/REGISTRATION/Issued and Active

The trademark application has been registered with the Office.

Status: The registration has been renewed.

Status Date: Jan. 15, 2021

Publication Date: Mar. 28, 2000

Mark Information | Expand All

Goods and Services

Note:

The following symbols indicate that the registrant/owner has amended the goods/services:

- Brackets [..] indicate deleted goods/services;
- Double parenthesis ((..)) identify any goods/services not claimed in a Section 15 affidavit of incontestability; and
- Asterisks *..* identify additional (new) wording in the goods/services.

For: Waste disposal for others

International Class(es): 037 - Primary Class | U.S Class(es): 100, 103, 106

Class Status: ACTIVE

First Use: Jul. 17, 1998 | Use in Commerce: Jul. 17, 1998

For: Refuse collection and transport by truck

International Class(es): 039 - Primary Class | U.S Class(es): 100, 105

Class Status: ACTIVE

First Use: Jul. 17, 1998 | Use in Commerce: Jul. 17, 1998

For: Recycling

International Class(es): 040 - Primary Class | U.S Class(es): 100, 103, 106

Class Status: ACTIVE

First Use: Jul. 17, 1998 | Use in Commerce: Jul. 17, 1998

For: Sorting of waste and recyclable materials

International Class(es): 042 - Primary Class | U.S Class(es): 100, 101

Class Status: ACTIVE

First Use: Jul. 17, 1998 | Use in Commerce: Jul. 17, 1998

In this example, four terms in the goods and services identification are extracted and shown below. We then try to match each term above with any of the 375 green expressions. Two out of the four terms are matched to Ref. 189 as follows, and the remaining two terms are not matched,

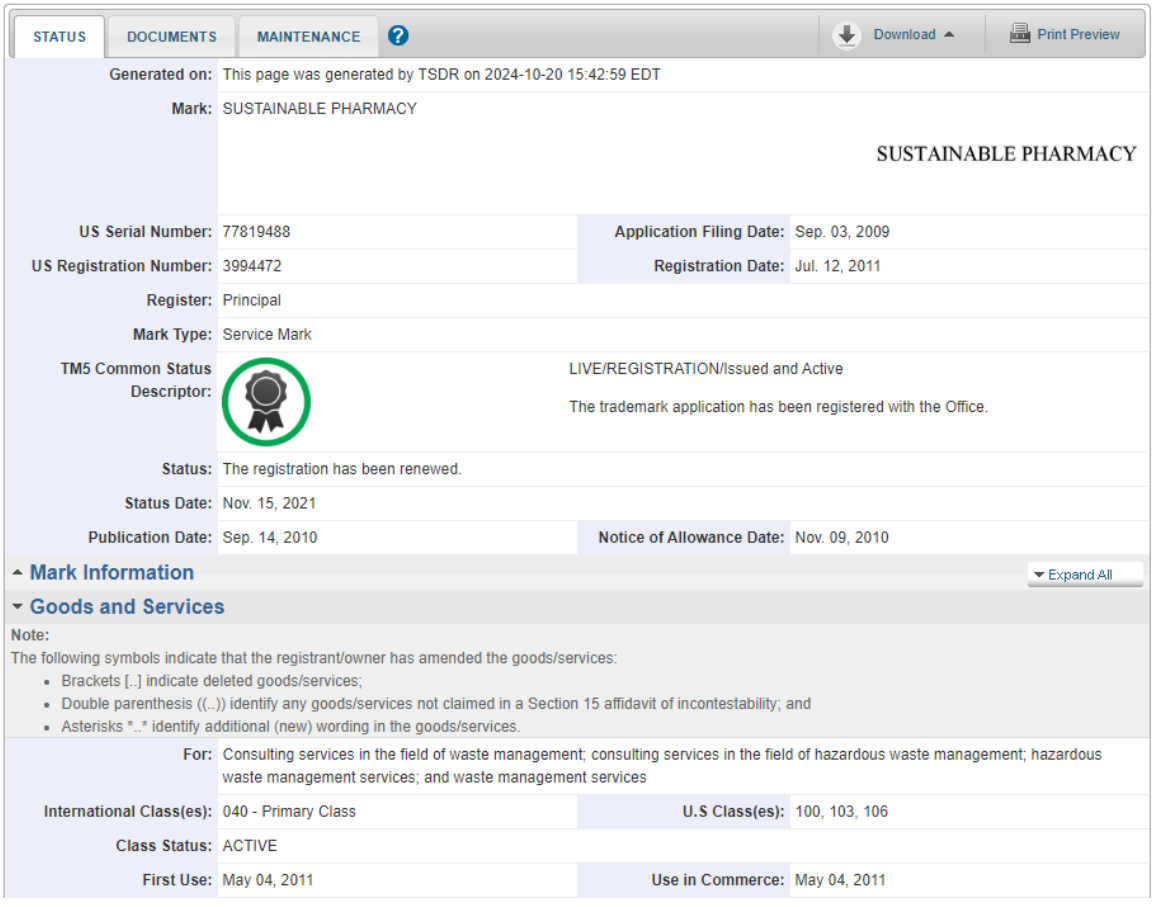
Registration number (Registration date)	Nice class	Green expression Ref.	Mark word	G&S identification at the term-level
2396798 (24-Oct-20)	37	Not matched	WM	Waste disposal for others.
2396798 (24-Oct-20)	39	Not matched	WM	Refuse collection and transport by truck.

2396798 (24-Oct-20)	40	189	WM	Recycling.
2396798 (24-Oct-20)	42	189	WM	Sorting of waste and recyclable materials.

Group	Category	Ref.	Green expression
Reusable	Recycling	189	+recycle −cost.price −tyres −tires −animal −wrappin

At the mark level, this mark is classified as "green" because its G&S identification contains at least one green term, regardless of other non-green terms included. The taxonomy assigns the green term to the group "reusable" and the category "recycling." It is clear that the main activity is related to "recycling," and the two other terms are secondary to this main activity.

Green mark 2
Waste Management Inc. applied for this trademark on September 3, 2009, and registered it on July 12, 2011. The Word Mark is "SUSTAINABLE PHARMACY" with the registration number 3994472.



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Mark:	SUSTAINABLE PHARMACY
	SUSTAINABLE PHARMACY
US Serial Number:	77819488
Application Filing Date:	Sep. 03, 2009
US Registration Number:	3994472
Registration Date:	Jul. 12, 2011
Register:	Principal
Mark Type:	Service Mark
TM5 Common Status Descriptor:	LIVE/REGISTRATION/Issued and Active The trademark application has been registered with the Office.
Status:	The registration has been renewed.
Status Date:	Nov. 15, 2021
Publication Date:	Sep. 14, 2010
Notice of Allowance Date:	Nov. 09, 2010

Mark Information — Expand All

Goods and Services

Note:
The following symbols indicate that the registrant/owner has amended the goods/services:
- Brackets [..] indicate deleted goods/services;
- Double parenthesis ((..)) identify any goods/services not claimed in a Section 15 affidavit of incontestability; and
- Asterisks *..* identify additional (new) wording in the goods/services.

