It's not easy being green*

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Abstract

This paper examines the green cost premium paid by customers and its underlying economic drivers. Using a large panel of nearly identical US federal procurement contracts – some green, some not – we estimate a premium of 25-38%. Accounting for potential biases using a Bartik instrument and a natural experiment reveals an even higher premium, reaching up to 188%. The green premium varies significantly across agencies and product types, driven in part by environmental characteristics and institutional experience. Much of the added cost reflects upfront investments to meet sustainability standards, along with regulatory complexity and supply chain frictions, rather than differences in contract size, quality, or competition. These findings suggest that a successful green transition depends not only on investors' willingness to pay, as emphasized in prior literature, but also on customers' readiness to bear higher costs for sustainable goods.

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1 Introduction

It's not easy being green. As governments, firms, and societies strive to transition to a more sustainable economy (IPCC, 2023), the costs of this change are borne by a wide range of stakeholders. Understanding how these costs are distributed is essential to make informed societal decisions about the green transition. While much of the existing research emphasizes the impact on investors, relatively little is known about the costs incurred by customers. This paper addresses this gap by empirically estimating the green cost premium paid by customers and exploring its underlying economic drivers.

Using data on procurement contracts by the US federal government, the largest customer in the world, we find that customers effectively pay 25% to 38% more for green contracts compared to comparable non-green contracts.[1] After accounting for potential sources of downward bias, we estimate that this additional cost burden on customers – the "green premium"– can be as high as 188%. We document substantial variation in the green premium across agencies and product types, driven in part by environmental characteristics and institutional experience with green procurement. Our findings indicate that a significant portion of the premium reflects the upfront investments needed to meet sustainability standards. Importantly, this added cost cannot be explained by differences in contract size, quality, or competition. Instead, it stems in part from regulatory complexity and supply chain frictions – costs that are ultimately passed on to customers. These findings suggest that a successful green transition depends not only on investors' willingness to pay, as emphasized in prior literature, but also on customers' readiness to bear higher costs for sustainable goods.

Federal procurement data are especially well suited to our research question for four additional reasons. First, federal agencies are required to prioritize green procurement when feasible. We identify a quasi-natural experiment where a new set of green clauses was intro-

[1] A green contract is defined as one that includes at least one green clause. Throughout the paper, we use the term "green clause" to refer to green contract requirements. We treat this as synonymous with "sustainable clauses" and "sustainable procurement," consistent with the terminology used by the US government.

duced and adaptation different across agencies. Second, an ideal empirical approach would be to compare the prices of green products with those of comparable non-green alternatives. However, this strategy faces a key empirical challenge: reliable and consistent criteria for identifying green products are often unavailable.[2] Manufacturer-provided labels or certifications are susceptible to greenwashing, undermining their credibility (Wittreich, 2025). We overcome this challenge by studying the US federal procurement contracts.[3] These contracts feature clearly defined and standardized criteria for identifying green purchases. Specifically, the federal government uses a set of designated green clauses – including bio-based, energy-efficient, environmentally preferable, and recoverable material – codified under FAR 52.223-4 and FAR 52.223-9. These categories are consistently labeled and standardized across procurement contracts.[4]

In addition to offering a clear and standardized definition of "green", federal procurement data are especially suited to our research question for four additional reasons. First, federal agencies are required to prioritize green procurement when feasible. Moreover, a new set of green clauses was introduced in October 2011 and different agencies adopted them at quasi-exogenously different speeds, providing a quasi-natural experiment setting for causal inference, an advantage often absent in other settings. Second, the federal government is the largest single buyer in the US economy, for example, spending $765 billion on procurement in fiscal year 2023 alone.[5] These purchases span millions of transactions across a wide array of products and services – from office supplies to advanced weapons systems – making our

[2]This issue is highlighted in the first paragraph of Starks' presidential address Starks (2023), which underscores the broader ambiguity: "there is no clear consensus on the meaning of sustainable finance or the acronyms associated with it—ESG (environmental, social, and governance), SRI (socially or sustainably responsible investing), and CSR (corporate social responsibility). Lack of clarity on the meaning of these terms leads to misunderstandings about how they affect investors, corporations, and asset markets, which can make it difficult to interpret evidence on investment behavior and to design related regulations." Furthermore, sustainability rankings of firms vary across providers (Berg et al., 2022).

