Green Products*

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

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Abstract

We apply a novel text-based classification method to identify green trademarks that capture the commercialization of green innovation through products and services brought to market. Firms with more green products generate higher green revenues, emit less greenhouse gas, and receive higher environmental ratings. These firms also exhibit higher future firm value, especially when green products align with core businesses, prior experience, and product synergies. The valuation effect is driven by consumer environmental awareness rather than investor preferences or concerns. Consistent with a consumer demand channel, firms expand green product offerings following nearby natural disasters or peer firms' environmental scandals.

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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

There is a large literature on how to motivate green innovation to curb pollution and combat climate change (see, for example, Acemoglu, Aghion, Bursztyn, and Hemous 2012; Nordhaus 2021), and on how such innovation leads to real and financial outcomes (see, for example, Bolton, Kacperczyk, and Wiedemann 2023; Hege, Li, and Zhang 2023; Cohen, Gurun, and Nguyen 2024). However, the *commercialization* of green innovation and its economic implications remain largely underexplored. As the opening quote suggests, green innovation extends beyond patents to include trademarks that capture new products and services brought to market, reflecting the commercialization of environmentally friendly technologies (Yorukoglu 2000; Scanlon 2019).

In this paper, we conduct a large-sample study of environmentally friendly products and services in the U.S. economy over the past four decades. We apply a novel text-based green classification method developed by the European Union Intellectual Property Office (EUIPO) to identify green trademarks ("green marks" henceforth) registered with the United States Patent and Trademark Office (USPTO) between 1981 and 2020. Using this new dataset, we address three research questions: 1) Are green products value-relevant? 2) Through which channels do any valuation effects arise? and 3) What motivates firms to introduce green products? Answering these questions will advance our understanding of the links among commercialized innovation, firm value, environmental performance, and policy.

Our green mark dataset offers several advantages for studying the commercialization of green innovation. First, because trademark registration is subject to a "use in commerce" requirement, the dataset uniquely captures green innovations that have been commercialized

rather than merely conceived.[1] Second, the classification is based on the goods and services (G&S) identification in trademark documents, which defines the scope of legal protection and is examined and approved by a USPTO attorney. The USPTO's regulatory oversight and the possibility of trademark litigation help mitigate concerns about corporate greenwashing. Finally, unlike patents, which are subject to stringent patentability criteria, trademarks cover all types of goods and services (Hall, Helmers, Rogers, and Sena 2014), regardless of technical complexity. As a result, our dataset enables a comprehensive analysis of the U.S. green product landscape.

We begin by presenting a time-series plot of newly registered trademarks by U.S. public firms from 1981 to 2020, distinguishing between all trademarks and green marks (see Figure 1). Although the total number of new trademarks registered by public firms has declined in recent decades (partly due to the continued decrease in the number of publicly listed firms), the number of new green marks has shown a sustained upward trend over the same period. We further show that manufacturing, energy, and services firms account for the largest share of green mark registrations in the U.S.

We assess the environmental relevance of green marks using several complementary tests. First, we show that green marks are significantly more likely to be renewed than non-green marks, indicating that they reflect substantive commercial commitments rather than symbolic branding. Second, firms with more intensive green marking activity experience significant increases in revenues from environmentally friendly goods and services, as classified by the FTSE Russell Green Revenues Classification System. Third, green marking activity is negatively and significantly associated with future emissions, as measured by Trucost. Consistent with these findings, such firms also receive higher environmental ratings from third-party providers, including MSCI, Sustainalytics, and Refinitiv. Overall, the evidence suggests that green marks

[1] 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.

capture meaningful efforts to commercialize green innovation with real environmental consequences.

We next examine the value relevance of green marks. We show that firms with more intensive green marking activity have higher market valuations, controlling for non-green marks and green patents. This association remains robust when we restrict the sample to firms without green patents or exclude manufacturing and energy firms (the two sectors with the highest green marking intensity).

To examine the underlying mechanisms, we analyze two potential channels: short-term investor responses and long-term consumer demand. The investor response channel operates through short-term stock price reactions to green mark registrations, driven by (i) investors with environmental preferences (e.g., Dimson, Karakas, and Li 2015; Krüger 2015; Morgan and Tumlinson 2019; Barber, Morse, and Yasuda 2021; Hwang, Titman, and Wang 2022; Oehmke and Opp 2025) or (ii) changes in discount rates reflecting regulatory penalties or climate risk exposure (e.g., Chava 2014; Krüger, Sautner, and Starks 2020; Bolton and Kacperczyk 2021, 2023; Ilhan, Sautner, and Vilkov 2021; Hsu, Li, and Tsou 2023; Sautner, Van Lent, Vilkov, and Zhang 2023). The consumer demand channel reflects households' environmental preferences, as revealed through market acceptance of green products (e.g., Luo and Bhattacharya 2006; Albuquerque, Koskinen, and Zhang 2019; Meier, Servaes, Wei, and Xiao 2024; Chen, Garlappi, and Lazrak 2025).

Following Krüger (2015), we examine the investor response channel using short-window stock market reactions around trademark registration dates. We find no significantly positive abnormal returns associated with the registration of green marks, providing little support for an investor response channel. In contrast, we find strong evidence for a consumer demand channel: the valuation premium associated with green marks is concentrated in business-to-consumer (B2C) industries and is accompanied by significant growth in future sales. This premium is highly

sensitive to variation in consumer environmental concerns. Our heterogeneity analyses show that green marks are more value-relevant during periods of heightened public attention to environmental issues and among firms with greater exposure to states whose residents exhibit strong pro-sustainability preferences.

We further exploit the rich textual information contained in the G&S identification of trademark registrations to examine heterogeneity in the valuation premium associated with green marks. We classify a firm's green marks by their proximity to core product lines (i.e., centrality), timing of introduction, and integration with non-green products. We find that green marks are value-relevant only when they pertain to a firm's core product offerings, further supporting the consumer demand channel. In addition, only follow-on green marks, rather than initial greenfield entries, are associated with higher market valuations, suggesting that valuation benefits depend on firms' prior experience in developing green products. Finally, green marks introduced jointly with non-green marks within the same product line are associated with higher valuations, highlighting the role of complementarity between green and non-green offerings.

We next examine potential drivers of firms' green product introductions. We proxy for managers' heightened awareness of climate risks using natural disasters in counties adjacent to, but not including, a firm's headquarters county. We capture increases in stakeholders' environmental concerns using environmental scandals within the firm's industry. We find that green marking activity increases significantly following both shocks, suggesting that firms' transitions toward environmentally friendly goods and services are shaped by managers' attention to climate risk, stakeholders' environmental concerns, and incentives to differentiate from industry peers.

Our study contributes to three strands of the literature. First, we add to the growing literature on measuring green technology and innovation. Existing studies primarily rely on patent-based measures (Acemoglu, Akcigit, Hanley, and Kerr 2016; Aghion et al. 2016; Bolton, Kacperczyk, and Wiedemann 2023; Aghion, Bénabou, Martin, and Roulet 2023; Cohen, Gurun,

and Nguyen 2024) and therefore focus on the production of green technologies. In contrast, we introduce green marks that capture the commercialization and market adoption of green innovation across a broad set of environmentally friendly goods and services. In this sense, our measure captures the "users" rather than the "producers" of green technology – a substantially larger segment of firms in the economy. Our green mark dataset complements existing patent-based measures and expands the empirical toolkit for studying sustainable innovation.

Second, our study contributes to the literature on the real effects of firms' environmental engagement.[2] Given the mixed evidence in this literature, we document a novel positive association between firms' commercialized green innovation and market value. Leveraging the rich textual information in the G&S identification of trademark registrations, we further identify specific features of green marks (e.g., relevance to core product lines, follow-on rather than greenfield introductions, and joint introduction with non-green marks) that explain this valuation effect.

Third and finally, we contribute to the literature on the value implications of firms' product differentiation and portfolio synergies. Prior studies emphasize differentiation based on the distance between a firm's product portfolio and those of its competitors (e.g., Hoberg, Phillips, and Prabhala 2014; Hoberg and Phillips 2016). In contrast, we examine firms' introduction of new environmentally friendly products. By documenting value-enhancing complementarities between green and non-green products, our findings provide new evidence on the financial effects of product synergies, consistent with Hoberg and Phillips (2024).

[2] On the one hand, a large number of papers show that corporate social responsibility (CSR) improves firms' financial performance and stakeholder welfare (e.g., Edmans 2011; Servaes and Tamayo 2013; Flammer 2015; Lins, Servaes, and Tamayo 2017; Albuquerque, Koskinen, and Zhang 2019). On the other hand, some studies uncover agency problems behind corporate doing goodness (Di Giuli and Kostovetsky 2014; Masulis and Reza 2015; Cheng, Hong, and Shue 2023). Bartram, Hou, and Kim (2022) and Duchin, Gao, and Xu (2025) further show that firms engage in greenwashing when facing regulatory/shareholder pressure.

2. Identifying Green Products

As far as we are aware, 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 method and provide a detailed description in the Online Appendix Section OA1.

2.1. Background on USPTO trademarks

When a firm plans to launch a new product or service, it will first apply for a trademark with the USPTO to support its marketing (Yorukoglu 2000; Scanlon 2019). As part of the application, the firm must submit an "identification" that clearly and accurately describes the goods or services covered by the mark. This description defines the scope of trademark protection and is reviewed and approved by a USPTO attorney.[3] A single mark application may span multiple Nice Classes, each of which requires a separate goods and services (G&S) identification.[4] Under U.S. trademark law, the "use in commerce" requirement obliges applicants to provide evidence of commercial use of the goods or services covered by a trademark to complete its registration.[5] Thus, the registration of a trademark signals the introduction of new products or services to the market, contributing to a firm's sales and consumer welfare.[6] While trademarks protect the concepts and consumer imagery of covered products, making them unique and distinguishable, they do not exclude others from offering products with similar features. Thus, while we use trademarks to measure new products, we acknowledge that they may or may not contain entirely new technological components for society.

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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 under 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.

2.2. The EUIPO green trademark taxonomy

In 2019, the European Commission launched the European Green Deal, committing to achieving net-zero greenhouse gas emissions by 2050.[7] The Commission acknowledged that both intellectual property and financial resources are essential to achieving this goal. To monitor the introduction of new products and services related to environmental protection and sustainability, the EUIPO (2021) developed a green trademark taxonomy to identify and classify green products.

The EUIPO begins by searching its Harmonized Database (HDB), introduced in 1996, for terms related to environmental protection and sustainability. Once this Harmonized Green Terms inventory is established, the EUIPO employs an algorithm that combines machine learning with expert intervention to generate 375 green expressions for identifying green marks.[8] The full EUIPO green trademark taxonomy is provided in Annex 2 of the same study (EUIPO 2021). To analyze the distribution of green marks across goods and services, the algorithm further classifies the green expressions into 35 categories, organized into nine broader groups.[9]

2.3. Identifying green marks

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 "the atomic definition of a product" in the G&S identification that contains a Nice Class and words or phrases to describe the product (service) (EUIPO 2021, page 12), and will be the basic data unit for our analysis. To illustrate, consider Tesla Inc.'s mark, Registration Number 6251645 with the Mark Word "T," which falls under

[7] See the European Green Deal for details.

[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), "mobile phone" (together, and in that order), "smartphone," or "wireless."

[9] See "Green Category" under Variable Definitions in the Appendix for details about the nine green groups and 35 categories.

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 separates the text into two distinct terms: 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 375 green expressions. To adapt the EUIPO green expressions to the U.S. context, we modify them using the British-American-English conversion.[10] In the case of Tesla's mark, both terms are classified as green, 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." Notably, the classification of a term as green depends not only on the presence of green phrases but also on the associated Nice Class. In another example, Tesla Inc.'s mark "MODEL Y," which falls under Nice Class 12, has a G&S identification stating, "Electric vehicles." This term matches the green expression Ref. 73 ("+electric +vehicle −cigarette −door −horn −lock −sunroof −alternator −alarm −temperature −theft −antitheft −washers −7 −37", which belongs to the category of "general transport") as it contains "electric" and "vehicle" but not other terms and it is not in Nice Class 7 or 13. It thus contains a green term in the "general transport" category. A mark is considered a green mark if its G&S identification contains at least one green term.[11]

At the firm-year level, we measure a firm's green product *capacity* by counting the number of green terms in its newly registered green marks. As illustrated in the two examples above, a single mark may contain multiple green terms across different categories. We leverage

[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.
[11] See Online Appendix Section OA1 for more details and other examples.

this information to capture the breadth of its green innovation. Specifically, we measure a firm's green product *scope* by counting the number of unique categories associated with the green terms in its newly registered green marks. It is worth noting that these two measures are not affected by mergers and acquisitions (M&As) or subsequent trademark transfers because they are recorded at the time of a mark's registration.

2.4. Key advantages of our approach to measuring green products

Green products and services can also be identified using alternative methods, such as keyword searches of company disclosures (e.g., advertisements, websites, financial reports, or earnings calls). However, our green mark dataset offers several advantages over alternative approaches. First, as discussed earlier, green marks, like all trademarks, are granted only when firms provide evidence of actual commercialization. Second, a trademark's registration is subject to cancellation if its G&S identification is found to be misleading.[12] Third, we identify green marks based on their G&S identifications, which are directly tied to the scope of legal protection and are examined and approved by a USPTO attorney. Together, these features help mitigate concerns that green marks are simply a form of corporate self-promotion or greenwashing.

Regarding concerns about greenwashing, an important feature of trademarks is the use of "mark words," which convey direct messages or imagery to consumers. For example, "Model X," "Model Y," and "CYBERTRUCK" are mark words. Notably, such terms do not include explicit "green words" (e.g., "green," "eco," or "environment"). In fact, the World Intellectual Property Office (WIPO) cautions that trademark applications containing certain environmental claims, such as labelling a product "green," "sustainable," or "eco-friendly," are more likely to be rejected, because these terms may be overly vague or potentially misleading.[13] All else equal,

[12] See § 1203 and § 1209 in Trademark Manual of Examining Procedure, November 2024.
[13] 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 friendly key cards, CARBON NEGATIVE FIBER for natural fibers used in composite materials for manufacturing, and ZERO WASTE TEE for clothing.

marketing strategies that incorporate these types of "green words" are more likely to face scrutiny. Importantly, the green marks in our sample, identified using the EUIPO taxonomy, generally lack such language and are therefore less likely to mislead consumers or to serve as instruments of greenwashing. This is supported by the fact that only 5.3% of our green marks contain any such green words in the mark text.[14]

Finally, firms *cannot* retroactively modify the identification of a registered mark to reclassify it as green, as identifications cannot be amended to broaden their scope once the mark is registered.[15] Nor can firms simply acquire green marks to signal environmental commitment without also acquiring the physical assets and know-how required to produce the associated green products.[16] Additionally, our green marks are based on USPTO trademark registrations, which are governed by federal legal standards and protections, independent of state-level environmental regulations.

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

3.1. Sample formation

Our sample period starts in 1981 because we require a mark's Nice Class(es) to identify green marks, which became more complete since 1981. We download the *case file* for all registered trademarks from the USPTO,[17] including a mark's identification, mark words, application date, registration date, Nice Class(es), owner name, and owner address. To match

[14] Our list of common green words includes "green," "sustainable," "environmentally-friendly," "recycl," "orga," "eco," "eco-friendly," "zero impact," "ESG," and "carbon-neutral."
[15] Trademark Rule 2.71(a), 37 C.F.R. § 2.71(a) restricts amendments to the identification of goods or services as follows, "The applicant may amend the application to clarify or limit, but not to broaden, the identification of goods and/or services . . . ." (see the Trademark Manual of Examining Procedure November 2024).
[16] Section 10 of the Lanham Act (15 U.S.C. § 1060(a)(1)) states, "A registered mark or a mark for which an application to register has been filed shall be assignable with the good will of the business in which the mark is used, or with that part of the good will of the business connected with the use of and symbolized by the mark."
[17] Here is the link for the dataset.