For:	Consulting services in the field of waste management; consulting services in the field of hazardous waste management; hazardous waste management services; and waste management services
International Class(es):	040 - Primary Class
U.S Class(es):	100, 103, 106
Class Status:	ACTIVE
First Use:	May 04, 2011
Use in Commerce:	May 04, 2011

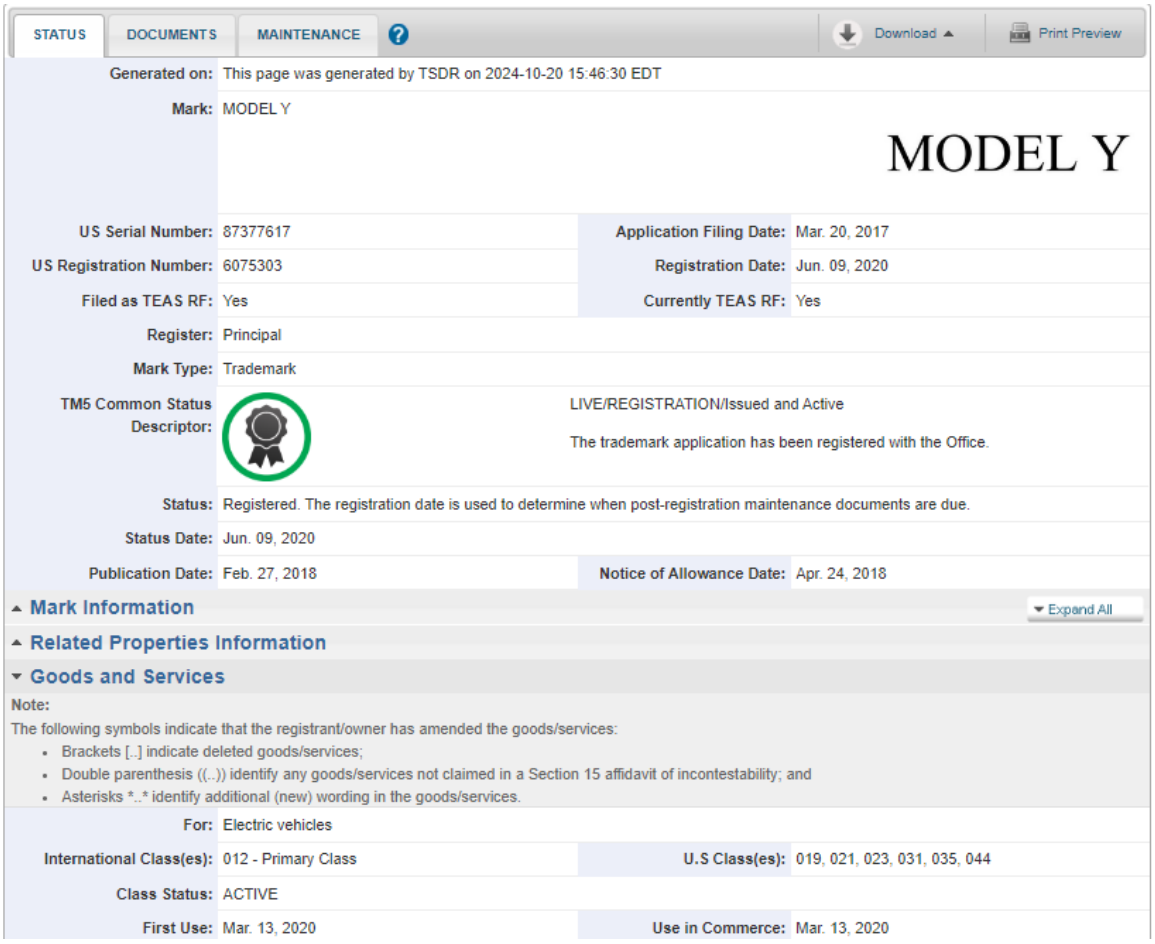
In this example, four terms in the goods and services identification are extracted and shown below. We then try to match each term above with any of the 375 green expressions. All four terms are matched to Ref. 267 as follows,

Registration number (Registration date)	Nice class	Green expression Ref.	Mark word	G&S identification at the term-level
3994472 (12-July-11)	40	267	SUSTAINABLE PHARMACY	Consulting services in the field of waste management;
3994472 (12-July-11)	40	267	SUSTAINABLE PHARMACY	Consulting services in the field of hazardous waste management;
3994472 (12-July-11)	40	267	SUSTAINABLE PHARMACY	Hazardous waste management services;
3994472 (12-July-11)	40	267	SUSTAINABLE PHARMACY	Waste management services.

Group	Category	Ref.	Green expression
Waste Management	Process waste	267	+waste +management

The taxonomy also assigns the green terms to the group “waste management” and the category “process waste.” It is clear that the main activity is related to waste management.

Company 2: Tesla Inc.



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Mark:	MODEL Y

MODEL Y

US Serial Number:	87377617	**Application Filing Date:**	Mar. 20, 2017
US Registration Number:	6075303	**Registration Date:**	Jun. 09, 2020
Filed as TEAS RF:	Yes	**Currently TEAS RF:**	Yes
Register:	Principal		
Mark Type:	Trademark		
TM5 Common Status Descriptor:	LIVE/REGISTRATION/Issued and Active The trademark application has been registered with the Office.		
Status:	Registered. The registration date is used to determine when post-registration maintenance documents are due.		
Status Date:	Jun. 09, 2020		
Publication Date:	Feb. 27, 2018	**Notice of Allowance Date:**	Apr. 24, 2018

Mark Information — Expand All

Related Properties Information

Goods and Services

Note:

The following symbols indicate that the registrant/owner has amended the goods/services:

- Brackets [..] indicate deleted goods/services;
- Double parenthesis ((..)) identify any goods/services not claimed in a Section 15 affidavit of incontestability; and
- Asterisks *..* identify additional (new) wording in the goods/services.

For:	Electric vehicles		
International Class(es):	012 - Primary Class	**U.S Class(es):**	019, 021, 023, 031, 035, 044
Class Status:	ACTIVE		
First Use:	Mar. 13, 2020	**Use in Commerce:**	Mar. 13, 2020

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Mark:	TESLA

TESLA

US Serial Number:	87080898	**Application Filing Date:**	Jun. 22, 2016
US Registration Number:	6158369	**Registration Date:**	Sep. 22, 2020
Filed as TEAS RF:	Yes	**Currently TEAS RF:**	Yes
Register:	Principal		
Mark Type:	Service Mark		
TM5 Common Status Descriptor:	LIVE/REGISTRATION/Issued and Active The trademark application has been registered with the Office.		
Status:	Registered. The registration date is used to determine when post-registration maintenance documents are due.		
Status Date:	Sep. 22, 2020		
Publication Date:	Jun. 06, 2017	**Notice of Allowance Date:**	Aug. 01, 2017