[3]Belo and Yu (2013) and Belo et al. (2013) explore the broader pricing implications of government spending.

[4]Details on these clauses can be found in the publicly accessible Federal Procurement Data System (FPDS) Data Dictionary: `https://www.fpds.gov/downloads/Version_1.5_specs/FPDS_DataDictionary_V1.5.pdf`

[5]See `https://www.highergov.com/reports/765b-federal-gov-contract-awards-2023`.

estimates highly generalizable. Third, unlike many proprietary or incomplete private sector datasets, federal procurement data is publicly available and accessible, ensuring transparency and replicability. Finally, contract-level prices, our primary outcome, are determined through competitive bidding. Although our analysis focuses on government contracts, the breadth of purchases and the shared cost-minimization incentives among economic actors make our findings broadly relevant to both public and private sectors.

Our sample consists of 5,772,981 unique contracts procured between October 2007 and February 2024. Based on this data set, we document that green contracts are, on average, 25% to 38% more expensive than comparable non-green contracts. We examine heterogeneity in the green premium across agencies and products, varying in both environmental friendliness and accumulated experience in green procurement over time, suggesting that the majority of the cost comes from initial fixed investments. Finally, we show that this green cost premium is not driven by differences in contract size, contract quality, or competition, but is instead partly attributable to regulatory burdens and supply chain frictions.

Despite the federal mandate, agencies retain discretion over when and how to implement green procurement requirements. As a result, whether a contract is procured as green remains, to some extent, a discretionary choice, introducing potential endogeneity concerns in our analysis. If green procurement is indeed more costly, agencies seeking to control expenditures may selectively apply green requirements to products where the cost premium is relatively small. This selection behavior is supported by three institutional features. First, agencies are mandated to procure a certain proportion of products with green clauses across their portfolios, making it cost-effective to prioritize greening products with lower associated premiums. Second, agencies are allowed to opt out of green procurement when costs are deemed prohibitive.[6] Third, agencies may not receive bids that comply with green clauses when suppliers find the requirements too costly. Collectively, these institutional characteris-

[6] For example, Executive Order 14057, issued by President Joe Biden, directs all federal agencies to prioritize the procurement of sustainable products. However, it includes a provision that allows agencies to forgo sustainable options if they are unable to obtain them at a reasonable price.

tics imply that green contracts are more likely to occur where the cost premium is relatively low, introducing a selection bias that would attenuate our estimated effect. Thus, any endogeneity in our setting likely biases our results downward.

We address this possible endogeneity issue in two ways. First, we construct a Bartik instrument based on changes in the use of green clauses for individual product classes at the federal level. The estimates suggest that green contracts command a cost premium of approximately 188%. Second, we exploit a natural experiment around the adoption of newly created green clauses in October 2011. However, the Department of Defense (DOD) was de facto exempt from the adoption. Therefore, we compare contracts with the DOD with contracts with other agencies in a difference-in-differences setup. We estimate a cost premium of at least 100%.

Our results thus far indicate that the greening of the economy entails significant costs. The estimated range of the green cost premium appears reasonable when compared to anecdotal and historical evidence. We provide two illustrative examples: a 50% green premium for Volkswagen's electric Golf model and a 325% premium for a wooden fork at Walmart. Historical comparisons also support the plausibility of our estimates. Moreover, Bessen (2002) finds that the adoption of information technology between 1970 and 1980 led to a 100% increase in capital adjustment costs. In the energy sector, Lazard's "Levelized Cost of Energy+" report presents cost comparisons across various energy sources.[7] Furthermore, McKinsey's Net-Zero Transition report projects that shifting the energy sector to zero carbon by 2050 will raise consumer energy bills by 25% between 2020 and 2040.[8] These examples provide useful context and suggest that the magnitude of our estimated green cost premium is consistent with broader trends in sustainability-related transitions.