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.[18] 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 period 1981-2020) comprises 109,129 firm-year observations associated with 7,865 unique firms and 9,547 green marks (16,389 green terms).[19]

3.2. Trends and composition of green products

Figure 1 Panels A and B document the temporal trends in trademarking from 1981 to 2020. While the total number of green marks (light green bars) peaked in 2011, consistent with the broader decrease in the number of public firms during that decade, the number of green terms (dark green bars) continues to rise steadily. *Green terms* are used to identify distinct product lines within a green mark. For instance, Tesla Inc.'s mark "T" covers two separate product lines. Since a single green mark can encompass multiple terms, the growth in green product lines, as measured by green terms, outpaces the rise in green patents documented by Cohen, Gurun, and Nguyen (2024). This divergence underscores the importance of using green terms as our primary unit of measure. Furthermore, the share of green terms relative to all new trademarks shown in Panel B has accelerated significantly following the 2009 Copenhagen Accord (COP 15), suggesting an intensified effort by U.S. firms to combat climate change.

Figure 1 Panel C and Table OA2 Panel A in the Online Appendix show that the manufacturing and energy sectors account for a substantial share of green product development.

[18] 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 improved 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).
[19] These firms are associated with 298,806 mark registrations over the sample period.

Moreover, both sectors have been industry leaders in green marking activity long before the term ESG was coined in 2004 (United Nations 2004). We note that the services sector is also a major producer of green marks, suggesting that green products and services span a broad landscape of the green economy beyond what is captured by green patents alone. At the firm level, Table OA2 Panel B ranks the top 50 green-marking firms, with NextEra Energy Inc. leading the sample.[20] General Electric Co. is the only firm to appear in the top five for both green patents (Cohen, Gurun, and Nguyen 2024) and green marks.

The frequency distribution of green products across the nine groups (35 categories) defined by the EUIPO taxonomy is shown in Figure 1 Panel D (Table OA3 of the Online Appendix). Activity is most heavily concentrated in "energy production" (23.5%), "energy conservation" (19.2%), and "pollution control" (14.9%). Word usage within these groups has evolved over time, as illustrated by the word clouds in Figure OA1 in the Online Appendix. As shown in Figure 1 Panel D, nearly all green mark groups have experienced a substantial increase in activity since 2000.

3.3. Regression sample overview

Table 1 presents the summary statistics for the firm-year sample used in the main analysis in the following sections. Panel A focuses on the trademarking firm 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 logarithm of *#Green Term*

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

plus one to measure a firm's green product capacity, denoted *Green Term*. The average number of unique categories with green terms in registered trademarks per firm-year (*Green Category*) is 0.06, which measures a firm's green product scope and is bounded between 0 and 35.[21] The sample firms, on average, register 2.74 marks and 0.08 green marks (which contain 0.13 green terms and span 0.06 green categories) per year. Among the trademarking sample, only a fifth of firms have produced at least one green patent over the sample period.[22] The sample firms, on average, register 12.90 patents and 0.51 green patents per year.

The left and middle sections of Panel B present the summary statistics for the non-green-marking and green-marking samples, respectively.[23] Specifically, green-marking firms average 5.68 marks (versus 1.42) and 32.64 patents (versus 4.05). They also exhibit a substantially higher share of green revenues, averaging 8.33% compared with 1.63% for firms without green products.

The right section of Panel B presents the subsample of firm-year observations in which a firm registers at least one green mark in a year. We show that, on average, these firms record 3.23 green terms in 1.43 unique categories. These firms, on average, register 12.76 marks, of which 1.88 are green marks. Consistent with their trademarking output, these firms are also highly productive in patenting, with an average of 80.6 patents, including 5.21 green patents.

[21] We find a Pearson correlation coefficient of 0.92 between *Green Term* and *Green Category*, suggesting that more green terms are also associated with broader green categories. Due to this strong correlation, we examine the roles of *Green Term* and *Green Category* separately in our regression analyses to mitigate concerns about multicollinearity.

[22] 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 covers technologies for four major environmental policy objectives: human health impacts of environmental pollution, addressing water scarcity, ecosystem health, and climate change migration.

[23] Table OA4 in the Online Appendix provides the corresponding two-sample mean tests, which reveal that green-marking firms are significantly more active in both innovation (i.e., patenting) and commercialization (i.e., trademarking) than their non-green-marking counterparts.

4. Green Products and Environmental Performance

Having presented the landscape and distribution of green marking activity, we now investigate whether firms' green product development is reflected in tangible real-world outcomes. Specifically, we examine how our measures relate to firms' commercialized green innovation and indicators of environmental performance. Anecdotal evidence offers some support, with initiatives such as General Electric's Ecomagination, SunPower's Light on Land, and Dominion Energy's Green Fleet, which focus on reducing GHG emissions through clean technology, sustainable land use, and electric vehicles, respectively (see Section OA1.5 in the Online Appendix for details). However, large-sample evidence is lacking. In this section, we employ a range of outcome variables to assess the economic and environmental relevance of our green product measures before exploring their implications for firm value.

As an initial validation of our measures, Panel C of Table 1 compares the renewal rates of green marks with those of non-green marks to assess whether green marks represent substantive commercial commitments or merely symbolic "cheap talk." Following Graham et al. (2013), we identify inactive trademarks and their expiration dates using USPTO status codes.[24] The table shows that green marks have a significantly higher probability of renewal at the 6th, 10th, and 20th-year intervals than non-green marks. These higher survival rates imply that firms use green marks to protect commercially valuable products rather than purely for strategic or symbolic branding. The fact that green marks are more likely to be maintained over longer horizons strongly supports the view that our measures capture economically significant activities in the marketplace.

[24] We identify "expired" trademarks in the USPTO Trademark Case Files Dataset. Specifically, cfh status code 900 indicates expiration for failure to file a timely renewal, while codes 710–714 indicate cancellation for failure to satisfy maintenance requirements. We also identify additional "expired/cancelled" trademarks using status-code definitions in the USPTO Trademark Application Documentation (TAD), specifically codes within the ranges 400-407, 411-417, 600-618, 626, 632, 709, 781-782, and 901. Expiration dates are assigned based on the last recorded cfh status date or the registration cancellation date, yielding registration-to-expiration lags comparable to Graham et al. (2013).

4.1. Green products and green revenues

If green marks we identify reflect genuine efforts to develop environmentally friendly products and services, they should be associated with higher revenues from these offerings. We examine whether our green mark measures are associated with firm-level green revenues from the FTSE Russell Green Revenues Classification System (GRCS). The GRCS assesses the impact of corporate economic activities within the framework of the EU Taxonomy on Sustainable Finance, covering broader environmental issues, such as climate change mitigation and adaptation, water and resource use, and pollution.[25] The GRCS Green Revenues 2.0 model, launched in 2020, provides point estimates of green revenues from 2016 onward.

We examine the relation between a firm's green marks and its future green revenues by running the following ordinary least squares (OLS) regression:

$$Green\ Revenues_{i,t+2} = \alpha + \beta_1 Green\ Product_{i,t} + Controls_{i,t} + Firm\ FE + Industry \times Year\ FE + \varepsilon_{i,t+2}\ , \quad (1)$$

where the dependent variable, $Green\ Revenues_{i,t+2}$, denotes a firm *i*'s share of green revenues relative to its total revenues in the next two years from year *t*. The variable of interest, $Green\ Product_{i,t}$, denotes the number of green terms (*Green Term*) and the number of unique green categories (*Green Category*) associated with green terms in green marks filed by firm *i* in year *t*. We control for the number of non-green marks, the number of green patents, firm size, firm age, return on assets, capital expenditure, R&D expenditure, cash holdings, and leverage. Moreover, we include firm fixed effects to capture time-invariant firm characteristics (such as corporate culture and managerial preferences) as well as SIC3-by-year fixed effects to capture time-varying industry-specific factors (such as federal environmental regulations, industry peer pressure, and market opportunities). Standard errors are clustered at the firm level.

[25] The EU Taxonomy was created to prevent greenwashing by identifying sustainable economic activities and assets for financial market participants. See https://ec.europa.eu/sustainable-finance-taxonomy/. This dataset has been used by Klausmann, Krüger, and Matos (2024) and Lel (2025).

Table 2 Panel A columns (1) and (2) show that both our measures of green product capacity (*Green Term*) and scope (*Green Category*) are positively and significantly associated with green revenues. The associations are economically meaningful: a one-standard-deviation increase in *Green Term* and *Green Category* corresponds to a 12.3% and 9.7% increase in the share of green revenues, respectively, relative to the sample mean.[26] In addition, we find insignificant coefficients on firms' non-green marks, confirming that our measures of green products are indeed related to firms' revenues from environmentally friendly products, rather than merely reflecting firms' marketing strategies. On the other hand, the significantly positive coefficients on firms' green patents suggest the important role of green technologies in firms' pursuit of corresponding markets.[27]

4.2. Green products and greenhouse gas emissions

We next evaluate whether green product development is associated with improvements in firms' environmental performance, measured by emissions. Our emissions data, sourced from Trucost, covers the period from 2002 to 2020. Trucost collects firm-level carbon and other greenhouse gas emissions across different scopes. For our purposes, we focus on total and Scope 1 emissions scaled by sales.

We examine the relation between a firm's green marks and its future GHG emissions by running the following OLS regression:

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

[26] For the green revenues sample, the standard deviations of *Green Term* and *Green Category* are 0.32 and 0.42, respectively, with the average green revenues being 4.24%.

[27] We address the concern that the data provider estimated some of the green revenue values by including an indicator variable to flag those cases in the regressions. Following the GRCS manual, we flag an observation as an estimate if *estimationtypecode* is coded as "Company Specific" or "Sector Specific." Table OA5 in the Online Appendix shows that our main findings remain.

where the dependent variable, $GHG\ emissions_{i,t+2}$, denotes Trucost's total emissions and Scope 1 emissions in the next two years, because it takes time for green innovation to be adopted. All firm-year control variables are the same as in Equation (1).

Table 2 Panel A columns (3) to (6) show that both green product capacity (*Green Term*) and scope (*Green Category)* are negatively and significantly associated with two measures of firms' future environmental performance. These negative associations are also economically meaningful: a one-standard-deviation increase in *Green Term* (*Green Category*) is associated with reductions in total emissions and Scope 1 emissions of 8.7% and 11.7% (9.5% and 12.8%), respectively, relative to the sample mean.[28] In addition, we find insignificant coefficients on non-green marks. These findings suggest that green marks are associated with tangible environmental outcomes, indicating that these marks reflect genuine efforts in line with trademark laws rather than merely being a form of strategic greenwashing.[29]

4.3. Green products and environmental ratings

We also examine the association between firms' green marking activity and their environmental performance, as measured by third-party ESG rating agencies (MSCI, Sustainalytics, and Refinitiv).[30] We match the rating data to our green mark dataset by the mark's

[28] 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 statistically insignificant.

[29] For robustness checks, we include an indicator variable to flag estimated observations in the regressions. We flag an observation as an estimate if the description contains any of the following terms: "approximate," "derive," or "estimate." Table OA5 in the Online Appendix shows that our main findings remain.

[30] 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 to 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. The third is the innovation score from Refinitiv, available from 2002 to 2020.

application year to more accurately capture the timing of green product development. Table 2 Panel B presents the results. We find that both green product capacity (*Green Term*) and scope (*Green Category*) are positively and significantly associated with all three measures of a firm's environmental performance. These associations are also economically meaningful: a one-standard-deviation increase in *Green Term* (*Green Category*) is associated with increases in MSCI, Sustainalytics, and Refinitiv innovation scores of 14.4%, 0.5%, and 3.2% (13.2%, 0.5%, and 2.6%), respectively, relative to the sample mean. By comparison, when a firm's *Green Patent* increases by one standard deviation, *MSCI E-score*, *Sustainalytics E-score*, and *Refinitiv Innovation Score* increase by 72.9%, 2.5%, and 7.4%, respectively. The coefficients on non-green marks are statistically insignificant. The findings suggest that a firm's green products are recognized and incorporated into its environmental score produced by ESG rating agencies. Moreover, firms with more green patents also receive better environmental ratings.

Taken together, the results in this section suggest that our green mark measures are significantly associated with both operational and environmental outcomes at the firm level. Firms with more intensive green marking activity tend to have higher green revenues, lower future greenhouse gas emissions, and better environmental ratings. These results support the view that green marks capture meaningful aspects of firms' commercialization of green inventions.

5. Green Products and Firm Value

Motivated by the prior literature, we hypothesize that green products may be value-relevant through two channels: investor responses and consumer demand. One strand of the literature emphasizes investor responses, arguing that investors either possess environmental preferences or are concerned about regulatory and climate-related risks. When investors have environmental preferences, stemming from personal beliefs or social image considerations, they may be willing to accept lower expected returns to hold the stocks of firms with superior or improving ESG performance (e.g., Dimson, Karakas, and Li 2015; Morgan and Tumlinson 2019;

Barber, Morse, and Yasuda 2021; Hwang, Titman, and Wang 2022; Oehmke and Opp 2025). Alternatively, when investors are concerned about regulatory penalties or climate risk exposure, improvements in environmental performance may reduce perceived risk and lead to lower discount rates applied to firms' future cash flows (e.g., Chava 2014; Krüger, Sautner, and Starks 2020; Bolton and Kacperczyk 2021, 2023; Ilhan, Sautner, and Vilkov 2021; Hsu, Li, and Tsou 2023; Sautner, Van Lent, Vilkov, and Zhang 2023).

Another strand of the literature emphasizes consumer preferences, suggesting that firms engage in socially responsible behavior in anticipation of financial benefits, such as higher profits from launching green products that align with consumers' environmental concerns (see, for example, Luo and Bhattacharya 2006; Albuquerque, Koskinen, and Zhang 2019; Meier et al. 2024; Chen, Garlappi, and Lazrak 2025). Guided by this prior literature, we examine whether and how firms' green marks are associated with higher firm value.

5.1. The baseline

We examine the relation between a firm's green marks and its value using the following OLS regression:

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

where the dependent variable, $Valuation\ Ratio_{i,t+2}$, denotes average *Total Q* and *Tobin's Q* over the next two years, because it takes time for green products to improve business operations and to be reflected in market valuation. *Total Q* is the market value of assets divided by the sum of tangible and intangible assets (Peters and Taylor 2017). Since green products are the result of intangible investments, *Total Q* offers a complementary perspective on firm value alongside *Tobin's Q*. All other variables are defined as in Equation (1).

Table 3 reports the main results. Both measures of green product activity—capacity (*Green Term*) and scope (*Green Category*)—are positively and significantly associated with firm

value. This association is also economically significant: when a firm produces one additional green term, its *Total Q* and *Tobin's Q* will increase by 2.8% and 14.3%, respectively.[31] We also find that non-green marks are positively and significantly associated with firm value, consistent with evidence that new product introductions attract market attention and facilitate customer acquisition (Hsu et al. 2022). We note that fully disentangling the effects of green and non-green marks is challenging because of potential complementarities between them; we examine this issue further in Section 6.3.

Table OA6 Panel B in the Online Appendix replicates the analysis in Table 3 using a sample of firms without green patents. The positive and statistically significant association between green marks and firm value persists in this subsample. Notably, the coefficients on *Green Term* and *Green Category* are comparable in magnitude to those in Table 3 using the baseline sample, suggesting that the value relevance of green products is not driven by firms' patenting decisions or ability to patent green innovations.

Table OA7 in the Online Appendix replicates the analysis in Table 3, excluding the two sectors with the highest green marking intensity—manufacturing and energy. The coefficients on *Green Term* and *Green Category* remain statistically significant and are larger in magnitude than those in Table 3, indicating that the valuation effects of green products are not concentrated in these industries.