Mark Information

Expand All

Related Properties Information

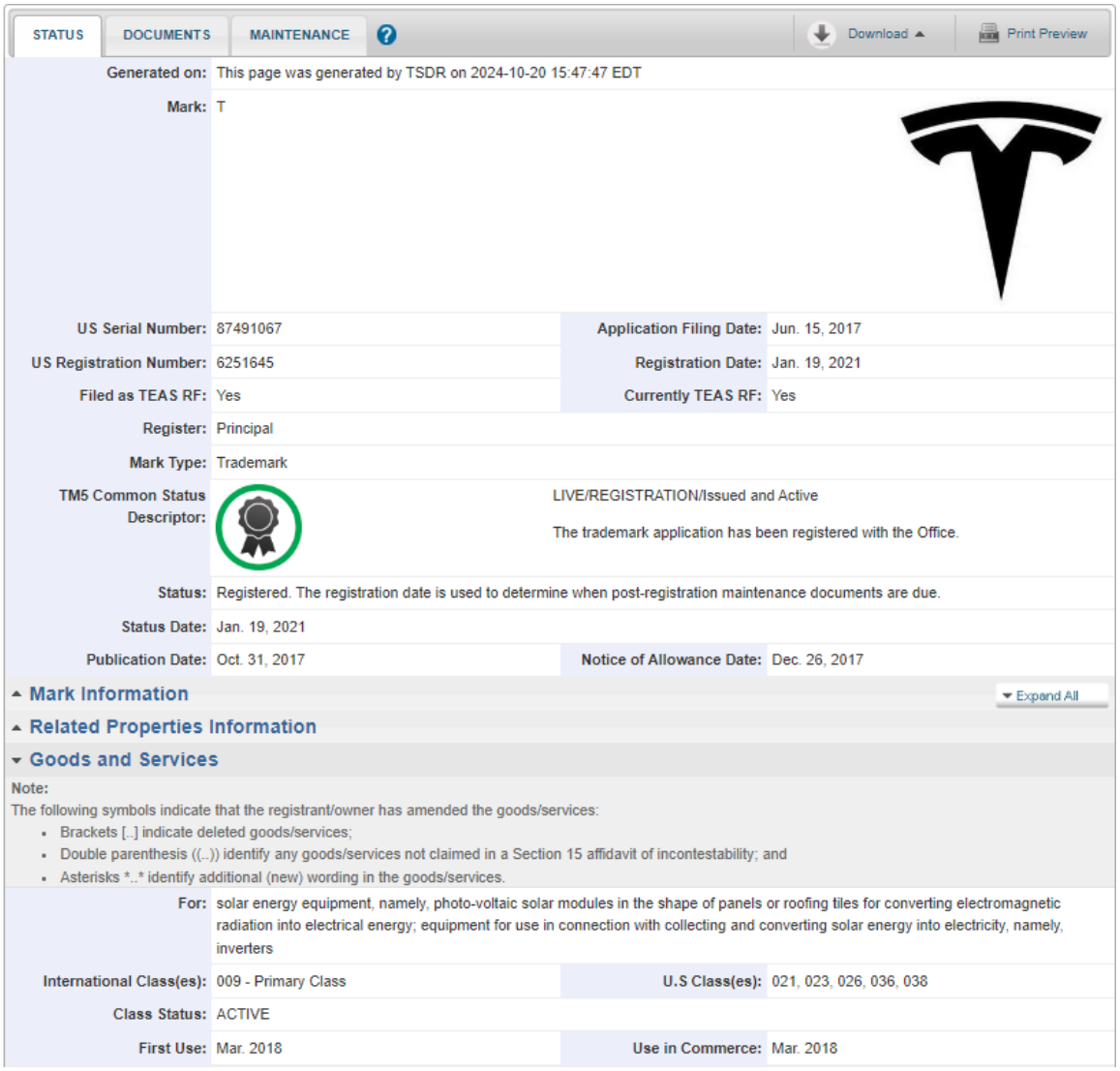
Goods and Services

Note:

The following symbols indicate that the registrant/owner has amended the goods/services:

- Brackets [..] indicate deleted goods/services;
- Double parenthesis ((..)) identify any goods/services not claimed in a Section 15 affidavit of incontestability; and
- Asterisks *..* identify additional (new) wording in the goods/services.

For:	Monitoring of solar panels and other equipment for use in converting solar energy into electricity to ensure proper functioning and programming for meeting electricity demands and usage goals; monitoring of efficiency, production levels and other performance data of solar panels and other equipment for use in converting solar energy into electricity		
International Class(es):	042 - Primary Class	**U.S Class(es):**	100, 101
Class Status:	ACTIVE		
First Use:	2017	**Use in Commerce:**	2017



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Mark:	T
US Serial Number:	87491067
Application Filing Date:	Jun. 15, 2017
US Registration Number:	6251645
Registration Date:	Jan. 19, 2021
Filed as TEAS RF:	Yes
Currently TEAS RF:	Yes
Register:	Principal
Mark Type:	Trademark
TM5 Common Status Descriptor:	LIVE/REGISTRATION/Issued and Active The trademark application has been registered with the Office.
Status:	Registered. The registration date is used to determine when post-registration maintenance documents are due.
Status Date:	Jan. 19, 2021
Publication Date:	Oct. 31, 2017
Notice of Allowance Date:	Dec. 26, 2017

▲ Mark Information ▼ Expand All

▲ Related Properties Information

▼ Goods and Services

Note:
The following symbols indicate that the registrant/owner has amended the goods/services:
- Brackets [..] indicate deleted goods/services;
- Double parenthesis ((..)) identify any goods/services not claimed in a Section 15 affidavit of incontestability; and
- Asterisks *..* identify additional (new) wording in the goods/services.

For:	solar energy equipment, namely, photo-voltaic solar modules in the shape of panels or roofing tiles for converting electromagnetic radiation into electrical energy; equipment for use in connection with collecting and converting solar energy into electricity, namely, inverters
International Class(es):	009 - Primary Class
U.S Class(es):	021, 023, 026, 036, 038
Class Status:	ACTIVE
First Use:	Mar. 2018
Use in Commerce:	Mar. 2018

After extracting and matching terms with the green taxonomy, we have the following,

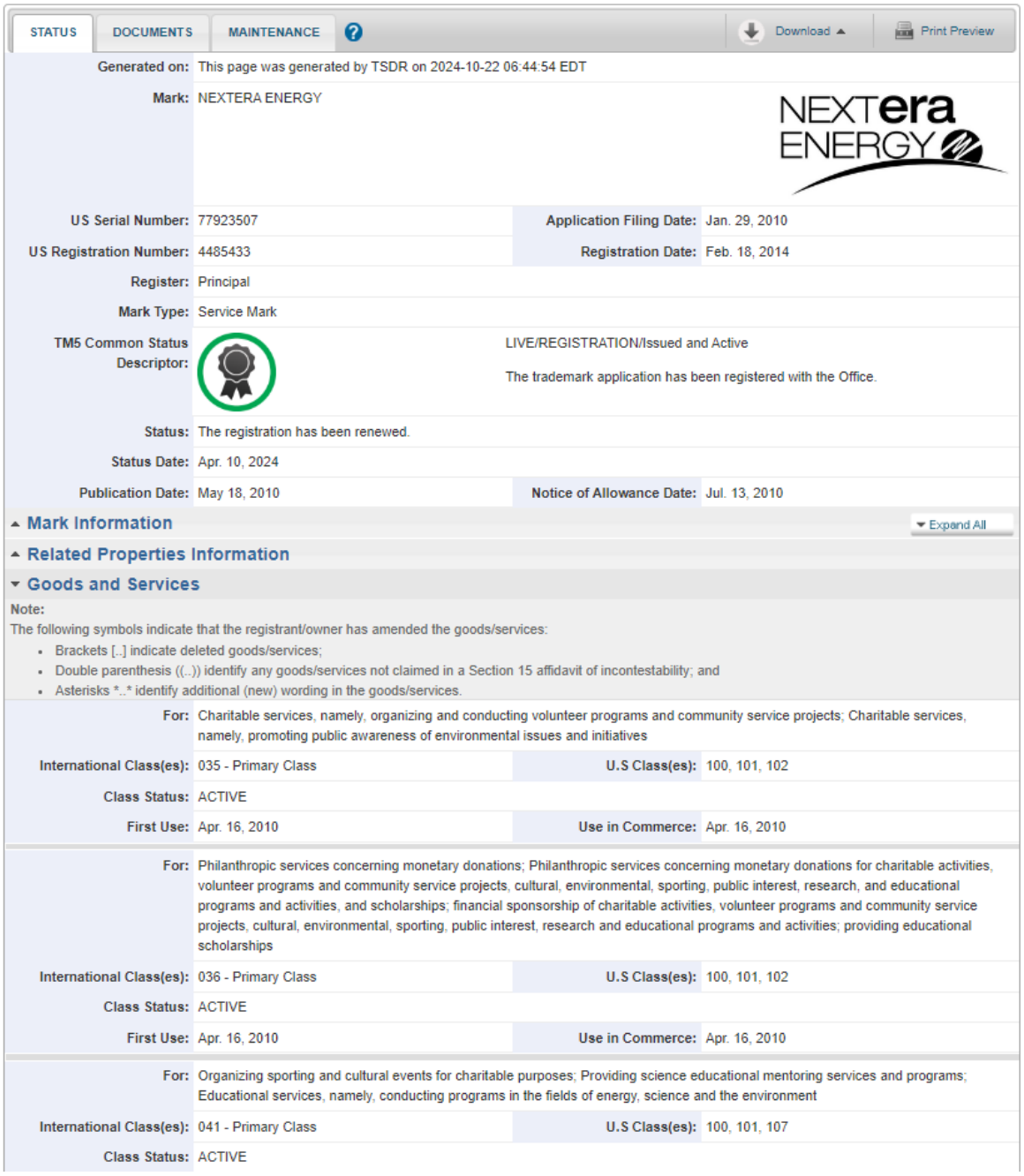
Registration number (Registration date)	Nice class	Green expression Ref.	Mark word	G&S identification at the term-level
6075303 (9-Jun-20)	12	73	MODEL Y	Electric vehicles.
6158369 (22-Sep-20)	42	224	TESLA	Monitoring of solar panels and other equipment for use in converting solar energy into electricity to ensure proper functioning and programming for meeting electricity demands and usage goals;