We then examine heterogeneity in the green premium across agencies and products, accounting for both environmental friendliness and the accumulated experience with green

[7] See https://www.lazard.com/research-insights/levelized-cost-of-energyplus/

[8] See https://www.mckinsey.com/capabilities/sustainability/our-insights/the-net-zero-transition-what-it-would-cost-what-it-could-bring?cid=netzero-pse-gaw-mst-mck-oth-2201

procurement over time. Many technology adoptions involve substantial fixed upfront costs followed by lower recurring expenses.[9] In the context of green technologies, Gerarden et al. (2017) finds that the adoption of energy-efficient technologies has been limited due to high initial costs.[10] However, it remains unclear to what extent the green cost premium is truly transient, as green initiatives may involve ongoing costs – such as procuring environmentally friendly raw materials – that keep prices elevated over time. We contribute empirical evidence to shed light on this issue and present two findings suggesting that a substantial portion of the green cost premium is indeed transient. First, in the cross-section, green cost premiums decline with the greenness of the product, the procuring agency, and the vendor. Second, in the time series, for contracts that are procured repeatedly, the green cost premium dissipates after approximately 25 contracts.[11] This empirical pattern is consistent with theoretical models in which green costs are modeled as one-time, lump-sum investments (Pastor et al., 2021; Gupta et al., 2024; Gupta and Starmans, 2025).

A natural next step is to investigate the underlying sources of green costs. We begin by ruling out two potential explanations. First, product quality could be an omitted variable that influences the price and correlates with contract greenness.[12] We find that green contracts are associated with worse performance on these dimensions, which would, if anything, bias against finding a cost premium. Second, we consider the role of competition. Green procurement requirements may limit the pool of eligible suppliers, potentially reducing competition and increasing prices. However, we find no evidence that green contracts are associated with reduced competition.

We then propose two potential channels. Guided by insights from the broader literature on technological change, we explore two hypotheses: (i) green costs vary with the intensity

[9]See, among others, Foster and Rosenzweig (2010), Gerarden et al. (2017), and Meles and Ryan (2022).

[10]For example, although heat pumps are both cost-efficient and environmentally friendly, their adoption rate stood at just 7% as of 2020. Meles and Ryan (2022) attribute this low uptake to significant fixed costs, including installation expenses and initial learning costs associated with the new technology.

[11]In Subsection 3.4, we discuss in detail whether this finding can be extrapolated to all green contracting.

[12]We follow Brogaard et al. (2021) and use four contract performance metrics: number of modifications, cost overrun, time overrun, and whether the contract was canceled.

of regulatory burden, and (ii) they are influenced by supply chain frictions.

First, Parente and Prescott (1994) point out regulatory constraints as one of the potential reasons behind costly technology adoption. The extent to which this claim remains valid in the context of going green is unclear. Green regulation may conceivably increase certain cost elements while decreasing others (e.g., reduced energy expenses stemming from the adoption of energy-efficient products). We not only document that each green clause carries a fairly similar premium but also that the costs are additive. In other words, additional green attributes specified by the regulation impose additional costs.

Next, we explore supply frictions proxied by geographic proximity between vendor and contract execution as an explanation for the green cost premium. Geographical proximity is a key factor for new technology diffusion (Skinner and Staiger, 2007; Foster and Rosenzweig, 2010; Griffith et al., 2011; Holmes, 2011). Acquiring goods from farther away increases transportation costs and also decreases monitoring. Acquiring goods from closer by can mean higher costs when local suppliers have not yet transitioned to green technology. We document that contracts procured locally are cheaper and that supply chain frictions driven by the absence of local green contractors contribute to the green cost premium.

This paper quantifies the costs of greening the economy.[13] Accordingly, we contribute to three related strands of literature.

First, we contribute to the related theoretical literature by providing an estimate of green cost premiums. Investors are willing to forgo some return for green causes. Theoretical explanations often have the following ingredients: Some investors voluntarily forgo returns for green causes (Pastor et al., 2021; Baker et al., 2022; Pedersen et al., 2021) and transitioning a firm from brown to green is costly (Pastor et al., 2021; Gupta et al., 2024; Gupta and Starmans, 2025).[14] We contribute by documenting green cost premium estimates. Our estimates

[13]We do not assess whether the benefits outweigh these costs, as our analysis does not aim to identify changes in externalities. Such an assessment is challenging due to the lack of a well-defined set of potential externalities and the imprecision in measuring externality reductions at the product level.

[14]Lontzek et al. (2024) take a different approach, arguing that heterogeneous beliefs combined with long-run risk can produce similar pricing implications.

can help researchers, regulators, and practitioners calibrate models related to greening the economy.