Although these baseline results establish a robust positive association between green marking activity and firm value, the underlying mechanisms warrant further investigation. In the following sections, we examine two potential channels: short-term investor responses to green

[31] Using Table 3 column (1) as the baseline specification, one unit increase in the number of green terms from 0 to 1 corresponds to an increase in the variable *Green Term* by Ln(1 + 1) – Ln(1 + 0) = 0.693; we then multiply it by the estimated coefficient on *Green Term*, 0.041, we obtain an increase of 2.8% in *Total Q*. Similarly, using Table 3 column (3) for *Tobin's Q*, one unit increase in the number of green terms corresponds to 14.3% increase in *Tobin's Q* (= Ln(1 + 1) × 0.206).

mark registrations (Section 5.2) and a longer-term consumer demand channel reflecting market demand for environmentally friendly products (Section 5.3).

5.2. Investor response channel

As discussed above, one potential channel through which green marks may affect firm value is investors' responses to trademark registration events. If market participants interpret the registration of green marks as favorable news about firms' green innovation or as a signal of reduced regulatory risk, such information could, in principle, be reflected in stock prices around the registration date. Following Krüger (2015), we employ an event-study approach, which helps mitigate concerns about confounding factors.

In the event study, we examine all trademark registration events, including both green and non-green marks, over the sample period. We estimate abnormal returns using three benchmark models: the CAPM, the Fama–French three-factor model, and the Fama–French four-factor model. We also consider daily excess returns, defined as stock returns net of the risk-free rate. We compute cumulative abnormal returns (CARs) over multiple event windows, ranging from a narrow three-day window [0, 2], consistent with Kogan et al. (2017), to broader windows such as [−3, 3] and [−10, 10].

We estimate the following OLS regression for the investor response channel:

$$CAR_j = \alpha + \beta_1 Green\ Product_j + Controls_{i,t} + Firm\ FE + Industry \times Year\ FE + \varepsilon_i, \quad (4)$$

where CAR_j denotes our CAR measures based on the registration date of trademark *j*, registered by firm *i* in year *t*. As in the regression specifications above, $Green\ Product_j$ denotes our two measures at the trademark level: *Green Term* and *Green Category*. We include firm fixed effects, SIC three-digit-by-year fixed effects, and the same firm-level controls as in Table 2. The results, reported in Table 4, provide little evidence of short-term investor responses to green mark registrations. When we include all mark registrations in Panel A, the estimated coefficients on

Green Term and *Green Category* are small and statistically insignificant across all specifications. Focusing on consumer-facing (B2C) industries (which include services, retail trade, and transportation and public utilities) in Panel B yields similarly insignificant results. Overall, these findings suggest that investors do not immediately react to news about firms' green product introductions.

The absence of short-term investor responses is consistent with several interpretations. First, investors with environmental preferences may constitute a relatively small segment of market participants, limiting their impact on prices. Second, investors may underreact to information about green products because innovation-related information is complex and may be subject to limited attention and skepticism (Chan, Lakonishok, and Sougiannis 2001; Hsu et al. 2022). Importantly, our analysis focuses on immediate market reactions. As the commercial potential of green products becomes clearer over time, firm valuations may adjust accordingly, consistent with the longer-term valuation effects documented in Table 3 and the differential effects between greenfield and follow-on green products examined in Section 6.2.

5.3. Consumer demand channel

A growing literature documents consumers' ESG preferences (Luo and Bhattacharya 2006; Albuquerque, Koskinen, and Zhang 2019; Chen, Garlappi, and Lazrak 2025). Using barcode-level retail sales data, Meier et al. (2024) provide direct evidence of ESG-related consumer demand: products sold by firms with stronger environmental and social ratings exhibit higher local sales, and demand responds more strongly when ESG considerations become more salient (e.g., through increased advertising intensity or negative ESG-related news coverage). In our setting, green marks facilitate consumers' identification of and learning about firms' green products and services. When consumers exhibit ESG preferences, green marks are therefore expected to translate into high sales and, over time, increased firm profitability.

To examine the consumer demand channel, we split the sample into B2C and other industries and estimate Equation (3) separately for each subsample. Table 5 presents the results. Panel A shows that firm value (*Total Q* and *Tobin's Q*) increases more strongly following green mark launches among firms in B2C industries. This pattern is consistent with the consumer demand channel, as consumers are more likely to observe and respond to the commercialization of green products and services in settings where purchase decisions are more subject to consumer preferences.

Panel B of Table 5 examines the relation between green mark launches and subsequent operating performance among B2C firms. We use sales growth, return on equity (ROE), and profit margin measured over the subsequent two years ($t + 1$ to $t + 2$) and three to five years ($t + 3$ to $t + 5$) as the dependent variables in Equation (3). Following green product launches, we observe increases in sales growth, while improvements in ROE and profit margins emerge only with a lag and become statistically significant after the initial two-year period. This timing is consistent with substantial upfront costs associated with commercializing green inventions, including compliance, product design, sourcing, logistics, and marketing expenditures, which may initially offset revenue gains. Over time, as products become established, firms appear to benefit from scale economies and learning curve effects that lower unit costs and improve profitability. As these benefits materialize, firm valuations adjust accordingly.

We further examine whether the valuation effects of green products vary with consumers' environmental concerns. If consumer preferences are an important driver of firm value, we expect the association between green products and firm value to be stronger in periods when (regions where) environmental issues receive greater public attention.

We use the WSJ Climate Change News Index developed by Engle et al. (2020)[32] as a time-varying proxy for public and consumer attention to environmental issues. Table 6 Panel A

[32] 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

examines how public environmental awareness moderates the relation between firms' green marks and market valuation. We partition the sample into two subsamples based on whether the average annual WSJ index value exceeds the top tercile over the 1984-2017 period, when the index is available. The "High Environmental Awareness" subsample comprises years with the index values above this threshold, while the "Low Environmental Awareness" subsample includes all remaining years. We show that the positive association between green marks and firm value is significantly stronger during periods of elevated public environmental awareness. Both green product capacity (*Green Term*) and green product scope (*Green Category*) are positively and significantly associated with *Total Q* and *Tobin's Q* in high-awareness periods. In contrast, these relations are weaker and statistically insignificant in periods of lower public attention, suggesting that the value relevance of green products is concentrated in times of heightened environmental concern.

Next, we examine whether the valuation effects of green products vary with the environmental preferences of a firm's consumer base across regions. If local environmental preferences drive valuation premiums, the association between green marks and firm value should be stronger for firms operating in areas with greater environmental consciousness. As a proxy for local environmental preferences, we use firms' exposure to Democratic-leaning ("blue") states, which are commonly associated with stronger pro-environmental attitudes.[33]

To construct this measure, we use data from Klarner (2013) for the period 1995-2010 and from the National Conference of State Legislatures (NCSL) for the period 2011-2020 to identify states with unified Democratic control.[34] We then follow Garcia and Norli (2012) and Bernile,

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climate documents. The index is the degree of textual similarity between WSJ articles and this vocabulary using a cosine similarity metric.

[33] A December 2024 Pew Research Center survey found that 83% of Democratic-leaning independents prioritized environmental protection, compared to 52% of Republican-leaning respondents. (Pew Research Center, December 9, 2024, https://pewrsr.ch/3D7bWMN). Prior research also indicates that political identity is linked to broader social and environmental preferences, influencing both consumer and investor behavior (Di Giuli and Kostovetsky 2014).

[34] https://www.ncsl.org/about-state-legislatures/state-partisan-composition.

Kumar, and Sulaeman (2015) to measure firms' operational presence across states using information from annual reports. Combining these data yields a firm-year measure of "Blue State Exposure." We classify a firm as having *High Presence in Blue States* if its "Blue State Exposure" is positive, indicating that a majority of its operations are located in Democratic-controlled states.

Table 6 Panel B presents the regression results. In columns (3) and (4), we show that green marks are positively and significantly associated with firm value, measured by *Tobin's Q*, among firms with high presence in Democratic-leaning states: the interaction terms *Green Term* × *High Presence in Blue States* and *Green Category* × *High Presence in Blue States* are both positive and statistically significant. In contrast, the corresponding interaction terms for firms with low presence in blue states are small and statistically insignificant.

Taken together, these findings indicate that the valuation effects of green products vary systematically with consumers' environmental concerns, both over time and across regions. This pattern underscores the role of consumer demand in shaping the economic value of green products and is less consistent with an interpretation based solely on strategic branding, which would not predict stronger valuation effects when and where sustainability concerns are more salient.

6. Heterogeneity in Green Products

In this section, we exploit the rich textual information in trademark registration forms to examine three dimensions of firms' green product development and their implications for consumer demand and firm value. First, we assess the centrality of green products by determining whether they fall within firms' core business areas or peripheral domains and examining its value implications. Second, we analyze how the timing and sequence of green product introductions affect value creation. Finally, we examine whether complementarities between green and non-

green products within the same product or service categories contribute to cross-sectional differences in firm value.

6.1. Core-business green products

We first examine whether green products are related to firms' core business and assess their value implications. We classify a firm's core business as the top three Nice Classes in which it has registered the largest number of products or services over the preceding five years. *Core-Business Green Term* denotes green terms within these three Nice Classes, whereas *Non-Core-Business Green Term* denotes green terms outside them. The summary statistics are provided in Table OA8 in the Online Appendix.

In Table 7 Panel A, we replicate the analysis in Table 3 by decomposing the aggregate *Green Term* measure into these two components. We find that the positive association between green marks and firm value is driven primarily by green marks associated with firms' core business areas. This result suggests that the value-relevance of green products arises from their prominence among firms' main customers and in their main markets.

6.2. Follow-on green products

Next, we examine whether greenfield green products, representing a firm's initial entry into green product development, have different value implications than follow-on green products. We classify a firm's green marks as greenfield if a green term is registered for the first time in the preceding five years. *Greenfield Green Term* thus refers to green terms for firms without any green mark registrations during the prior five years, whereas *Follow-on Green Term* refers to green terms for firms with at least one green mark registration over that period.

Table 7 Panel B reports the relation between green marks and firm value under this decomposition. We find that only follow-on green marks are significantly associated with higher firm value. This pattern is consistent with greater risk and uncertainty surrounding greenfield entries, whereas follow-on green marks likely reflect successful prior green innovation and the

accumulation of firm-specific capabilities and market presence, making them more likely to generate value (Hoberg and Phillips 2024). Moreover, the concentration of value relevance in follow-on green marks is consistent with the absence of immediate investor responses to green mark registrations, as investors may require time to assess and validate the potential of newly introduced green products.

6.3. Cross-selling green and non-green products

Finally, we examine whether complementarities between green and non-green products within the same goods or service classes contribute to firm value. Recall that a mark is classified as green if it contains at least one green term, and that a mark may include both green and non-green terms spanning multiple Nice Classes.[35] By analyzing how green and non-green terms are distributed across Nice Classes, we gain insight into a firm's green innovation strategies, specifically, whether introducing green products alongside non-green products within the same product category (Nice Class) enhances firm value.

Motivated by variation in the composition of green and non-green terms across a mark's goods (service) classes, we decompose *Green Term* into two components. *Common-Class Green Term* captures green terms that fall within the same Nice Class(es) as a mark's non-green terms, whereas *Unique-Class Green Term* captures green terms that fall into Nice Class(es) different from those of the mark's non-green terms.

Table 7 Panel C replicates the analysis in Table 3 using these two components. We show that the positive association between green marks and firm value is driven primarily by green marks introduced within the same Nice Class(es) as non-green products. This result suggests that

[35] To motivate our measures, we provide some examples in Section OA1.4 in the Online Appendix. In The J.M. Smucker Company's green mark "SMUCKER'S," the green term ("Reusable plastic water bottles sold empty") falls under the same Nice Class 21 as six of its non-green terms ("Decorative plates; Ice cream scoops; Lunch bags not of paper; Lunch boxes; Mugs; Recipe boxes"). This is an example of a common-class green term. By contrast, in Waste Management Inc.'s green mark "WM," the green term "Recycling" is the only term listed under Nice Class 40, making it a unique-class green term.

green products are most value-enhancing when they are integrated into existing product categories, potentially reflecting greater opportunities to apply green innovations across a firm's established product portfolio.

Taken together, our findings indicate that green products generate significantly more value when they are closely tied to firms' core product lines, introduced as follow-on rather than greenfield initiatives, and integrated with non-green offerings within the same product categories. More broadly, this evidence sheds new light on the sources of value created by the commercialization of green innovation.

7. Why Do Firms Develop Green Products?

In this section, we examine several factors that may motivate firms to develop green products. These include managers' heightened awareness of climate risks, shaped by exposure to natural disasters, as well as increased regulatory scrutiny and public attention following environmental scandals involving industry peers.

7.1. Natural disasters and green product development

Natural disasters have become an increasingly salient global concern. Prior research shows that such events disrupt business operations (Barrot and Sauvagnat 2016), reduce credit supply (Cortés and Strahan 2017), and affect managerial behavior (Bernile, Bhagwat, and Rau 2017; Dessaint and Matray 2017). Climate-related disasters, including floods, hurricanes, tornadoes, and wildfires, can also serve as salient signals of climate risks, heightening awareness of the need for sustainable solutions. We therefore expect that firms whose management teams are (indirectly) exposed to these events are more likely to expand green product development.

To test this conjecture, we use data from the Spatial Hazard and Loss Database for the United States (SHELDUS), maintained by Arizona State University, which records hazardous events at the county level. We classify a county as "disaster-affected" if annual property and crop

damage exceeds $1 million (in 2021 dollars). To avoid capturing the direct operational impact of disasters, we exclude firms headquartered in disaster-affected counties.

Our analysis focuses on firms headquartered in counties adjacent to disaster-affected counties. Although these firms are not directly affected, meaning they do not incur significant physical damage, their proximity likely increases the salience of such events through local media coverage and heightened public attention. Because top management teams are typically concentrated near headquarters, whereas customers and suppliers are more geographically dispersed, increases in green product development following nearby disasters are more likely to reflect shifts in managerial awareness rather than direct market or operational shocks. This design helps isolate the awareness channel from the direct economic effects of natural disasters on firm strategies.

To quantify the impact of this exposure, we estimate the following Poisson regression model:

$$E[Green\ Product_{i,t+n}|\mathcal{X}] = \exp\ (\alpha + \beta_1 Adjacent\ to\ Natural\ Disaster_{i,t} + Controls_{i,t} + Firm\ FE + Industry \times Year\ FE), \quad (5)$$

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.[36] 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.[37] Our analysis focuses on the post-2000 period, when both green innovation and the

[36] The lag between R&D input and the commercialization of innovation output varies significantly across industries. A cross-industry study by Pakes and Schankerman (1984) estimates this lag to range from 1.2 to 2.6 years. Similarly, Suzuki (2011), analyzing a y of 2,357 Japanese inventors, finds that the mode and median lags are 24 and 33 months, respectively. Additionally, de Rassenfosse and Jaffe (2018) report a median lag of one year between R&D and patenting. These statistics support our choice of a one- to two-year lag in the empirical specification.

[37] In untabulated analyses, we also use alternative thresholds to define natural disasters, such as the one from Barrot and Sauvagnat (2016) and $500 thousand threshold. In all cases, our main findings remain. For

incidence of major natural disasters became more pronounced. Firm fixed effects and SIC3-by-year fixed effects control for time-invariant firm characteristics and time-varying industry-wide shocks, respectively. Our SIC3-by-year fixed effects help address concerns that firms' responses may be driven by peers' exposure to natural disasters or by contemporaneous competitive pressures. Standard errors are clustered at the firm level.

Table 8 Panel A presents the results from the Poisson regression model in Equation (5). We find that firms headquartered in counties adjacent to disaster zones significantly increase green marking activity in the years following the event. In column (1), the coefficient on *Adjacent to Natural Disaster* is 0.521 and significant at the 1% level, indicating an average increase of 0.84 new green terms ((exp(0.521) − 1) × 1.227) relative to a sample mean of 1.227. In column (3), the coefficient on *Adjacent to Natural Disaster* is 0.350 and significant at the 1% level, suggesting an average increase of 0.20 new green categories ((exp(0.350) − 1) × 0.48) relative to a sample mean of 0.48. Table OA9 Panel A in the Online Appendix shows little evidence of pre-trends in the outcome variables. In Panel B, we re-estimate the model with standard errors clustered at the county level to account for potential spatial correlation in disaster exposure. Overall, these results suggest that heightened managerial awareness of climate risks significantly influences the development of green products within firms.