6158369 (22-Sep-20)	42	224	TESLA	Monitoring of efficiency, production levels and other performance data of solar panels and other equipment for use in converting solar energy into electricity.
6251645 (19-Jan-21)	9	162	T	Solar energy equipment, namely, photo-voltaic solar modules in the shape of panels or roofing tiles for converting electromagnetic radiation into electrical energy;
6251645 (19-Jan-21)	9	224	T	Equipment for use in connection with collecting and converting solar energy into electricity, namely, inverters.

Some of the terms are matched to Ref. 73, 162, and 224 and shown below,

Group	Category	Ref	Green expression
Transportation	General transport	73	+electric +vehicle −cigarette −door −horn −lock −sunroof −alternator −alarm −temperature −theft −antitheft −washers −7 −37
Energy Production	Solar energy	162	+photovoltaic
Energy Production	Solar energy	224	+solar +energy

Company 3: NextEra Energy Inc.



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Mark:	NEXTERA ENERGY
US Serial Number:	77923507
Application Filing Date:	Jan. 29, 2010
US Registration Number:	4485433
Registration Date:	Feb. 18, 2014
Register:	Principal
Mark Type:	Service Mark
TM5 Common Status Descriptor:	LIVE/REGISTRATION/Issued and Active The trademark application has been registered with the Office.
Status:	The registration has been renewed.
Status Date:	Apr. 10, 2024
Publication Date:	May 18, 2010
Notice of Allowance Date:	Jul. 13, 2010

▲ Mark Information — Expand All

▲ Related Properties Information

▼ Goods and Services

Note:
The following symbols indicate that the registrant/owner has amended the goods/services:
- Brackets [..] indicate deleted goods/services;
- Double parenthesis ((..)) identify any goods/services not claimed in a Section 15 affidavit of incontestability; and
- Asterisks *..* identify additional (new) wording in the goods/services.

For:	Charitable services, namely, organizing and conducting volunteer programs and community service projects; Charitable services, namely, promoting public awareness of environmental issues and initiatives		
International Class(es):	035 - Primary Class	U.S Class(es):	100, 101, 102
Class Status:	ACTIVE		
First Use:	Apr. 16, 2010	Use in Commerce:	Apr. 16, 2010
For:	Philanthropic services concerning monetary donations; Philanthropic services concerning monetary donations for charitable activities, volunteer programs and community service projects, cultural, environmental, sporting, public interest, research, and educational programs and activities, and scholarships; financial sponsorship of charitable activities, volunteer programs and community service projects, cultural, environmental, sporting, public interest, research and educational programs and activities; providing educational scholarships		
International Class(es):	036 - Primary Class	U.S Class(es):	100, 101, 102
Class Status:	ACTIVE		
First Use:	Apr. 16, 2010	Use in Commerce:	Apr. 16, 2010
For:	Organizing sporting and cultural events for charitable purposes; Providing science educational mentoring services and programs; Educational services, namely, conducting programs in the fields of energy, science and the environment		
International Class(es):	041 - Primary Class	U.S Class(es):	100, 101, 107
Class Status:	ACTIVE		

After extracting and matching terms with the green taxonomy, we have the following terms,

Registration number (Registration date)	Nice class	Green expression Ref.	Mark word	G&S identification at the term-level
4485433 (18-Feb-14)	35	Not matched	NEXTERA ENERGY	Charitable services, namely, organizing and conducting

				volunteer programs and community service projects;
4485433 (18-Feb-14)	35	97	NEXTERA ENERGY	Charitable services, namely, promoting public awareness of environmental issues and initiatives.
4485433 (18-Feb-14)	36	Not matched	NEXTERA ENERGY	Philanthropic services concerning monetary donations;
4485433 (18-Feb-14)	36	97	NEXTERA ENERGY	Philanthropic services concerning monetary donations for charitable activities, volunteer programs and community service projects, cultural, environmental, sporting, public interest, research, and educational programs and activities, and scholarships;
4485433 (18-Feb-14)	36	97	NEXTERA ENERGY	Financial sponsorship of charitable activities, volunteer programs and community service projects, cultural, environmental, sporting, public interest, research and educational programs and activities;
4485433 (18-Feb-14)	36	Not matched	NEXTERA ENERGY	Providing educational scholarships.
4485433 (18-Feb-14)	41	Not matched	NEXTERA ENERGY	Organizing sporting and cultural events for charitable purposes;
4485433 (18-Feb-14)	41	Not matched	NEXTERA ENERGY	Providing science educational mentoring services and programs;
4485433 (18-Feb-14)	41	Not matched	NEXTERA ENERGY	Educational services, namely, conducting programs in the fields of energy, science and the environment.

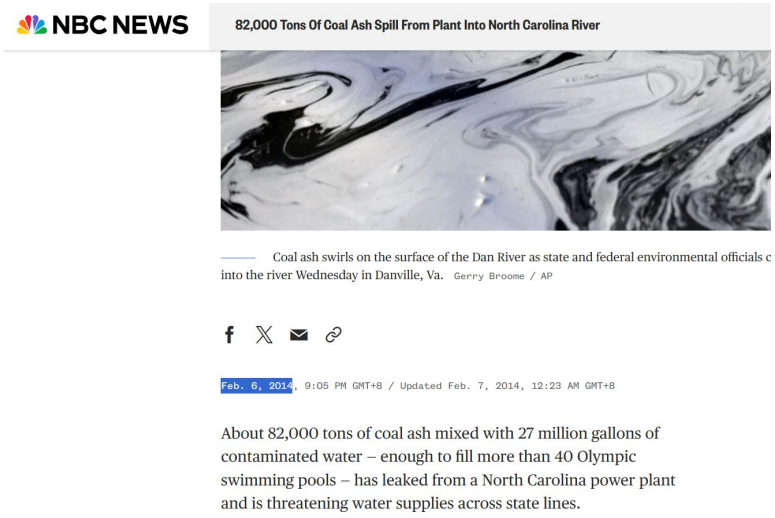
The green term is matched to Ref. 97 and shown below,

Group	Category	Ref.	Green expression
Climate Change	Environmental services	97	+environmental +services

OA2. RepRisk incident examples

Case 1: Coal ash spill from Duke Energy's facilities

Brief: Starting on February 2, 2014, a drainage pipe burst in a facility owned by Duke Energy in Eden, North Carolina, led to 82,000 tons of coal ash mixed with 27 million gallons of contaminated water leaked into the Dan River.[7]



NBC NEWS

82,000 Tons Of Coal Ash Spill From Plant Into North Carolina River

Coal ash swirls on the surface of the Dan River as state and federal environmental officials c into the river Wednesday in Danville, Va. Gerry Broome / AP

Feb. 6, 2014, 9:05 PM GMT+8 / Updated Feb. 7, 2014, 12:23 AM GMT+8

About 82,000 tons of coal ash mixed with 27 million gallons of contaminated water – enough to fill more than 40 Olympic swimming pools – has leaked from a North Carolina power plant and is threatening water supplies across state lines.