Second, we contribute to the literature on the direct costs and benefits of green transitions, or ESG/CSR in general, on a firm level.[15] Naaraayanan et al. (2021) document the net positive effects of environmental activism on pollution that cannot be explained by changes in production. Schiller (2018) and Dai et al. (2021) present evidence that socially responsible customers help generate better subsequent ESG/CSR in their suppliers with some benefits in operating performance, albeit primarily at the customer level. Edmans (2011, 2012) documents the positive effects of employee satisfaction on stock market performance. These papers are consistent with the argument presented in Edmans (2023b,a): investments in ESG/CSR are investments in intangible assets that create returns in the long term. Our paper challenges the conjecture that turning products green leads to better operational outcomes. In our setting, the government's sustainable actions are costly to the government and ultimately to taxpayers, at least in the short run. Not only is there an increase in costs, but there is also a decrease in quality.

Lastly, our paper contributes to the current policy debate around the government actively subsidizing the green transition. The federal government implements green restrictions in its procurement processes as a strategic measure to leverage its purchasing power for environmental sustainability.[16] To make informed decisions about sustainable procurement practices, one needs to understand the economics of green cost premiums. Our finding that a significant portion of these additional costs gradually decreases is consistent with a strategic

[15]See Gillan et al. (2021) for a comprehensive overview of the current state of the literature.

[16]On August 3, 2023, the US DOD, the General Services Administration (GSA), and the National Aeronautics and Space Administration (NASA) proposed to amend the Federal Acquisition Regulation (FAR). The new "sustainable products and services procurement rule" requires agencies to "procure sustainable products and services . . . to the maximum extent practicable." As the Biden administration puts it, "[t]he Sustainable Products and Services procurement rule, a proposal through the Federal Acquisition Regulation (FAR) Council, strengthens existing sustainable products requirements by directing Federal buyers to purchase sustainable products and services to the maximum extent possible." Robin Carnahan, Administrator of the US General Services Administration, added that "[a]s the world's largest buyer, [the US] ha[s] a responsibility to lead by example and accelerate the move toward buying clean." https://www.whitehouse.gov/ceq/news-updates/2023/08/01/biden-harris-administration-announces-plan-to-maximize-purchases-of-sustainable-products-and-services-as-part-of-the-presidents-investing-in-america-agenda/

subsidy mechanism: the government effectively bridges the divide between initial investment and long-term sustainability.[17] In related work, Dupas (2014) documents in a randomized field experiment that short-run subsidies can have a positive long-run effect on adoption of health products.

The paper proceeds as follows. Section 2 describes institutional details and the data. Section 3 presents our main results. Section 4 studies the economics of green cost premiums and Section 5 concludes.

2 Institutional details and data

2.1 Institutional details

We focus on government procurement contracts at the federal level. Federal procurement contracts are agreements between government agencies and businesses to obtain products and services for a negotiated price and over a negotiated length of time.

The process of awarding government contracts starts with a federal agency identifying a need for a purchase of a good or service. The agency decides the inclusion of a green clause, the degree and method by which the contract is competed, the form of pricing appropriate to the contract, and whether the contract is for a definitive quantity or some indefinite delivery vehicle (IDV). Then, a contracting officer of this agency posts a solicitation on the SAM.gov website. A solicitation announcement identifies what the agency wants to buy, provides instructions to potential contractors, identifies the source selection method

[17] As such, we relate to the literature that analyzes the role of the government in firms' sustainability decisions. Hart and Zingales (2017) and Hsu et al. (2023) argue that governments are better positioned than private firms to handle ESG issues because of their ability to deal with market failures as well as the relevance of unpriced externalities. However, there is recent evidence that government can also have a negative effect on firms' ESG practices. For example, Bisetti et al. (2025) document a causal relationship between partisanship and firm pollution. Akey and Appel (2021) show the causal role of regulation – in particular limiting the scope of limited liability – on increasing firm pollution. Lastly, Duchin et al. (2025) provide some nuanced evidence. That is, firms that divest from pollutive plants are more likely to receive government contracts. However, aggregate pollution is unchanged because the pollutive plant is still in the supply chain, just under a different owner.

to evaluate offers, and includes a deadline for the submission of bids or proposals. Firms then submit their offers for review by agency officers who evaluate them and make the final decision.