7.2. Environmental scandals in an industry and green product development

We next examine whether external shocks, specifically environmental scandals within an industry, influence firms' green product development. When a firm experiences an environmental scandal, regulatory scrutiny and public attention toward the industry often intensify, potentially

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.

increasing pressure on peer firms to invest in green products to meet stakeholder expectations and signal environmental responsibility.[38]

To test this conjecture, we construct an industry-level measure of adverse environmental events using data from RepRisk, a global ESG risk intelligence company (Gantchev, Giannetti, and Li 2022; Derrien, Krüger, Landier, and Yao 2023). RepRisk aggregates information from media sources and regulatory and commercial documents, and classifies events into 29 ESG issue categories.[39] We identify severe environmental incidents as those with a severity score of 2 or 3 (medium or high severity) that involve violations of at least one United Nations Global Compact (UNGC) environmental principle.[40] We then aggregate these incidents to the SIC3-year level. To mitigate endogeneity concerns, we exclude firms that are themselves subjects of these incidents, as both their green product responses and the occurrence of these incident(s) may be driven by firm-specific factors.

We examine the impact of peer firms' environmental scandals on a firm's green marking activity by estimating the following Poisson regression:

$$E[Green\ Product_{i,t+n}|\mathcal{X}] = \exp\left(\alpha + \beta_1 Peer\ Scandal_{j,t} + Controls_{i,t} + Firm\ FE + Year\ FE\right), \quad (6)$$

where the variable of interest, $Peer\ Scandal_{j,t}$, is an indicator variable that takes the value of one if firm *i* belongs to SIC3 industry *j* that experienced a severe environmental scandal in year *t*, and

[38] Prior studies show that consumers respond to firms' ESG scandals by reducing their demand (e.g., Meier et al. 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).

[39] See RepRisk Research Scope: ESG Issues for details. We provide 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.

[40] The UN environmental principles include 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 untabulated analysis, we use an alternative definition of severe environmental incidents based on RepRisk's own classification of environment-related issues. Our main findings remain.

zero otherwise.[41] The sample period spans 2007-2020 due to the availability of RepRisk data. We include firm and year fixed effects to absorb time-invariant firm characteristics, including culture and regulatory exposure. We do not include SIC3-by-year fixed effects because the variable of interest, $Peer\ Scandal_{j,t}$, is measured at the industry-year level. Standard errors are clustered at the industry level.

Table 8 Panel B presents the results from the Poisson regression model in Equation (6). Across specifications, we find a positive and statistically significant association between peer environmental scandals and firms' subsequent green marking activity. In column (1), the coefficient on *Peer Scandal* is 0.325 and significant at the 1% level, indicating an average increase of 0.289 new green terms ((exp(0.325) − 1) × 0.753), relative to a sample mean of 0.753. In column (3), the coefficient on *Peer Scandal* is 0.137 and significant at the 5% level, indicating an average increase of 0.045 new green categories ((exp(0.137) − 1) × 0.308), relative to a sample mean of 0.308. Table OA10 in the Online Appendix shows little evidence of pre-trends in the outcome variables.

Taken together, Table 8 provides causal evidence that heightened managerial awareness of environmental risks and increased stakeholder scrutiny following peer environmental scandals significantly influence firms' green product development,[42] consistent with salience and pressure, rather than symbolic branding, playing a central role in firms' commercialization of green innovation.

8. Conclusions

[41] 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.

[42] Our findings indicate that while both natural disasters and industry scandals increase firms' green marks, the impact of natural disasters appears to be more substantial. Specifically, firms adjacent to disaster-affected areas increase their green terms 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.

Applying the green trademark taxonomy recently released by the European Union Intellectual Property Office (EUIPO) (2021) to the USPTO trademark dataset, we construct a novel dataset of environmentally friendly products and services introduced in the U.S. economy over the past four decades. Owing to the "use in commerce" requirement and the legal and regulatory nature of trademarks, our data uniquely capture the commercialization of green innovation. In contrast to datasets that focus on producers of green technologies, our approach captures a broader set of firms and industries by focusing on the users of green technologies.

We first document that green products are most prevalent in the manufacturing, energy, and services sectors. Firms with more green products generate higher green revenues, emit less greenhouse gas, and receive higher environmental ratings. We further show that green product activity is positively associated with firm value. We then examine two potential channels underlying this association: short-term investor responses driven by environmental preferences or concerns, and long-term consumer demand driven by environmental awareness. Our evidence supports the consumer demand channel but provides little support for the investor response channel.

Leveraging the rich textual information in trademark registrations, we further show that green products are more value-enhancing when they fall within firms' core product lines, are introduced as follow-on rather than greenfield initiatives, and are launched alongside non-green products within the same product categories. These patterns identify specific features of green products that drive firm value and provide additional support for the consumer demand channel. Finally, we provide evidence that firms increase green product development following natural disasters in nearby counties and in response to environmental scandals involving industry peers.

Taken together, our findings highlight an important and previously overlooked dimension of firms' engagement with environmental protection and sustainability—green product development. Our results also have a number of policy implications. First, effective enforcement of trademark regulations, particularly those aimed at preventing misleading or deceptive claims

(such as greenwashing), plays a critical role in protecting consumers and the environment. Second, policymakers may benefit from incorporating green marks into sustainability indicators, as these measures capture firms' commercialization of green innovation beyond traditional patent-based metrics or pollution abatement investments. Third, our evidence on the value relevance of commercializing green innovation suggests that policies facilitating the adoption and diffusion of green technologies, such as incentives for licensing or technology transfer, may be particularly effective. Lastly, by documenting the link between green product development and firm value, our findings underscore the potential role of green products in promoting the green transition of polluting firms and in supporting economic growth.

Appendix
Variable definitions

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

Variable	Definition
Trademark Variables	
#Green Term	The total number of green terms associated with 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 total number 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 total number 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 total number of newly registered marks by a firm in a year.
#Non-Green Mark	The total number 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 total number of green terms associated with newly registered green marks by a firm in a year, whereby the green terms' Nice Classes belong to a firm's core business. A firm's core business is identified as the top three Nice Classes with the highest number of products or services registered over the past five years.
Core-Business Green Term	Natural logarithm of #Core-Business Green Term plus one.
#Non-Core-Business Green Term	The total number of green terms associated with newly registered green marks by a firm in a year, whereby the green terms' Nice Classes do not belong to a firm's core business.

Non-Core-Business Green Term	Natural logarithm of #Non-Core-Business Green Term plus one.
#Follow-on Green Term	The total number of green terms associated with newly registered green marks by a firm in a year, whereby the firm has registered some green marks over the past five years.
Follow-on Green Term	Natural logarithm of #Follow-on Green Term plus one.
#Greenfield Green Term	The total number of green terms associated with newly registered green marks by a firm in a year, when 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 total number of green terms associated with newly registered green marks by a firm in a year, whereby within a green mark, these green terms fall into 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 total number of green terms associated with newly registered green marks by a firm in a year, whereby within a green mark, either these green terms are not paired with non-green terms, or they do not fall into 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 total number 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 total number 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.
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)
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)
Green Revenues	Green revenues divided by total revenues in a year, in percentage points. Green revenues refer to the revenues generated from environmentally friendly products and services, as classified under the Green Revenues Classification System (GRCS). Data is from FTSE Russell, available from 2016 to 2020.
GHG Total Emissions	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). 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 (the data quality for Scope 3 emissions is poor). Data is from Trucost, available from 2002 to 2020.
GHG Scope1 Emissions	Direct emissions from operations 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.
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." The Refinitiv database has three environmental component scores: innovation score, resource use score, and emission reduction score. The innovation is directly linked to green products. The data is available from 2002 to 2020.
Sales Growth	Sales growth (Compustat: (sale – lagged sale)/(lagged sale)).
ROE	Income divided by book equity (Compustat: ib/(at-lt+txditc-ps)).
Profit Margin	Net income divided by sales (Compustat: ebit/sale).
WSJ Climate Change News Index	Monthly index of media discourse on climate issues, developed by Engle et al. (2020), available from 1984.1 to 2017.6.

High Presence in Blue States	An indicator variable that takes the value of one if a firm's aggregate exposure to state-level Democratic control is positive in a year, and zero otherwise. Exposure is computed by weighting each state's partisan score (1 for Democratic control, -1 for Republican control, 0 otherwise; from Klarner (2013) over the period 1995-2010 and the NCSL over the period 2011-2020) by a firm's operational presence in different states, measured using state name counts from annual reports following Garcia and Norli (2012) and Bernile, Kumar, and Sulaeman (2015).
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 annual property and crop damage exceeding $1 million (in 2021 dollars) in a year, and zero otherwise. Natural disaster data is from SHELDUS, available from 2000 to 2020.
Peer Scandal	An indicator variable that takes the value of one if a firm's SIC3 industry peers have severe environmental incidents in a year, and zero otherwise. Severe environmental incidents refer to those with a severity score of 2 or 3 (medium or high severity) and a violation of at least one of the following three UNGC environmental 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, available from 2007 to 2020.

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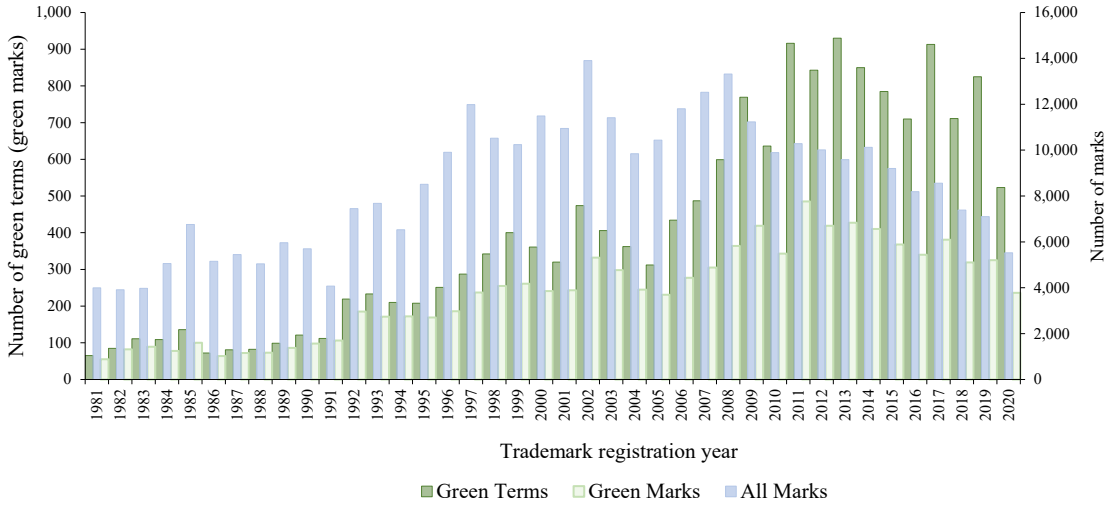
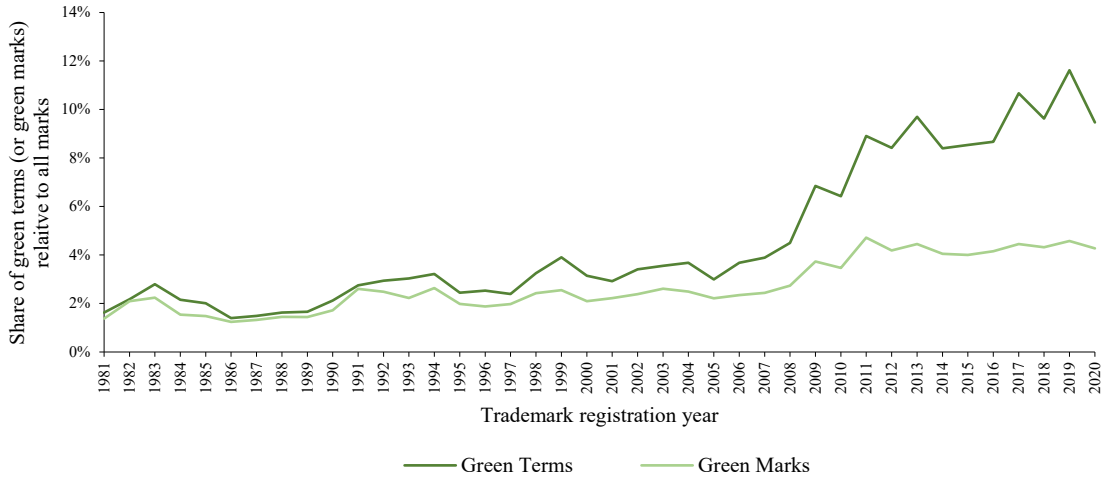
Figure 1
Green products over time by industry and green group

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.

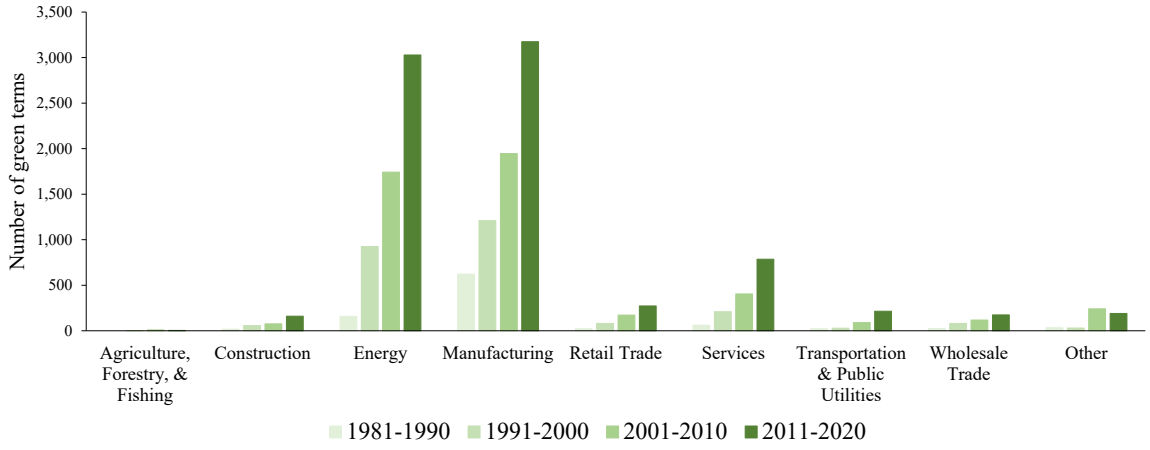
Panel A: Green terms, green marks, and marks registered by U.S. public firms over time



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

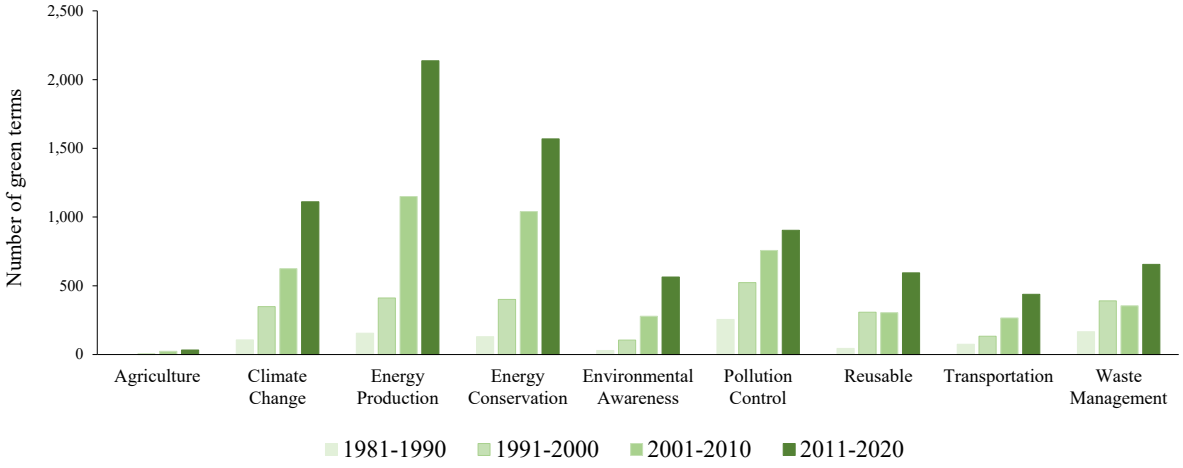


Table 1
Summary statistics

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, comprising 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; 33,774 firm-year observations associated with 1,506 unique firms) and for a subset of that sample with at least one current year green mark registration (4,503 firm-year observations). Variable definitions are provided in the Appendix.