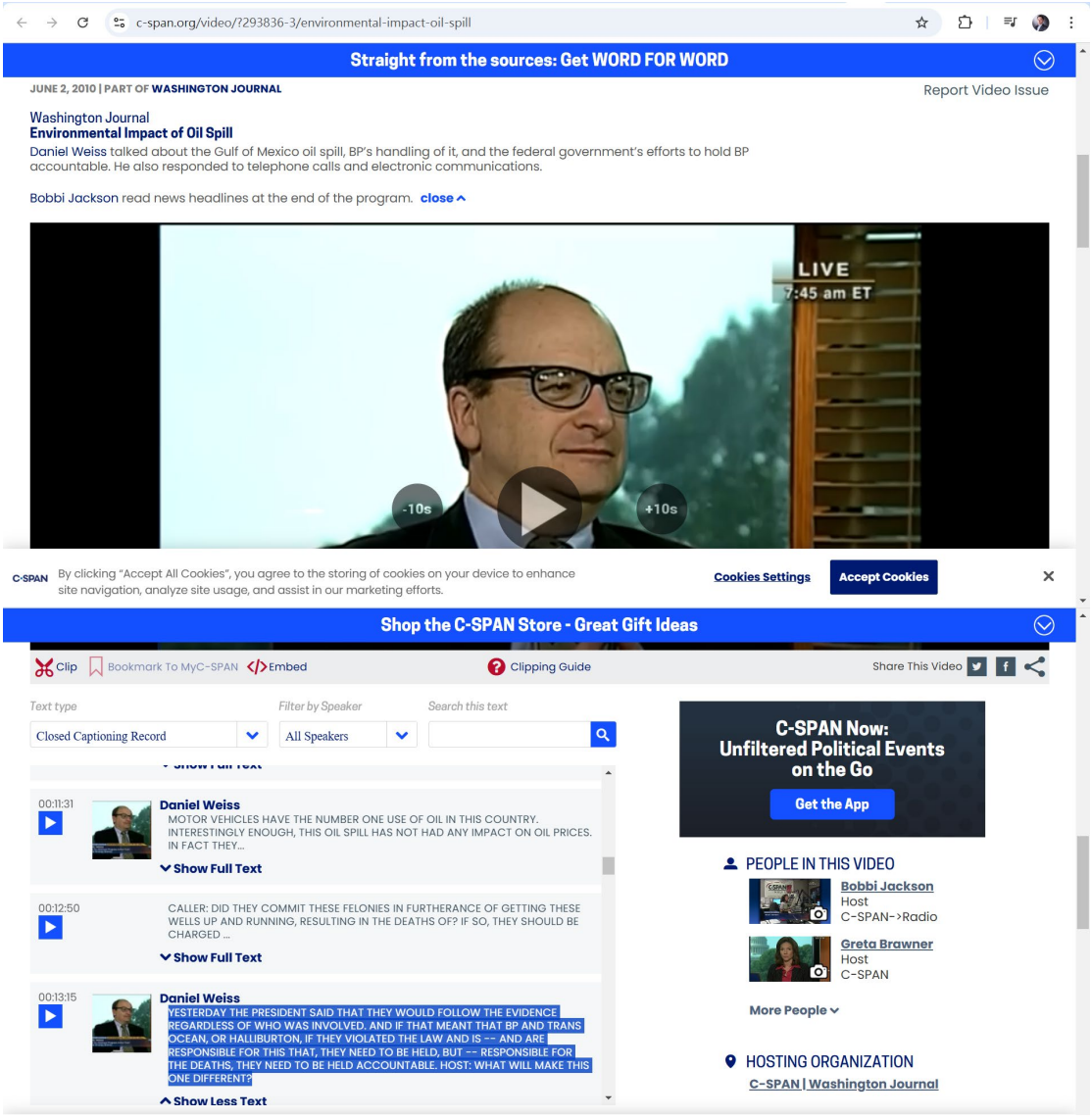
This case is recorded in the RepRisk dataset as the following:

Reprisk_id: 1143
Headquarters_country: United States of America
Reprisk_story_id: 74912
Severity: 2
Novelty: 1
Reach: 1
News_date: 2014-02-03
Source language: English
Related issues: Impacts on landscapes, ecosystems and biodiversity; Local pollution; Waste issues
Related_topic_tags: Land ecosystems
Related_ungc_principles: Principle 7 (Environment); Principle 8 (Environment); Principle 9 (Environment)
Related_countries: United States of America

[7] https://www.nbcnews.com/news/us-news/82-000-tons-coal-ash-spill-power-plant-n-c-n23401

Case 2: Halliburton Co. being named by Barack Obama

Brief: US President Barack Obama said that they would follow the evidence regardless of who was involved. And if that meant that BP and Transocean, or Halliburton, … and are responsible for this, they need to be held accountable.[8]



Reprisk_id: 80
Headquarters_country: United States of America
Reprisk_story_id: 15287
Severity: 3
Novelty: 1
Reach: 2
News_date: 2010-06-20

[8] https://www.c-span.org/video/?293836-3/environmental-impact-oil-spill

Source language: English
Related issues: Impacts on landscapes, ecosystems and biodiversity; Violation of national legislation
Related_topic_tags: Negligence
Related_ungc_principles: Principle 7 (Environment); Principle 8 (Environment); Principle 9 (Environment)
Related_countries: United States of America

OA3. Supplemental figures and tables

Figure OA1
Word clouds by green group

The sample comprises 379,590 green terms associated with 186,612 green marks registered by individuals, U.S. firms, and foreign firms at the USPTO over the period 1981-2020. The font of each word (phrase) is proportional to its frequency of occurrences in these 379,590 green terms.

Figure OA2
WSJ Climate Change News Index and green products over time by green group

This figure presents the monthly trends in the six-month trailing average of the WSJ Climate Change News Index (red line, Engle et al. 2020) and the six-month forward average of green terms (blue line) over the period 1984.1–2017.6, by green group. The sample comprises 14,897 green terms associated with 8,713 green marks filed by 1,625 U.S. public firms.