By using their position as biggest customer, the government tries to transform firms' ESG practices. According to the National Association of State Procurement Officials (NASPO), sustainable procurement is defined as "purchasing a product that has a lesser or reduced negative effect or increased positive effect on human health and the environment, when compared with competing products that serve the same purpose."[18] For example, the recent "Executive Order on Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability"[19] explicitly addresses this objective by writing that "Agencies shall reduce emissions, promote environmental stewardship, support resilient supply chains, drive innovation, and incentivize markets for sustainable products and services by prioritizing products that can be reused, refurbished, or recycled."

To track agencies' progress in the implementation of sustainable procurement, the agencies are required to annually provide scorecards to the Office of Management and Budget (OMB). For these OMB sustainability scorecards, the agencies select 5% of the applicable contract actions from the previous two calendar quarters and review those actions to show compliance with the sustainable product and service acquisition requirements. The agencies report the number and value of contracts that contain one of the five green clauses introduced by the FAR.[20] As an example, Figure 1 displays the scorecard that the Department of Energy reported for fiscal year 2020. According to this OMB scorecard for 2020, there are 1,626 contract actions with green clauses in the 2020 fiscal year.

Insert Figure 1

Practically, sustainable procurement is implemented by including terms or conditions,

[18] `https://www.naspo.org/green-purchasing-guide/`

[19] `https://www.whitehouse.gov/briefing-room/presidential-actions/2021/12/08/executive-order-on-catalyzing-clean-energy-industries-and-jobs-through-federal-sustainability/`

[20] We thank Shabnam Fardanesh (Sustainable Acquisition Coordinator at Department of Energy) for providing us this information.

the so-called clauses, in contracts and their solicitation.[21] Whether an individual contract contains a green clause is publicly available information. The FPDS Data Dictionary is a publicly accessible document that includes instructions to identify whether green clauses were included. The relevant field is 8L, "Recovered Materials/Sustainability." This field represents whether the green contract clauses FAR 52.223-4, FAR 52.223-9, bio-based, energy efficient, environmentally preferable, or their combinations are included in a contract. All of these labels are at the individual product level and are issued by different government agencies. For example, energy efficient products are identified by the ENERGY STAR Program or Federal Energy Management Program (FEMP),[22] while bio-based product classification is within the authority of the Department of Agriculture.[23] Table 1 provides an overview of these five clauses, their description, issuing agency, the date that each clause was first introduced to FPDS Data Dictionary, and the relevant legislation.

Insert Table 1

2.2 Data

We obtain the complete sample of procurement contracts between the US government and individual firms from the FPDS-NG, accessed via USAspending[24]. We focus on contracts with specified terms and conditions, the so-called definitive contracts (DCs). DCs allow us to assess how the inclusion of green clauses impacts cost and quality of stand-alone, one-time agreements with a single firm for the purchase of products or services under specified terms and conditions.[25] We limit the sample to contracts that are awarded competitively, which ensures that government contracts are valued at market prices. Additionally, we require

[21] https://www.acquisition.gov/far/part-2

[22] https://www.acquisition.gov/far/part-23#FAR_23_103

[23] https://www.acquisition.gov/far/part-52#FAR_52_223

[24] https://www.usaspending.gov/download_center/award_data_archive

[25] In contrast, IDVs are contracts with one or more firms, and at the time of the contract award there is uncertainty about the quantity of products or services to be provided, the timing of delivery, or the scope of the agreement. This initial uncertainty might affect the tractability of the contract performance measures. DCs and IDVs each represent approximately half of the contract spending. https://about.bgov.com/news/staffing-spending-trends-feed-appetite-for-high-value-contracts/.

that the contract be directly awarded to a firm, meaning the contract is not awarded to the parent company and is not part of a bundled project; that the contract be awarded and performed inside the US without any foreign funding; that the contractor be neither a government organization or a nonprofit; and that the contractor be registered in the US and not be foreign owned.

Our main variable of interest are indicator variables equaling one if a green clause is included in a government contract. Figure 2 reports the absolute number of contracts per year that included green clauses from 2007 to 2024.[26] Figure 3 presents a time series plot of the dollar-weighted share of government contracts containing any green clause from 2007 to 2024. In 2007, the FAR takes a more active role in promoting sustainable contracts and their further monitoring (see, for example, FAR 23.703 and FAR 42.3). Three out of five green clauses – bio-based, energy efficient, and environmentally preferable – were introduced to the FPDS Data Dictionary in October 2011. Up to 2018, the federal agencies increasingly included sustainable criteria in their contracts. Subsequent to 2018, we observe a considerable drop in the use of sustainable contracts that coincides (given an initial lag) with the Trump presidency.[27] At the end of the sample, there is an increase of contracts that are environmentally preferable.