Panel A: The trademarking sample

	Mean	P50	Std. Dev.
Green Marking Firm	0.309	0	0.462
#Green Term	0.133	0	1.502
Green Term	0.047	0	0.26
Green Category	0.059	0	0.344
#All Mark	2.738	0	9.56
All Mark	0.672	0	0.916
#Green Mark	0.077	0	0.558
Green Mark	0.039	0	0.205
#Non-Green Mark	2.661	0	9.451
Non-Green Mark	0.656	0	0.909
Green Patenting Firm	0.203	0	0.402
#Patent	12.895	0	116.129
#Green Patent	0.508	0	8.685
Green Patent	0.078	0	0.4
Green Revenue (%)	4.242	0	15.976
Total Assets (in $million)	3,093	232	17,429
Firm Size	5.553	5.448	2.191
Firm Age	20.451	16	14.817
ROA	-0.024	0.035	0.22
Capex	0.058	0.041	0.056
RD	0.049	0.002	0.096
Cash Holdings	0.167	0.086	0.197
Leverage	0.234	0.206	0.207
Total Q	1.701	1.023	2.095
Tobin's Q	6.923	2.513	13.278

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

	Non-green-marking firms			Green-marking firms			Green-marking firms (with at least 1 green mark in this year)		
	Mean	P50	Std. Dev.	Mean	P50	Std. Dev.	Mean	P50	Std. Dev.
#Green Term	0	0	0	0.431	0	2.676	3.231	2	6.683
Green Term	0	0	0	0.153	0	0.45	1.146	1.099	0.614
Green Category	0	0	0	0.191	0	0.598	1.429	1	0.955
#All Mark	1.419	0	3.967	5.681	1	15.736	12.764	5	23.263
All Mark	0.495	0	0.731	1.068	0.693	1.138	2.021	1.792	1.015
#Green Mark	0	0	0	0.25	0	0.981	1.875	1	2.044
Green Mark	0	0	0	0.127	0	0.354	0.949	0.693	0.398
#Non-Green Mark	1.419	0	3.967	5.431	1	15.569	10.889	4	22.92
Non-Green Mark	0.495	0	0.731	1.015	0.693	1.136	1.62	1.609	1.273
Green Patenting Firm	0.108	0	0.31	0.416	0	0.493	0.521	1	0.5
#Patent	4.046	0	29.102	32.639	0	202.785	80.554	1	425.545
#Green Patent	0.101	0	2.327	1.418	0	15.181	5.212	0	34.993

Green Patent	0.024	0	0.2	0.199	0	0.638	0.435	0	1.008
Green Revenue (%)	1.632	0	9.521	8.326	0	22.038	14.571	0	27.907

Panel C: Trademark renewal

	Non-green marks (1)	Green marks (2)	Difference (1) - (2) (3)
Observations	331,096	9,547	
Renewal at 6th year after registration year	53%	62%	-9%***
Renewal at 10th year after registration year	42%	51%	-9%***
Renewal at 20th year after registration year	36%	46%	-10%***

Table 2
Green products, green revenues, emissions, and environmental performance

The table reports the OLS regression results examining the relation between a firm's green products, green revenues, and emissions and environmental performance. In Panel A, the dependent variable in columns (1) and (2) is *Green Revenues*, measured as green revenues divided by total revenues in a year. The dependent variable in columns (3) and (4) is *GHG Total Emissions*. The dependent variable in columns (5) and (6) is *GHG Scope 1 Emissions*. In Panel B, 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. 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, green revenues, and emissions

	Green Revenues (next 2 years)		GHG Total Emissions (next 2 years)		GHG Scope1 Emissions (next 2 years)	
	(1)	(2)	(3)	(4)	(5)	(6)
Green Term	1.635**		-1.030**		-0.777*	
	(0.650)		(0.508)		(0.399)	
Green Category		0.978**		-0.805**		-0.606**
		(0.465)		(0.332)		(0.255)
Non-Green Mark	0.008	0.034	2.737	2.745	0.465	0.471
	(0.229)	(0.229)	(1.998)	(1.999)	(0.297)	(0.296)
Green Patent	4.161***	4.174***	-0.120	-0.117	-0.026	-0.023
	(1.106)	(1.105)	(0.485)	(0.485)	(0.277)	(0.277)
Firm Size	0.032	0.037	-6.948	-6.938	-2.453	-2.445
	(0.618)	(0.620)	(5.070)	(5.068)	(1.966)	(1.967)
Firm Age	-2.246***	-2.238***	0.437	0.438	0.153	0.154
	(0.578)	(0.578)	(0.306)	(0.306)	(0.168)	(0.168)
ROA	-2.980**	-2.969**	-8.018	-7.994	-1.007	-0.989
	(1.283)	(1.285)	(11.349)	(11.346)	(1.883)	(1.882)
Capex	3.840	4.008	123.158	123.191	1.751	1.776
	(8.150)	(8.322)	(116.565)	(116.570)	(20.298)	(20.298)
RD	2.351	2.286	34.703	34.832	-0.783	-0.686
	(3.525)	(3.528)	(65.129)	(65.122)	(9.035)	(9.032)
Cash Holdings	-2.280	-2.264	2.004	2.022	-0.239	-0.224
	(2.165)	(2.163)	(14.645)	(14.643)	(2.194)	(2.194)
Leverage	0.593	0.573	-14.471	-14.467	-1.420	-1.417
	(1.241)	(1.243)	(13.769)	(13.768)	(2.211)	(2.211)
Firm FE	Y	Y	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y	Y	Y
Adjusted R-squared	0.687	0.687	0.191	0.191	0.764	0.764
Observations	8,513	8,513	11,826	11,826	11,826	11,826

Panel B: Green products and environmental performance

	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

Table 3
Green products and firm value

This table reports the OLS regression results examining the relation between a firm's green products and firm value. The sample period is 1981-2020. The dependent variable in columns (1) and (2) 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 (3) and (4) 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.

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

Table 4
Investor response channel – CAR analysis

This table reports event-study regressions of short-window cumulative abnormal returns (CAR) around the registration date of a trademark. Panel A includes all firms. Panel B restricts the sample to business-to-consumer industries. The dependent variable are firm-event CARs computed over windows of trading days [0,2], [-3,3], and [-10,10] centered around the registration date (day 0), and cumulative excess return relative to the risk-free rate. Three alternative return models are used: CAPM, the Fama–French three-factor model, and the Fama–French four-factor model. Variable definitions are provided in the Appendix. All model specifications include firm fixed effects and SIC3-by-year fixed effects, and the same set of firm-year-level controls as Table 3. 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: All firms

	Window [0,2]				Window [-3,3]				Window [-10,10]			
	CAPM	3-factor	4-factor	Excess ret	CAPM	3-factor	4-factor	Excess ret	CAPM	3-factor	4-factor	Excess ret
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Green Term	-0.0004	-0.0002	-0.0003	-0.0005	-0.0006	-0.0004	-0.0006	-0.0008	-0.0021	-0.0014	-0.0014	-0.0023
	(0.0005)	(0.0005)	(0.0005)	(0.0006)	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0014)	(0.0014)	(0.0014)	(0.0014)
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Adjusted R-squared	0.065	0.065	0.064	0.063	0.061	0.061	0.061	0.061	0.088	0.087	0.087	0.088
Observations	307,022	307,022	307,022	307,022	307,021	307,021	307,021	307,021	307,007	307,007	307,007	307,007

	Window [0,2]				Window [-3,3]				Window [-10,10]			
	CAPM	3-factor	4-factor	Excess ret	CAPM	3-factor	4-factor	Excess ret	CAPM	3-factor	4-factor	Excess ret
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Green Category	-0.0005	-0.0003	-0.0003	-0.0005	-0.0004	-0.0001	-0.0003	-0.0005	-0.0015	-0.0010	-0.0010	-0.0016
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0010)	(0.0010)	(0.0010)	(0.0010)
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Adjusted R-squared	0.065	0.065	0.064	0.063	0.061	0.061	0.061	0.061	0.088	0.087	0.087	0.088
Observations	307,023	307,023	307,023	307,023	307,022	307,022	307,022	307,022	307,008	307,008	307,008	307,008

Panel B: Business-to-consumer industries

	Window [0,2]				Window [-3,3]				Window [-10,10]			
	CAPM	3-factor	4-factor	Excess ret	CAPM	3-factor	4-factor	Excess ret	CAPM	3-factor	4-factor	Excess ret
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Green Term	-0.0005	-0.0003	-0.0002	-0.0006	-0.0016	-0.0016	-0.0016	-0.0015	-0.0031	-0.0031	-0.0026	-0.0033
	(0.0012)	(0.0011)	(0.0011)	(0.0012)	(0.0018)	(0.0018)	(0.0017)	(0.0018)	(0.0028)	(0.0027)	(0.0027)	(0.0028)
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Adjusted R-squared	0.068	0.067	0.067	0.066	0.069	0.069	0.067	0.068	0.091	0.091	0.090	0.091
Observations	190,248	190,248	190,248	190,248	190,247	190,247	190,247	190,247	190,236	190,236	190,236	190,236

	Window [0,2]				Window [-3,3]				Window [-10,10]			
	CAPM	3-factor	4-factor	Excess ret	CAPM	3-factor	4-factor	Excess ret	CAPM	3-factor	4-factor	Excess ret
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Green Category	-0.0002	-0.0001	-0.0001	-0.0002	-0.0006	-0.0006	-0.0006	-0.0005	-0.0018	-0.0018	-0.0013	-0.0020
	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0013)	(0.0012)	(0.0012)	(0.0012)	(0.0019)	(0.0019)	(0.0019)	(0.0020)
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Adjusted R-squared	0.068	0.067	0.067	0.066	0.069	0.069	0.067	0.068	0.091	0.091	0.090	0.091
Observations	190,248	190,248	190,248	190,248	190,247	190,247	190,247	190,247	190,236	190,236	190,236	190,236

Table 5
Consumer demand channel

In this table, Panel A replicates the analysis in Table 3 using two subsamples: firms in business-to-consumer (BTC) industries (columns (1)-(4)) and those in non-BTC industries (columns (5)-(8)). Panel B replicates the analysis in Table 3 using a firm's sales growth, profitability, and profit margin as dependent variables and the subsample of firms in BTC industries. 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: Firm value in BTC vs. non-BTC industries

	Total Q (next 2 years)		Tobin's Q (next 2 years)		Total Q (next 2 years)		Tobin's Q (next 2 years)	
	BTC				Non-BTC			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Green Term	0.128***		0.658**		0.025		0.147	
	(0.048)		(0.283)		(0.017)		(0.094)	
Green Category		0.084**		0.385*		0.017		0.114*
		(0.038)		(0.214)		(0.012)		(0.069)
Non-Green Mark	0.020	0.020	0.153	0.156	0.049***	0.049***	0.174***	0.174***
	(0.020)	(0.020)	(0.105)	(0.105)	(0.012)	(0.012)	(0.067)	(0.067)
Green Patent	-0.151	-0.142	-1.854*	-1.797*	0.079	0.079	0.048	0.047
	(0.190)	(0.191)	(1.029)	(1.034)	(0.067)	(0.067)	(0.195)	(0.195)
Firm Size	-0.432***	-0.433***	-1.597***	-1.600***	-0.344***	-0.344***	-1.609***	-1.609***
	(0.042)	(0.042)	(0.242)	(0.242)	(0.028)	(0.028)	(0.175)	(0.175)
Firm Age	-0.062***	-0.062***	-0.330***	-0.329***	0.024	0.024	0.150	0.150
	(0.013)	(0.013)	(0.095)	(0.095)	(0.023)	(0.023)	(0.133)	(0.133)
ROA	0.949***	0.949***	4.073***	4.075***	1.038***	1.038***	2.743***	2.743***
	(0.119)	(0.119)	(0.821)	(0.821)	(0.099)	(0.099)	(0.731)	(0.731)
Capex	0.099	0.098	-8.580***	-8.582***	0.753***	0.752***	-7.509***	-7.509***
	(0.294)	(0.294)	(1.434)	(1.434)	(0.209)	(0.209)	(1.054)	(1.054)
RD	-1.393**	-1.393**	-6.118	-6.117	-0.234	-0.235	4.982*	4.978*
	(0.582)	(0.582)	(4.266)	(4.267)	(0.355)	(0.355)	(2.690)	(2.690)
Cash Holdings	1.350***	1.349***	6.169***	6.168***	1.223***	1.223***	6.822***	6.821***
	(0.198)	(0.198)	(1.304)	(1.304)	(0.125)	(0.125)	(0.886)	(0.886)
Leverage	-0.170	-0.169	0.784	0.789	0.079	0.079	1.574**	1.572**
	(0.146)	(0.146)	(0.776)	(0.776)	(0.093)	(0.093)	(0.729)	(0.729)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SIC3-by-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.607	0.607	0.623	0.623	0.580	0.580	0.649	0.649
Observations	28,733	28,733	28,733	28,733	61,662	61,662	61,662	61,662

Panel B: Sales growth, profitability, and profit margin in BTC industries

	Sales Growth				ROE				Profit Margin			
	(next 2 years)		(next 3-5 years)		(next 2 years)		(next 3-5 years)		(next 2 years)		(next 3-5 years)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Green Term	0.019**		0.002		0.007		0.029***		0.008		0.015**	
	(0.008)		(0.007)		(0.011)		(0.011)		(0.007)		(0.007)	
Green Category		0.015**		0.003		0.001		0.017**		0.008		0.010**
		(0.008)		(0.006)		(0.010)		(0.007)		(0.005)		(0.005)
Non-Green Mark	0.015***	0.015***	0.003	0.003	0.002	0.002	0.006	0.006	-0.016***	-0.016***	-0.005	-0.005
	(0.003)	(0.003)	(0.002)	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)	(0.006)	(0.005)	(0.005)
Green Patent	0.012	0.013	-0.017	-0.017	0.004	0.005	0.018	0.021	0.025	0.025	0.006	0.007
	(0.014)	(0.014)	(0.014)	(0.014)	(0.025)	(0.025)	(0.028)	(0.029)	(0.018)	(0.018)	(0.017)	(0.017)
Firm Size	-0.098***	-0.098***	-0.099***	-0.099***	-0.046***	-0.046***	-0.035***	-0.035***	-0.019	-0.019	-0.023*	-0.023*
	(0.007)	(0.007)	(0.005)	(0.005)	(0.008)	(0.008)	(0.009)	(0.009)	(0.014)	(0.014)	(0.012)	(0.012)
Firm Age	-0.000	-0.000	0.002	0.002	-0.006***	-0.006***	-0.001	-0.001	-0.003**	-0.003**	-0.004*	-0.004*
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
ROA	-0.042	-0.042	-0.084***	-0.084***	0.463***	0.463***	-0.023	-0.023	0.445***	0.445***	0.052	0.052
	(0.028)	(0.028)	(0.021)	(0.021)	(0.055)	(0.055)	(0.044)	(0.044)	(0.092)	(0.092)	(0.053)	(0.053)
Capex	0.275***	0.275***	-0.019	-0.020	0.023	0.023	-0.014	-0.014	0.039	0.039	-0.003	-0.003
	(0.070)	(0.070)	(0.040)	(0.040)	(0.078)	(0.078)	(0.066)	(0.066)	(0.155)	(0.155)	(0.111)	(0.111)
RD	-0.348***	-0.348***	-0.043	-0.043	-0.104	-0.104	-0.162	-0.161	-0.763	-0.763	-0.229	-0.229
	(0.118)	(0.118)	(0.120)	(0.120)	(0.158)	(0.158)	(0.172)	(0.172)	(0.483)	(0.483)	(0.332)	(0.332)
Cash Holdings	0.341***	0.341***	0.084***	0.084***	0.118***	0.118***	0.003	0.002	-0.376***	-0.376***	-0.040	-0.040
	(0.031)	(0.031)	(0.025)	(0.025)	(0.040)	(0.040)	(0.037)	(0.037)	(0.097)	(0.097)	(0.055)	(0.055)
Leverage	-0.098***	-0.098***	-0.023	-0.023	0.031	0.031	0.102***	0.102***	0.109**	0.109**	0.073	0.073
	(0.026)	(0.026)	(0.021)	(0.021)	(0.038)	(0.038)	(0.031)	(0.031)	(0.052)	(0.052)	(0.047)	(0.047)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SIC3-by-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.330	0.330	0.430	0.430	0.456	0.456	0.528	0.527	0.628	0.628	0.699	0.699
Observations	28,733	28,733	20,944	20,944	26,633	26,633	19,224	19,224	28,733	28,733	20,944	20,944