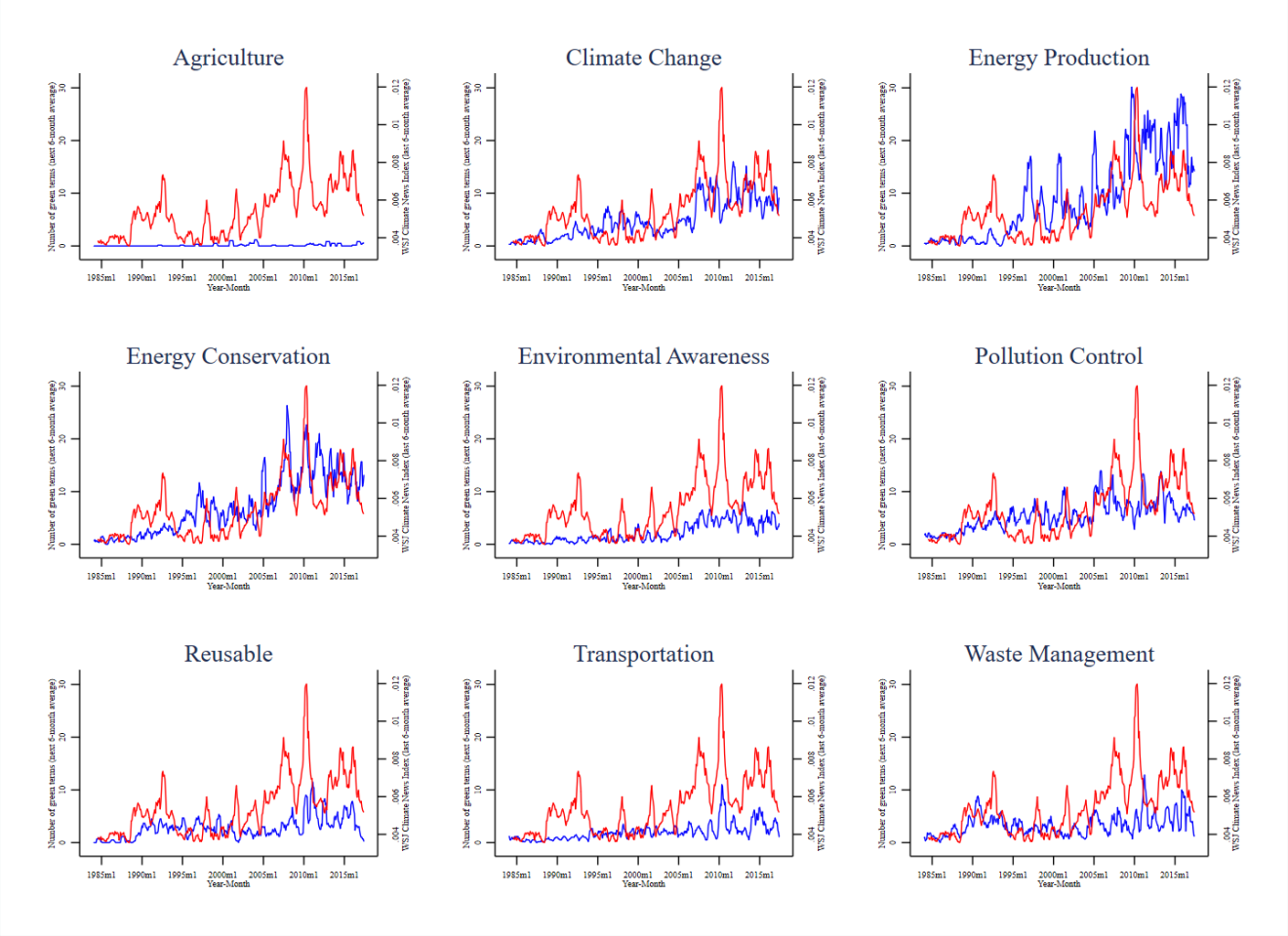


Table OA1
Sample formation

This table lists the steps taken to form the sample used in the regression analysis.

	Number of marks
1. Collect USPTO marks registered between 1981 to 2020	5,084,151
2. Keep marks whose owners are U.S. firms (i.e., not individuals nor foreign firms like Toyota, Volkswagen)	3,334,855
3. Keep marks with available information on their Nice class(es)	3,328,197
4. Keep marks whose owners are U.S. public firms by merging with the Compustat database	365,625
5. Drop marks whose owners are financial firms (i.e., drop firms with SIC>=6000 and SIC<=6999)	332,581
Aggregate mark-level into firm-year-level	
6. Keep firm-year observations with available financial information	142,527
7. Keep trademarking firms (i.e., firms with at least one newly registered mark between 1981 to 2020)	109,129

Table OA2
The non-green patenting firms

We repeat the analyses in Tables 4 and 5 using the sample of non-green patenting firms, i.e., a subsample of the baseline trademarking firms without registering any green patents over the period 1981-2020. The non-green patenting sample comprises 86,950 firm-year observations associated with 6,908 unique firms. Panel A presents the summary statistics. Panel B reports the OLS regression results examining the contemporaneous relation between a firm's green products and its environmental scores. Panel C reports the OLS regression results examining the relation between a firm's green products and its future GHG emissions. Panel D reports the OLS regression results examining the relation between a firm's green products and its future sales growth and firm value. Variable definitions are provided in the Appendix. All model specifications include firm fixed effects and SIC3-by-year fixed effects. Robust standard errors clustered at the firm level are reported in parentheses. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Summary statistic

	Mean	Std. Dev.	P1	P25	P50	P75	P99
Green Marking Firm	0.227	0.419	0	0	0	0	1
#Green Term	0.073	1.14	0	0	0	0	2
Green Term	0.027	0.194	0	0	0	0	1.099
Green Category	0.033	0.246	0	0	0	0	1
#All Mark	1.973	5.826	0	0	0	2	26
All Mark	0.577	0.823	0	0	0	1.099	3.296
#Green Mark	0.041	0.354	0	0	0	0	1
Green Mark	0.022	0.151	0	0	0	0	0.693
#Non-Green Mark	1.932	5.768	0	0	0	2	26
Non-Green Mark	0.565	0.818	0	0	0	1.099	3.296
Green Patenting Firm	0	0	0	0	0	0	0
#Patent	1.347	7.32	0	0	0	0	24
Total Assets (in $million)	1,410	5,530	2.387	40.617	164.175	737	22,410
Firm Size	5.192	2.039	0.97	3.704	5.101	6.603	10.017
Firm Age	18.069	13.221	3	8	14	25	59
ROA	-0.036	0.232	-1.214	-0.038	0.031	0.071	0.242
Capex	0.058	0.059	0	0.019	0.040	0.074	0.311
RD	0.049	0.102	0	0	0	0.054	0.563
Cash Holdings	0.173	0.204	0	0.024	0.087	0.249	0.851
Leverage	0.237	0.216	0	0.037	0.204	0.37	0.941
Sales Growth	0.180	0.501	-0.62	-0.021	0.082	0.232	3.149
Total Q	1.740	2.166	0.101	0.628	1.027	1.877	13.584
Tobin's Q	7.442	14.088	0.271	1.193	2.617	6.735	90.925

Panel B: Green products and environmental scores

	MSCI E-Score		Sustainalytics E-Score		Refinitiv Innovation Score	
	(1)	(2)	(3)	(4)	(5)	(6)
Green Term	0.007**		0.005*		0.014*	
	(0.003)		(0.002)		(0.007)	
Green Category		0.005**		0.003*		0.007
		(0.003)		(0.002)		(0.006)
Non-Green Mark	0.001	0.001	-0.002*	-0.002*	-0.002	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)
Firm Size	-0.007**	-0.007**	0.006	0.006	0.005	0.005
	(0.004)	(0.004)	(0.004)	(0.004)	(0.008)	(0.008)
Firm Age	-0.003*	-0.003*	-0.000	-0.000	0.004	0.004
	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)
ROA	-0.004	-0.004	-0.026***	-0.026***	0.022	0.022
	(0.007)	(0.007)	(0.009)	(0.009)	(0.020)	(0.020)

Capex	-0.003	-0.003	-0.048	-0.048	-0.026	-0.027
	(0.031)	(0.031)	(0.041)	(0.041)	(0.099)	(0.098)
RD	-0.026	-0.026	-0.064	-0.064	0.104**	0.104**
	(0.020)	(0.020)	(0.072)	(0.072)	(0.047)	(0.047)
Cash Holdings	0.009	0.009	0.017	0.017	-0.040	-0.040
	(0.009)	(0.009)	(0.020)	(0.020)	(0.027)	(0.027)
Leverage	0.010	0.010	-0.010	-0.010	-0.024	-0.024
	(0.008)	(0.008)	(0.012)	(0.012)	(0.020)	(0.020)
Firm FE	Y	Y	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y	Y	Y
Adjusted R-squared	0.442	0.442	0.836	0.836	0.735	0.734
Observations	17,209	17,209	3,657	3,657	9,267	9,267