Table 6
Green products and firm value: Consumer environmental concerns

In this table, Panel A reports the OLS regression results examining the role of public environmental awareness in the relation between a firm's green products and firm value. Public environmental awareness is proxied by the WSJ Climate Change News Index (Engle et al. 2020). The analysis is conducted on subsamples split by whether the average annual WSJ index value exceeds the top tercile during the period 1984-2017. The high environmental awareness subsample includes years with the index value above the top tercile. Panel B reports the OLS regression results examining the role of stakeholder awareness in the relation between a firm's green products and firm value. We proxy a firm *i*'s exposure to Democratic-leaning "blue states" in year *t* as:

$$Blue\ State\ Exposure_{it} = \sum_{s} Blue\ Partisan\ Status_{st} \times Operational\ Presence_{ist}$$

where *Blue Partisan Status*$_{st}$ takes the value of 1 if Democrats truly control state *s*, -1 if Republicans truly control it, and 0 otherwise. The state partisan control measure is from Klarner (2013) over the period 1995-2010 and from the National Conference of State Legislatures (NCSL) over the period 2011-2020. *Operational Presence*$_{ist}$ is firm *i*'s share of operations in state *s* in year *t*, following Garcia and Norli (2012) and Bernile, Kumar, and Sulaeman (2015). *High Presence in Blue States* is an indicator variable that takes the value of one if *Blue State Exposure* is positive, and zero otherwise. The sample period is 1995-2020. 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: Public environmental awareness

	Total Q (next 2 years)		Tobin's Q (next 2 years)		Total Q (next 2 years)		Tobin's Q (next 2 years)	
	High Environmental Awareness				Low Environmental Awareness			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Green Term	0.035**		0.274***		0.012		0.021	
	(0.016)		(0.096)		(0.022)		(0.111)	
Green Category		0.018*		0.155***		0.010		0.033
		(0.010)		(0.060)		(0.018)		(0.075)
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y	Y	Y	Y	Y
Adjusted R-squared	0.687	0.687	0.763	0.763	0.610	0.610	0.636	0.636
Observations	21,841	21,841	21,841	21,841	58,991	58,991	58,991	58,991

Panel B: Stakeholder environmental awareness

	Total Q (next 2 years)		Tobin's Q (next 2 years)	
	(1)	(2)	(3)	(4)
Green Term × High Presence in Blue States	0.031		0.401**	
	(0.026)		(0.183)	
Green Term × (1 – High Presence in Blue States)	0.031		0.101	
	(0.020)		(0.111)	
Green Category × High Presence in Blue States		0.027		0.312**
		(0.019)		(0.129)
Green Category × (1 – High Presence in Blue States)		0.018		0.049
		(0.015)		(0.078)
Controls	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y
Adjusted R-squared	0.680	0.680	0.723	0.723
Observations	51,897	51,897	51,897	51,897

Table 7
Dissecting green products: Core business, follow-on, and common-class 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 firm value. The sample period is 1981-2020. Panel A reports the results when green products are divided into two groups: Core-*Business Green Term* (i.e., green terms belong to a firm's core business) and *Non-Core-Business Green Term*. Panel B reports the results when green products are divided into two groups: *Follow-on Green Term* and *Greenfield Green Term* (i.e., green terms appear for the first time over the past five years). Panel C reports the results when green products are divided into two groups: *Common-Class Green Term* and *Unique-Class Green Term* (i.e., a mark's green terms do not fall into the same Nice Class(es) as its non-green terms). Variable definitions are provided in the Appendix. 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 versus non-core-business green products

	Total Q (next 2 years) (1)	Tobin's Q (next 2 years) (2)
Core-Business Green Term	0.045**	0.209*
	(0.021)	(0.118)
Non-Core-Business Green Term	0.016	0.109
	(0.020)	(0.107)
Controls	Y	Y
Firm FE	Y	Y
SIC3-by-year FE	Y	Y
Adjusted R-squared	0.591	0.641
Observations	90,401	90,401

Panel B: Follow-on versus greenfield green products

	Total Q (next 2 years) (1)	Tobin's Q (next 2 years) (2)
Follow-on Green Term	0.058***	0.276**
	(0.020)	(0.116)
Greenfield Green Term	0.009	0.072
	(0.021)	(0.110)
Controls	Y	Y
Firm FE	Y	Y
SIC3-by-year FE	Y	Y
Adjusted R-squared	0.591	0.641
Observations	90,401	90,401

Panel C: Common-class versus unique-class green products

	Total Q (next 2 years) (1)	Tobin's Q (next 2 years) (2)
Common-Class Green Term	0.047**	0.214*
	(0.022)	(0.127)
Unique-Class Green Term	0.015	0.117
	(0.018)	(0.103)
Controls	Y	Y
Firm FE	Y	Y
SIC3-by-year FE	Y	Y
Adjusted R-squared	0.591	0.641
Observations	90,401	90,401

Table 8
Natural disasters, peer environmental scandals, and green products

This table reports the Poisson regression results examining different motivating factors behind firms' development of green products. 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 A presents the results examining the relation between a firm's headquarters adjacent to natural disasters and its green product introductions. The sample period is 2000-2020. 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. Panel B presents the results examining the relation between a firm's industry peers' environmental scandals and its green product introductions. The sample period is 2007-2020. All model specifications include firm and year fixed effects. Robust standard errors clustered at the SIC3 level are reported in parentheses. Variable definitions are provided in the Appendix. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Natural disasters and green products

	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***
	(0.140)	(0.089)	(0.089)	(0.056)
Controls	Y	Y	Y	Y
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

Panel B: Peer environmental scandals and green products

	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)
Controls	Y	Y	Y	Y
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

Online Appendix for
"Green Products"

OA1. Constructing the green trademark dataset

We construct a new green trademark dataset that provides a birds-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, which 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 with which the identification of goods and services of EU trademarks is related to environmental protection and sustainability.

A trademark application requires G&S identification using the Nice Classification. A "term" is the basic unit of G&S identification and consists of a class (or classes) from the Nice Classification and words or phrases that describe a product or service. Since 1996, the EUIPO's online trademark application platform has used the Harmonised Database (HDB), which contains 85,000 terms, from which EUIPO experts classify 904 as green phrases. Specifically, 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 '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*.

[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).

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), 'mobile 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]

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 occurrence in these green terms registered at the USPTO over different sample periods. We note that the top words (phrases) associated with each green group seem to pass face validity. For example, in Panel A over the sample period 1981-2020, 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. We also examine whether and how key terms might have changed since 1996 when the EUIPO adopted the Harmonised Database from which to develop the initial list of green terms. Panels B and C plot the word list over the pre-1996 subperiod and post-1996 subperiod (when in 1996, the EUIPO introduced its Harmonized Database for online trademark registration), respectively. We note some variations in word clouds across the two subperiods, suggesting that the EUIPO green taxonomy is capable of capturing evolving green technology.

OA1.4. Examples of green marks identified from the USPTO

In this section, we demonstrate how our procedure identifies green marks by analyzing trademark registrations obtained from the USPTO, using examples from three companies: Waste Management Inc., Tesla Inc., and The J.M. Smucker Company.

---

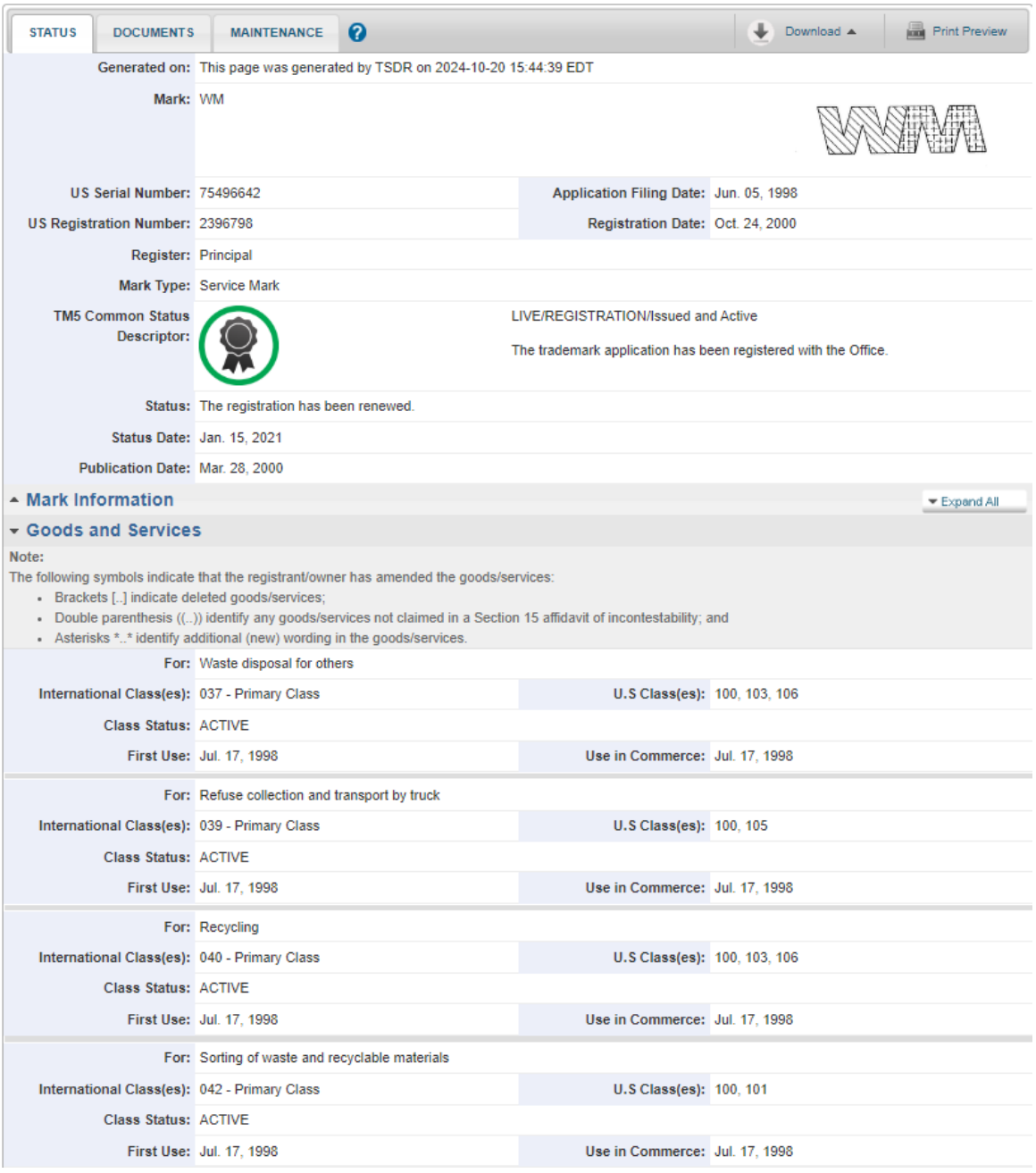
[3] A trademark can apply under multiple Nice Classes.

[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%).

Company 1: Waste Management Inc.
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.



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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,

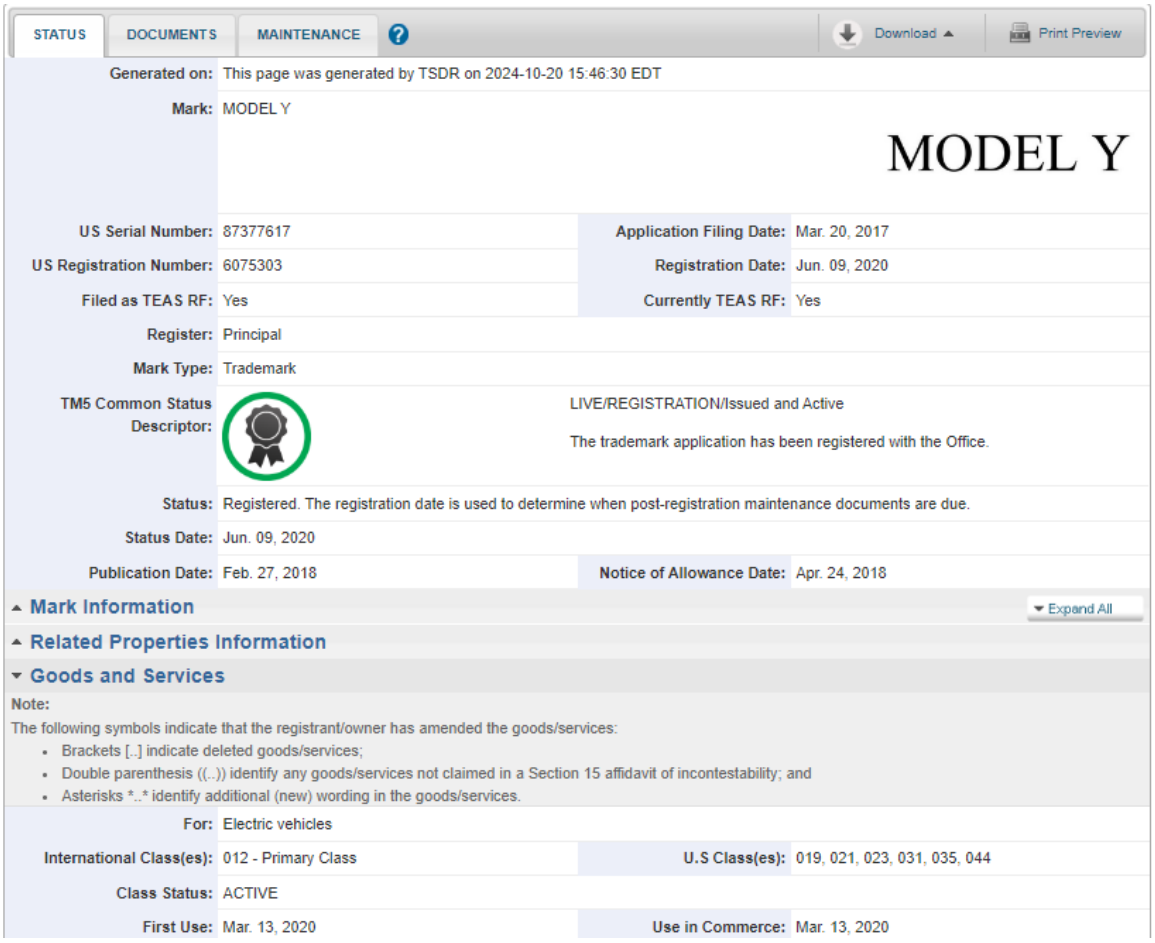
Registration number (Registration date)	Nice Class	Green expression Ref.	Mark word	G&S identification at the term-level

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.

Company 2: Tesla Inc.



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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

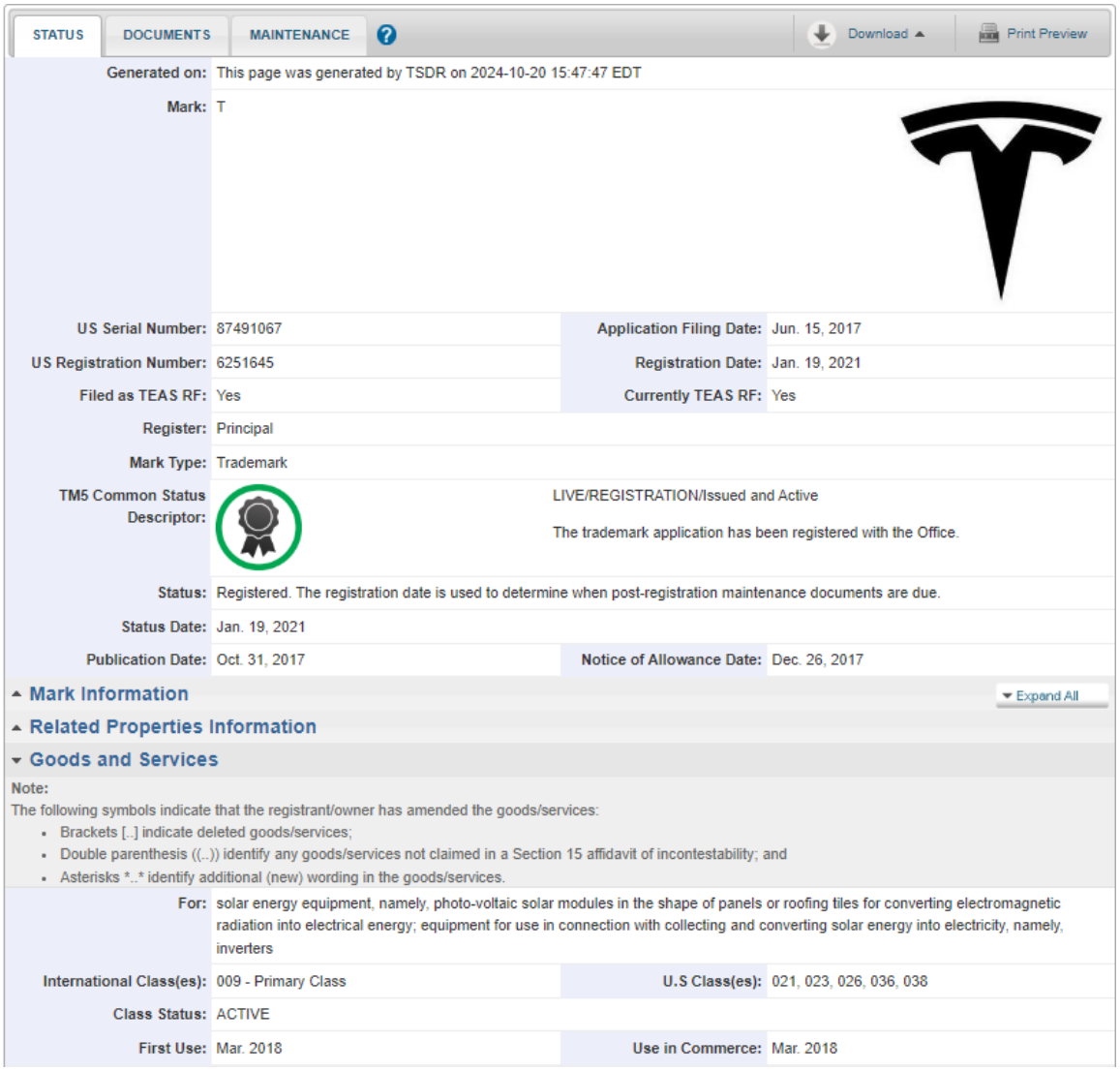
Goods and Services

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

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▲ 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,

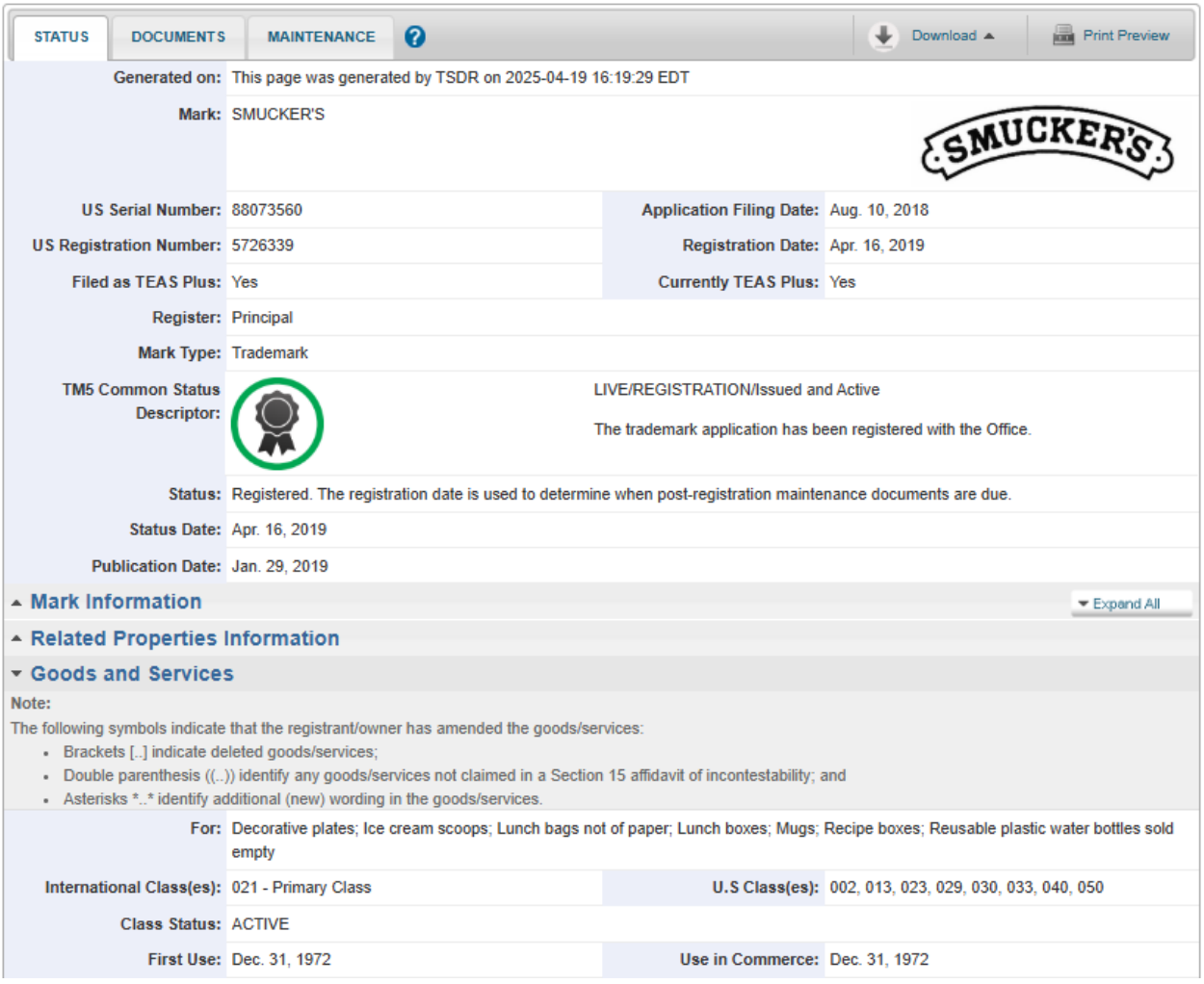
Registration number (Registration date)	Nice Class	Green expression Ref.	Mark word	G&S identification at the term-level
6075303 (9-Jun-20)	12	73	MODEL Y	Electric vehicles.
6158369 (22-Sep-20)	42	224	TESLA	Monitoring of solar panels and other equipment for use in converting solar energy into electricity 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: The J.M. Smucker Company



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Mark: SMUCKER'S

US Serial Number: 88073560 — Application Filing Date: Aug. 10, 2018

US Registration Number: 5726339 — Registration Date: Apr. 16, 2019

Filed as TEAS Plus: Yes — Currently TEAS Plus: 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: Apr. 16, 2019

Publication Date: Jan. 29, 2019

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: Decorative plates; Ice cream scoops; Lunch bags not of paper; Lunch boxes; Mugs; Recipe boxes; Reusable plastic water bottles sold empty

International Class(es): 021 - Primary Class — U.S Class(es): 002, 013, 023, 029, 030, 033, 040, 050

Class Status: ACTIVE

First Use: Dec. 31, 1972 — Use in Commerce: Dec. 31, 1972

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
5726339 (16-Apr-19)	21	Not matched	SMUCKER'S	Decorative plates;
5726339 (16-Apr-19)	21	Not matched	SMUCKER'S	Ice cream scoops;
5726339 (16-Apr-19)	21	Not matched	SMUCKER'S	Lunch bags not of paper;
5726339 (16-Apr-19)	21	Not matched	SMUCKER'S	Lunch boxes;
5726339 (16-Apr-19)	21	Not matched	SMUCKER'S	Mugs;
5726339 (16-Apr-19)	21	Not matched	SMUCKER'S	Recipe boxes;
5726339 (16-Apr-19)	21	203	SMUCKER'S	Reusable plastic water bottles sold empty.

The green term is matched to Ref. 203 and shown below,

Group	Category	Ref.	Green expression
Reusable	Reusable bottles	203	+reusable +bottle

OA1.5. Examples of green products and services associated with green marks

In this section, we provide some green product and service examples associated with green marks, using three companies: General Electric Co., SunPower Corporation, and Dominion Energy Inc.

Company 1: General Electric Co.

Green mark 1: Ecomagination

Company	General Electric Co
Mark	ECOMAGINATION
Serial No.	77504252
Registration No.	3723234
Filing Date	Jun. 20, 2008
Registration Date	Dec. 08, 2009

Background: In 2005, GE launched its "ecomagination" initiative to align its operations with sustainability goals. The program focused on increasing investments in clean R&D, boosting revenue from environmentally friendly products, reducing greenhouse gas emissions, improving energy efficiency, and enhancing transparency through public disclosure. GE described ecomagination as "a business strategy to help meet customers' demand for more energy-efficient, less emissive products and to drive growth for GE—growth that will greatly reward investors." [7]

Green mark 2: AllSites

Company	General Electric Co
Mark	ALLSITES
Serial No.	85633330
Registration No.	5891806
Filing Date	Aug. 24, 2017
Registration Date	Oct. 22, 2019

Background: The GE Daintree AllSites Energy Management Application, associated with the ALLSITES trademark, is a platform designed to monitor and control energy use across multiple sites, with a focus on improving energy efficiency and reducing environmental impact. It centralizes energy data, provides analytics, and integrates with building systems to support sustainable energy management.[8]

[7] https://files.gecompany.com/ecomagination/progress/ge_2005_ecomagination_report.pdf
[8] https://www.led.com/sites/default/files/documents/GE%20Daintree%20AllSites%20Energy%20Mgmt%20App%20Cut%20Sheet%20_%20AS001.pdf

Green mark 3: PowerUp

Company	General Electric Co
Mark	POWERUP
Serial No.	88089890
Registration No.	6048477
Filing Date	Aug. 23, 2018
Registration Date	May 05, 2020

Background: GE's PowerUp technology, associated with the POWERUP trademark, is a software-based solution that optimizes wind turbine performance. It analyzes operational data to adjust turbine settings, increasing energy output. In 2014, PowerUp had been applied to more than 1,000 wind turbines worldwide.[9]

Company 2: *SunPower Corporation*

Green mark 1: Light on Land

Company	*SunPower Corp*
Mark	LIGHT ON LAND
Serial No.	86853808
Registration No.	5247139
Filing Date	Dec. 18, 2015
Registration Date	Jul. 18, 2017

Background: SunPower's "Light on Land" initiative focuses on building solar power plants with minimal environmental impact. The program emphasizes sustainable practices, such as selecting low-impact sites, preserving biodiversity, and co-locating solar installations with agricultural activities where feasible.[10, 11]

Green mark 2: Helix

Company	*SunPower Corp*
Mark	HELIX
Serial No.	86530938
Registration No.	5514044
Filing Date	Feb. 11, 2015
Registration Date	Jul. 10, 2018

Background: SunPower Helix is an integrated commercial solar solution combining solar panels, pre-engineered components, and energy management software.[12]

Green mark 3: Equinox

Company	SunPower Corp

[9] https://www.ge.com/news/press-releases/ges-wind-powerup-technology-improving-output-more-1000-units-worldwide

[10] https://us.sunpower.com/blog/infographic-sunpower-maps-its-sustainable-solar-power-plants-worldwide

[11] https://us.sunpower.com/blog/sunpower-light-land-while-building-solar-power-plants

[12] https://www.led.com/sites/default/files/documents/GE%20Daintree%20AllSites%20Energy%20Mgmt%20App%20Cut%20Sheet%20_%20AS001.pdf

Mark	EQUINOX
Serial No.	86729049
Registration No.	5794785
Filing Date	Aug. 18, 2015
Registration Date	Jul. 02, 2019

Background: SunPower Equinox is a fully integrated home solar system with solar panels, built-in microinverters, and monitoring software.[13]

Company 3: Dominion Energy Inc.

Green mark 1: Dominion Green Fleet

Company	Dominion Energy Inc.
Mark	DOMINION GREEN FLEET
Serial No.	85468051
Registration No.	4466927
Filing Date	Nov. 09, 2011
Registration Date	Jan. 14, 2014

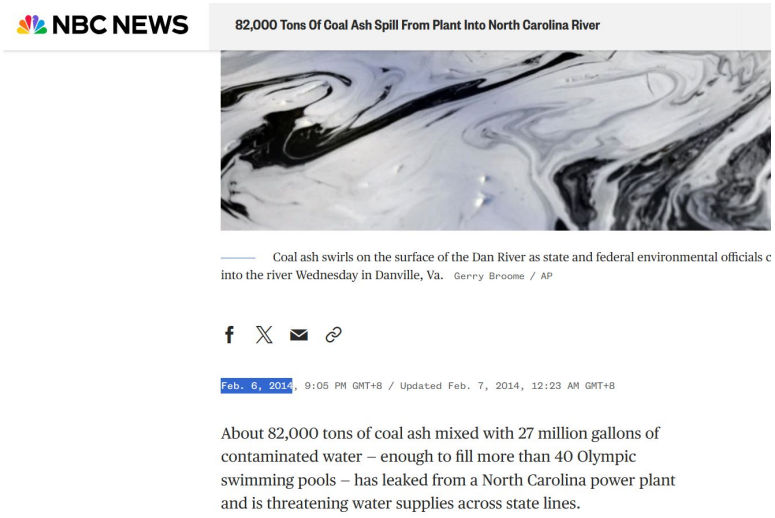
Background: Dominion Energy's "Green Fleet" initiative involves transitioning its fleet of over 7,000 vehicles to electric and alternative fuel options. The fleet includes service vehicles, bucket trucks, and other utility vehicles used for operations like maintenance, repairs, and installations, with a goal of achieving 25% electrification by 2030 and a fully green fleet by 2050.[14]

[13] https://us.sunpower.com/home-solar/equinox-home-solar-systems
[14] https://dailyenergyinsider.com/news/31526-dominion-energy-introduces-green-fleet-inititiative/

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.[15]



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.