Panel C: Green products and GHG emissions

	GHG Total Emission (next 2 years)		GHG Scope1 Emission (next 2 years)	
	(1)	(2)	(3)	(4)
Green Term	-0.587		-0.537	
	(0.658)		(0.624)	
Green Category		-0.636		-0.592
		(0.443)		(0.421)
Non-Green Mark	0.392	0.408	0.198	0.213
	(0.341)	(0.340)	(0.185)	(0.186)
Firm Size	-3.506	-3.505	-3.460	-3.459
	(3.942)	(3.942)	(3.560)	(3.560)
Firm Age	-1.449	-1.439	-1.720	-1.710
	(1.375)	(1.377)	(1.272)	(1.273)
ROA	12.792	12.814	1.921	1.942
	(11.693)	(11.696)	(2.355)	(2.354)
Capex	-38.551*	-38.580*	-26.425	-26.453
	(21.626)	(21.622)	(19.560)	(19.558)
RD	111.915	112.011	6.213	6.304
	(103.167)	(103.169)	(13.605)	(13.600)
Cash Holdings	12.724	12.729	0.484	0.489
	(9.358)	(9.356)	(1.882)	(1.878)
Leverage	4.240	4.226	0.841	0.828
	(5.311)	(5.310)	(2.586)	(2.585)
Firm FE	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y
Adjusted R-squared	0.389	0.389	0.824	0.824
Observations	6,730	6,730	6,730	6,730

Panel D: Green products, sales growth, and firm value

	Sales Growth (next 2 years)		Total Q (next 2 years)		Tobin's Q (next 2 years)	
	(1)	(2)	(3)	(4)	(5)	(6)
Green Term	0.013**		0.047**		0.279**	
	(0.005)		(0.022)		(0.129)	
Green Category		0.011***		0.037**		0.213**
		(0.004)		(0.016)		(0.097)
Non-Green Mark	0.014***	0.014***	0.042***	0.042***	0.189***	0.190***
	(0.002)	(0.002)	(0.012)	(0.012)	(0.069)	(0.069)
Firm Size	-0.104***	-0.104***	-0.392***	-0.392***	-1.807***	-1.807***
	(0.005)	(0.005)	(0.026)	(0.026)	(0.161)	(0.161)
Firm Age	-0.003	-0.003	-0.021	-0.021	-0.099	-0.099
	(0.002)	(0.002)	(0.025)	(0.025)	(0.156)	(0.156)

ROA	-0.191***	-0.191***	0.921***	0.921***	2.968***	2.968***
	(0.021)	(0.021)	(0.082)	(0.082)	(0.606)	(0.606)
Capex	0.235***	0.234***	0.385**	0.385**	-8.140***	-8.141***
	(0.049)	(0.049)	(0.181)	(0.181)	(0.901)	(0.901)
RD	-0.112	-0.112	-0.387	-0.388	3.473	3.471
	(0.072)	(0.072)	(0.315)	(0.315)	(2.463)	(2.463)
Cash Holdings	0.370***	0.370***	1.217***	1.216***	7.145***	7.144***
	(0.021)	(0.021)	(0.118)	(0.118)	(0.840)	(0.840)
Leverage	-0.075***	-0.075***	-0.041	-0.041	1.507**	1.506**
	(0.019)	(0.019)	(0.089)	(0.089)	(0.663)	(0.663)
Firm FE	Y	Y	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y	Y	Y
Adjusted R-squared	0.296	0.296	0.593	0.593	0.641	0.641
Observations	70,038	70,038	70,038	70,038	70,038	70,038

Table OA3
Summary statistics for dissecting green products

This table presents the summary statistics for the variables of interest used in Tables 6 and 7. There are three pairs of variables: (1) *Core-Business Green Term* vs. *Non-Core-Business Green Term*; (2) *Follow-up Green Term* vs. *Greenfield Green Term*; and (3) *Common-Class Green Term* vs. *Unique-Class Green Term*. Variable definitions are provided in the Appendix.

	Mean	Std. Dev.	P1	P25	P50	P75	P99
#Core-Business Green Term	0.076	1.018	0	0	0	0	2
#Non-Core-Business Green Term	0.057	0.717	0	0	0	0	2
#Follow-Up Green Term	0.096	1.417	0	0	0	0	2
#First-Time Green Term	0.037	0.504	0	0	0	0	1
#Common-Class Green Term	0.067	1.099	0	0	0	0	2
#Unique-Class Green Term	0.067	0.652	0	0	0	0	2
Core-Business Green Term	0.029	0.199	0	0	0	0	1.099
Non-Core-Business Green Term	0.023	0.176	0	0	0	0	1.099
Follow-Up Green Term	0.031	0.22	0	0	0	0	1.099
First-Time Green Term	0.016	0.142	0	0	0	0	0.693
Common-Class Green Term	0.022	0.184	0	0	0	0	1.099
Unique-Class Green Term	0.030	0.191	0	0	0	0	1.099

Table OA4
Natural disasters and green products: Alternative definitions of disasters

This table reports the Poisson regression results examining the relation between a firm's headquarters adjacent to natural disasters and its green products, using alternative definitions of natural disasters. The sample period is 2000-2020. The dependent variable in columns (1) and (2) is the number of green terms associated with green marks filed in the next year or over the next two years. The dependent variable in columns (3) and (4) is the number of unique green categories associated with green marks filed in the next year or over the next two years. In Panel A, we classify a county affected by natural disasters if its total estimated property and crop damages exceed $1 billion in 2021 constant dollars and the duration of those disasters lasts less than 30 days (Barrot and Sauvagnat 2016). In Panel B, we classify a county affected by natural disasters if its total estimated property and crop damages exceed $500 thousand in 2021 constant dollars. Variable definitions are provided in the Appendix. All model specifications include firm fixed effects and SIC3-by-year fixed effects. Robust standard errors clustered at the firm level are reported in parentheses. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Using Barrot and Sauvagnat's (2016) classification of natural disasters

	Green Term		Green Category	
	(next year)	(next 2 years)	(next year)	(next 2 years)
	(1)	(2)	(3)	(4)
Adjacent to Natural Disaster	0.225	0.341**	0.256**	0.298***
(Barrot and Sauvagnat 2016)	(0.242)	(0.170)	(0.130)	(0.086)
Firm Size	0.183	0.131	0.202***	0.151**
	(0.125)	(0.123)	(0.076)	(0.072)
Firm Age	0.002	0.043	0.022	0.061
	(0.109)	(0.101)	(0.067)	(0.067)
ROA	0.598	0.151	0.732**	0.412*
	(0.385)	(0.315)	(0.296)	(0.234)
Capex	-0.912	-0.883	0.709	1.056
	(1.794)	(1.576)	(1.105)	(0.897)
RD	1.991	1.758	2.433**	1.676*
	(1.391)	(1.251)	(1.016)	(0.905)
Cash Holdings	-0.071	0.434	0.395	0.738**
	(0.606)	(0.435)	(0.382)	(0.326)
Leverage	-1.266**	-1.243**	-0.357	-0.357
	(0.547)	(0.533)	(0.330)	(0.290)
Firm FE	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y
Pseudo R-squared	0.511	0.571	0.301	0.320
Observations	9,210	10,209	9,440	10,750

Panel B: Using $500k damages as the disaster threshold

	Green Term		Green Category	
	(next year)	(next 2 years)	(next year)	(next 2 years)
	(1)	(2)	(3)	(4)
Adjacent to Natural Disaster ($500k)	0.565***	0.389***	0.391***	0.230***
	(0.152)	(0.104)	(0.095)	(0.067)
Firm Size	-0.159	-0.178	0.107	0.063
	(0.168)	(0.132)	(0.123)	(0.102)
Firm Age	0.073	0.109	0.047	0.084
	(0.123)	(0.115)	(0.090)	(0.082)
ROA	1.479***	1.225***	1.470***	1.072**
	(0.517)	(0.446)	(0.542)	(0.434)
Capex	-5.765*	-2.116	-0.555	0.565
	(3.223)	(2.219)	(1.920)	(1.556)
RD	1.512	-0.682	2.877	0.639
	(2.278)	(1.996)	(1.821)	(1.521)
Cash Holdings	-2.315**	-0.387	-0.294	0.225
	(1.035)	(0.615)	(0.616)	(0.469)
Leverage	-1.714**	-1.422**	-0.497	-0.282
	(0.759)	(0.624)	(0.460)	(0.408)
Firm FE	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y
Pseudo R-squared	0.553	0.609	0.303	0.332
Observations	2,880	3,689	2,960	3,913

Table OA5
Natural disasters and green products: Restrictions on sample firms' disaster damages

This table reports the Poisson regression results examining the relation between a firm's headquarters adjacent to natural disasters and its green products, imposing restrictions on sample firms' disaster-related damages. The sample period is 2000-2020. The dependent variable in columns (1) and (2) is the number of green terms associated with green marks filed in the next year or over the next two years. The dependent variable in columns (3) and (4) is the number of unique green categories associated with green marks filed in the next year or over the next two years. We require the headquarters county of sample firms to have total estimated property and crop damages below $50 thousand ($100 thousand) in 2021 constant dollars. Variable definitions are provided in the Appendix. All model specifications include firm fixed effects and SIC3-by-year fixed effects. Robust standard errors clustered at the firm level are reported in parentheses. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Focal counties' damages less than $50k

	Green Term		Green Category	
	(next year)	(next 2 years)	(next year)	(next 2 years)
	(1)	(2)	(3)	(4)
Adjacent to Natural Disaster	1.348***	0.582***	0.743***	0.249**
	(0.250)	(0.188)	(0.179)	(0.117)
Firm Size	-0.125	-0.171	0.041	-0.011
	(0.327)	(0.247)	(0.229)	(0.205)
Firm Age	-0.075	-0.072	0.055	0.126
	(0.252)	(0.220)	(0.151)	(0.150)
ROA	1.625**	1.805***	0.780	0.862
	(0.663)	(0.610)	(0.848)	(0.620)
Capex	0.229	-0.481	3.665	3.631
	(6.481)	(4.263)	(4.694)	(3.086)
RD	-3.492	-4.827*	1.801	-2.346
	(5.335)	(2.796)	(2.998)	(2.231)
Cash Holdings	-0.646	0.233	0.606	1.269
	(1.752)	(1.279)	(1.361)	(1.005)
Leverage	-1.698	-1.636*	-0.614	-0.565
	(1.309)	(0.848)	(0.843)	(0.640)
Firm FE	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y
Pseudo R-squared	0.619	0.667	0.314	0.358
Observations	920	1,304	961	1,407

Panel B: Focal counties' damages less than $100k

	Green Term		Green Category	
	(next year)	(next 2 years)	(next year)	(next 2 years)
	(1)	(2)	(3)	(4)
Adjacent to Natural Disaster	0.801***	0.444***	0.501***	0.125
	(0.285)	(0.134)	(0.146)	(0.090)
Firm Size	-0.202	-0.156	-0.096	-0.087
	(0.262)	(0.206)	(0.176)	(0.160)
Firm Age	-0.222	-0.047	-0.082	0.074
	(0.210)	(0.175)	(0.130)	(0.095)
ROA	1.403**	1.047	1.127*	0.382
	(0.669)	(0.712)	(0.671)	(0.514)
Capex	-4.590	-2.863	0.984	1.115
	(5.237)	(3.011)	(3.009)	(2.362)
RD	1.199	-3.814	1.634	-2.587
	(3.121)	(2.661)	(2.310)	(2.062)
Cash Holdings	-2.286	-1.037	-0.139	0.072

	(1.497)	(1.002)	(0.953)	(0.787)
Leverage	-1.289	-1.321*	-0.750	-0.614
	(0.988)	(0.725)	(0.654)	(0.547)
Firm FE	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y
Pseudo R-squared	0.603	0.647	0.309	0.347
Observations	1,333	1,841	1,371	1,968

Table OA6
Natural disasters and green products: Alternative clustered standard errors

This table reports the Poisson regression results examining the relation between a firm's headquarters adjacent to natural disasters and its green products, employing an alternative clustering method for standard errors. The sample period is 2000-2020. The dependent variable in columns (1) and (2) is the number of green terms associated with green marks filed in the next year or over the next two years. The dependent variable in columns (3) and (4) is the number of unique green categories associated with green marks filed in the next year or over the next two years. Variable definitions are provided in the Appendix. All model specifications include firm fixed effects and SIC3-by-year fixed effects. Robust standard errors clustered at the county level are reported in parentheses. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Green Term		Green Category	
	(next year)	(next 2 years)	(next year)	(next 2 years)
	(1)	(2)	(3)	(4)
Adjacent to Natural Disaster	0.521***	0.321***	0.350***	0.165***
	(0.139)	(0.090)	(0.081)	(0.057)
Firm Size	-0.016	0.092	0.157	0.148
	(0.167)	(0.142)	(0.125)	(0.109)
Firm Age	0.026	0.089	0.032	0.091
	(0.091)	(0.086)	(0.076)	(0.071)
ROA	1.292***	0.918***	1.240***	0.945**
	(0.469)	(0.355)	(0.458)	(0.385)
Capex	-5.369**	-2.427	-0.719	0.206
	(2.668)	(1.569)	(1.529)	(1.240)
RD	2.332	0.838	2.881**	1.060
	(2.427)	(1.751)	(1.425)	(1.150)
Cash Holdings	-1.332	-0.195	-0.026	0.438
	(0.877)	(0.479)	(0.496)	(0.373)
Leverage	-1.304**	-1.016	-0.284	-0.108
	(0.653)	(0.649)	(0.445)	(0.402)
Firm FE	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y
Pseudo R-squared	0.565	0.622	0.306	0.332
Observations	3,749	4,694	3,846	5,001

Table OA7
Industry environmental scandal and green products: Alternative definition of environmental scandals

This table reports the Poisson regression results examining the relation between a firm's industry peers' environmental scandals and its green products, using an alternative definition of industry peers' environmental scandals. The sample period is 2007-2020. The dependent variable in columns (1) and (2) is the number of green terms associated with green marks filed in the next year or over the next two years. The dependent variable in columns (3) and (4) is the number of unique green categories associated with green marks filed in the next year or over the next two years. *Peer Scandal* is defined as peer firms' negative environmental news (of medium to high severity) featuring the violation of at least one of the following RepRisk issues: climate change, GHG emissions, global pollution, impacts on landscapes and biodiversity, local pollution, other ESG issues, overuse and wasting of resources, product-related health and environmental issues, and waste issues. Variable definitions are provided in the Appendix. All model specifications include firm fixed effects and year fixed effects. Robust standard errors clustered at the SIC3 level are reported in parentheses. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Green Term		Green Category	
	(next year)	(next 2 years)	(next year)	(next 2 years)
	(1)	(2)	(3)	(4)
Peer Scandal	0.320**	0.178**	0.132*	0.071
(RepRisk issues)	(0.127)	(0.088)	(0.071)	(0.054)
Firm Size	-0.047	-0.070	0.056	0.039
	(0.154)	(0.157)	(0.110)	(0.100)
Firm Age	0.174**	0.211***	0.251***	0.243***
	(0.077)	(0.080)	(0.069)	(0.070)
ROA	0.774**	0.066	0.375	0.082
	(0.353)	(0.282)	(0.285)	(0.227)
Capex	-1.444	-0.524	-0.857	0.819
	(1.570)	(1.720)	(1.125)	(1.167)
RD	1.363	1.162	1.124	0.349
	(1.489)	(1.656)	(1.204)	(1.141)
Cash Holdings	0.193	0.554	0.480	0.350
	(0.522)	(0.383)	(0.515)	(0.464)
Leverage	0.473	0.406	0.322	0.196
	(0.583)	(0.527)	(0.378)	(0.317)
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Pseudo R-squared	0.357	0.442	0.205	0.232
Observations	7,144	6,587	7,397	7,010