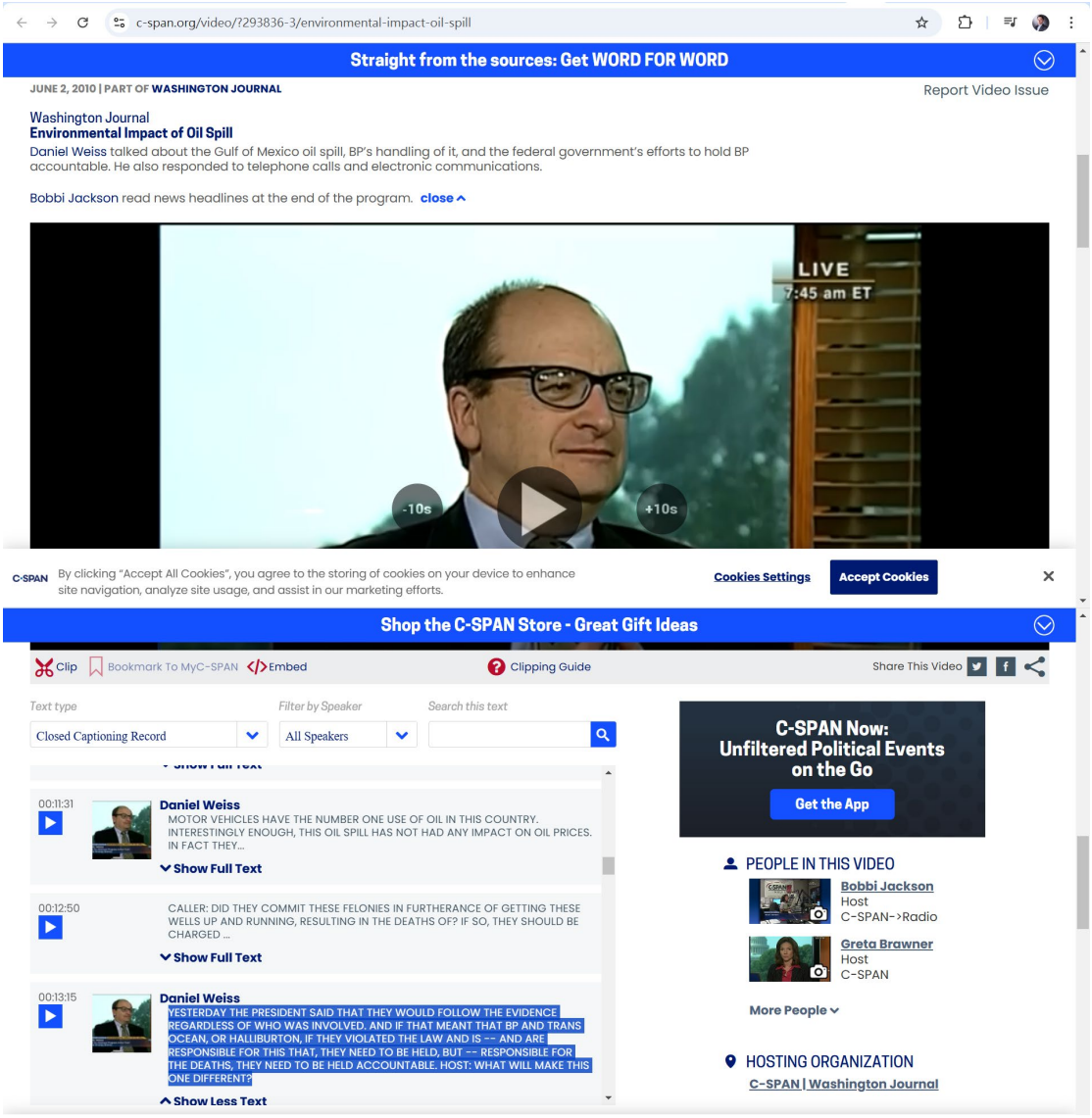
This case is recorded in the RepRisk dataset as the following:

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

[15] 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.[16]



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

[16] 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

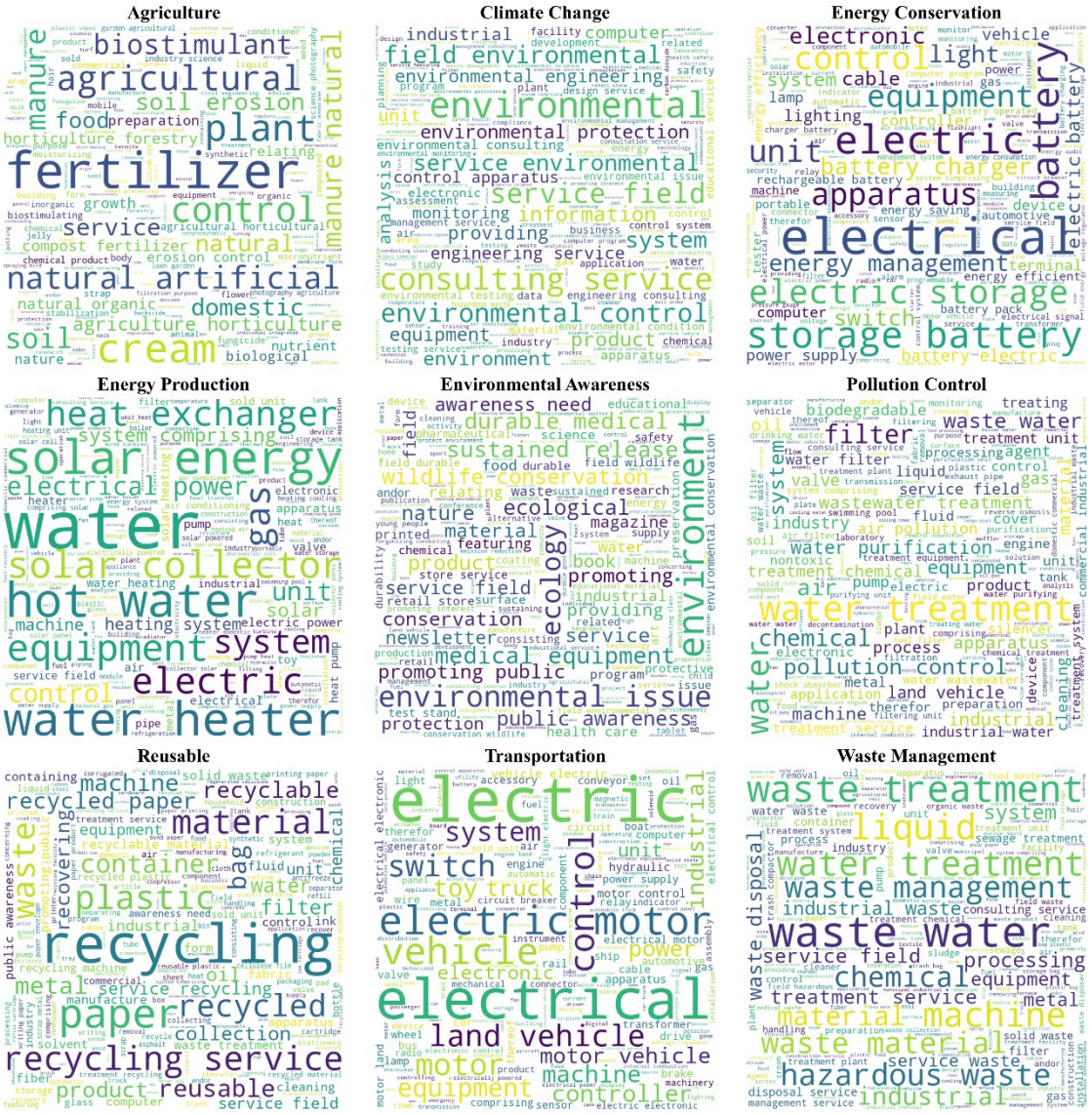
OA3. Supplemental figures and tables

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 occurrence in these 379,590 green terms. Panel A presents the word cloud plot using the full sample period. Panels B and C present the word cloud plot for the pre-1996 subperiod and post-1996 subperiod (when in 1996, the EUIPO introduced its Harmonized Database for online trademark registration), respectively.

Panel A: The full sample period 1981-2020

Panel B: The pre-1996 period



Panel C: The post-1996 period

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 by corporations 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
Green products by industry sector and firm

This table presents the distribution of green products. The sample comprises 16,389 green terms associated with 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 OA3
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 associated with 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 OA4
Greenness between non-green marking firms and green-marking firms

This table examines the two-sample mean test for non-green-marking firms and green-marking firms reported in Table 1 Panel B.

	Non-green-marking firms (1)	Green-marking firms (2)	Difference (1) - (2) (3)
#Green Term	0	0.431	-0.431***
Green Term	0	0.153	-0.153***
Green Category	0	0.191	-0.191***
#All Mark	1.419	5.681	-4.262***
All Mark	0.495	1.068	-0.574***
#Green Mark	0	0.25	-0.250***
Green Mark	0	0.127	-0.127***
#Non-Green Mark	1.419	5.431	-4.012***
Non-Green Mark	0.495	1.015	-0.520***
Green Patenting Firm	0.108	0.416	-0.308***
#Patent	4.046	32.639	-28.593***
#Green Patent	0.101	1.418	-1.317***
Green Patent	0.024	0.199	-0.175***
Green Revenue (%)	1.632	8.326	-6.694***

Table OA5
Estimated versus actual green revenues and GHG emissions

This table replicates the analysis in Table 2 Panel A, addressing the concern that some green revenues or GHG emissions values are estimated by the data provider. We also include an indicator variable to flag observations estimated by the data provider. 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.

	Green Revenues (next 2 years)		GHG Total Emissions (next 2 years)		GHG Scope1 Emissions (next 2 years)	
	(1)	(2)	(3)	(4)	(5)	(6)
Green Term	1.634**		-1.031**		-0.776*	
	(0.651)		(0.510)		(0.399)	
Green Category		0.977**		-0.804**		-0.606**
		(0.465)		(0.333)		(0.255)
Non-Green Mark	0.007	0.034	2.734	2.743	0.466	0.472
	(0.229)	(0.229)	(1.995)	(1.996)	(0.297)	(0.296)
Green Patent	4.159***	4.172***	-0.124	-0.121	-0.024	-0.022
	(1.106)	(1.105)	(0.488)	(0.488)	(0.278)	(0.278)
Firm Size	0.034	0.039	-6.958	-6.947	-2.449	-2.441
	(0.617)	(0.620)	(5.075)	(5.074)	(1.962)	(1.963)
Firm Age	-2.244***	-2.236***	0.443	0.444	0.151	0.152
	(0.578)	(0.578)	(0.304)	(0.304)	(0.169)	(0.169)
ROA	-2.980**	-2.969**	-7.976	-7.951	-1.024	-1.006
	(1.283)	(1.285)	(11.299)	(11.296)	(1.885)	(1.883)
Capex	3.841	4.009	123.594	123.627	1.579	1.603
	(8.150)	(8.322)	(117.040)	(117.044)	(20.440)	(20.440)
RD	2.331	2.266	34.906	35.034	-0.862	-0.766
	(3.490)	(3.494)	(65.048)	(65.042)	(9.077)	(9.074)
Cash Holdings	-2.284	-2.268	1.917	1.936	-0.205	-0.190
	(2.163)	(2.161)	(14.621)	(14.620)	(2.186)	(2.186)
Leverage	0.599	0.579	-14.611	-14.607	-1.365	-1.361
	(1.239)	(1.241)	(13.920)	(13.919)	(2.220)	(2.219)
Estimated Indicator	0.481	0.494	-1.680	-1.679	0.662	0.663
	(2.271)	(2.269)	(2.278)	(2.278)	(0.842)	(0.842)
Firm FE	Y	Y	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y	Y	Y
Adjusted R-squared	0.687	0.687	0.191	0.191	0.764	0.764
Observations	8,513	8,513	11,826	11,826	11,826	11,826

Table OA6
Green products and firm value: the non-green patenting firms

This table replicates the analysis in Table 3 using a 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 relation between a firm's green products and its future 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 statistics

	Mean	P50	Std. Dev.
Green Marking Firm	0.227	0	0.419
#Green Term	0.073	0	1.14
Green Term	0.027	0	0.194
Green Category	0.033	0	0.246
#All Mark	1.973	0	5.826
All Mark	0.577	0	0.823
#Green Mark	0.041	0	0.354
Green Mark	0.022	0	0.151
#Non-Green Mark	1.932	0	5.768
Non-Green Mark	0.565	0	0.818
Green Patenting Firm	0	0	0
#Patent	1.347	0	7.32
Green Revenue (%)	2.91	0	13.70
Total Assets (in $million)	1,410	164.175	5,530
Firm Size	5.192	5.101	2.039
Firm Age	18.069	14	13.221
ROA	-0.036	0.031	0.232
Capex	0.058	0.040	0.059
RD	0.049	0	0.102
Cash Holdings	0.173	0.087	0.204
Leverage	0.237	0.204	0.216
Total Q	1.740	1.027	2.166
Tobin's Q	7.442	2.617	14.088

Panel B: Green products and firm value

	Total Q (next 2 years)		Tobin's Q (next 2 years)	
	(1)	(2)	(3)	(4)
Green Term	0.047**		0.279**	
	(0.022)		(0.129)	
Green Category		0.037**		0.213**
		(0.016)		(0.097)
Non-Green Mark	0.042***	0.042***	0.189***	0.190***
	(0.012)	(0.012)	(0.069)	(0.069)
Controls	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y
Adjusted R-squared	0.593	0.593	0.641	0.641
Observations	70,038	70,038	70,038	70,038

Table OA7
Green products and firm value: Excluding the manufacturing and energy sectors

This table replicates the analysis in Table 3, excluding the manufacturing and energy sectors. 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.

	Total Q (next 2 years)		Tobin's Q (next 2 years)	
	(1)	(2)	(3)	(4)
Green Term	0.123***		0.667***	
	(0.040)		(0.232)	
Green Category		0.077**		0.421***
		(0.030)		(0.152)
Controls	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
SIC3-by-year FE	Y	Y	Y	Y
Adjusted R-squared	0.628	0.628	0.642	0.642
Observations	34,504	34,504	34,504	34,504

Table OA8
Summary statistics for dissecting green products

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

	Mean	P50	Std. Dev.
#Core-Business Green Term	0.076	0	1.018
#Non-Core-Business Green Term	0.057	0	0.717
#Follow-on Green Term	0.096	0	1.417
#Greenfield Green Term	0.037	0	0.504
#Common-Class Green Term	0.067	0	1.099
#Unique-Class Green Term	0.067	0	0.652
Core-Business Green Term	0.029	0	0.199
Non-Core-Business Green Term	0.023	0	0.176
Follow-on Green Term	0.031	0	0.22
Greenfield Green Term	0.016	0	0.142
Common-Class Green Term	0.022	0	0.184
Unique-Class Green Term	0.030	0	0.191

Table OA9
Natural disasters and green products: pre-trends and alternative clustered standard errors

This table examines the parallel trend assumption and replicates the analysis in Table 8 Panel A employing an alternative clustering method for standard errors. Panel A 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. Panel B employs alternative county level (instead of firm level) clustering to compute standard errors. 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 (county) level are reported in parentheses. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: 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***
	(0.142)	(0.138)	(0.091)	(0.094)
Adj to Natural Disaster (-1)	0.154	0.065	0.085	0.028
	(0.131)	(0.125)	(0.093)	(0.095)
Adj to Natural Disaster (-2)	0.115	0.081	0.041	0.042
	(0.117)	(0.125)	(0.087)	(0.097)
Adj to Natural Disaster (-3)		-0.156		-0.040
		(0.122)		(0.091)
Controls	Y	Y	Y	Y
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

Panel B: Clustering standard errors at the county level

	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)
Controls	Y	Y	Y	Y
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 OA10
Peer environmental scandals and green products: pre-trends

This table examines the parallel trend assumption in Table 8 Panel B. 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.

	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)
Controls	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
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