Insert Figure 2

Insert Figure 3

In our main analysis, we designate a particular contract as green if it contains at least one of the five green clauses: bio-based, energy efficient, environmentally preferable, FAR 52.223-4, or FAR 52.223-9. Thus, it is informative to see how each individual clause relates

[26] Please note that only around one month of data are available for 2024.

[27] There is some anecdotal evidence suggesting a link between this drop and actual actions by the Trump administration. Schooner and Speidel (2020) report that "the Trump administration revoked and replaced [executive orders (EO) by the Obama administration] with an EO that subordinated energy and environmental performance to "actions that reduce waste, cut costs, enhance the resilience of federal infrastructure and operations, and enable more effective accomplishment of [the government's] mission…" A specific example is the revoking of the Clean Power Plan within his first day of office (Heitz et al., 2023).

to the others. Although some of the clauses seem to be correlated, they are not perfectly correlated, as shown in Table 2 Panel B. For instance, among contracts that contain energy efficient, 10.9% of the contracts contain bio-based, 9.1% contain environmentally preferable, 14.9% contain FAR 52.223-4, and 0% contain FAR 52.223-9. This implies that the energy efficient clause carries additional information that is not captured by the other four clauses, although the energy efficient clause is correlated with three of the other clauses.

To highlight the breadth of contracting captured in the data set, Figure 4 displays the share of contracts with green clauses across different product and service codes. Panel A (B) shows the top (bottom) 10 product and service categories incorporating dollar-weighted green clauses. Some of the products and services that have a large share of green contracts are building demolition, motor vehicles, trailers, and cycles. Some of the products and services that have a small share of green contracts are bearings, aircraft components, and nuclear ordnance.

Insert Figure 4

Table 2 Panel A provides summary statistics for the set of all contracts between 2001 and 2024. We winsorize all variables at .5% and 99.5%. The sample consists of 5,772,981 unique contracts, each worth $26.44 thousand initially on average, amounting to $152 billion. Of these contracts, 1. 1% (3. 4% if weighted in dollars) contain at least one green clause.

Insert Table 2

We report several contract statistics for the whole sample as well as subsamples of contracts with and without green clauses. The amount of the green contract in dollars as originally agreed upon, *federal action obligation*, is on average $81.8 thousand and higher than for all contracts. The difference from the sample mean is partly driven by regulation. For example, the scope of the mandate that outlines the acquisition of items that have a designated green clause issued by the Environmental Protection Agency or the Department of Agriculture has a lower price bound of $10,000. As this lower bound is not sharp – it depends on forward-looking assessment as well as backward-looking conditions – we do not limit our sample to contracts above $10,000.[28] Given these differences between green contracts and the non-green contracts, adding controls and fixed effects in the main model is paramount.

The next six rows report the share of contracts that include at least one of the five different green clauses, as well as the share of contracts that include at least one clause. In the whole sample, 1.1% of all contracts has at least one green clause. As the average green contract is larger in dollar amount, the value-weighted share of green contracts is greater, as shown in Figure 3. Of the five individual clauses, FAR 52.223-4 is the most common prior to 2018, when the use of green clauses plummets. This is not unexpected, as this clause has been included since the beginning of the sample (see Figure 3) while other clauses (with the exception of FAR 52.223-9) have been explicitly recorded only after October 2010. After 2018, the more recent increase in green clauses is due to environmentally preferable contracts.

Next, we consider four measures of contract performance: number of modifications, cost overrun, time overrun, and whether the contract was canceled. These measures are inspired by Brogaard et al. (2021), who show that renegotiations and changes in contract terms are fairly common. *Number of modifications* is defined as the number of modifications recorded in the contract after the initial registration of the contract in FPDS-NG. *Cost overrun* is defined as the log of final costs divided by initial costs (*federal action obligation*). *Time overrun* is defined as the log of the number of days between the final completion and the end date agreed on initially plus one. *Cancellation* is an indicator variable equaling one if the contract was canceled. Comparing those four measures of performance of green versus non-green contracts, we see differences in all four measures, and green contracts perform worse. However, to conclude that the performance of green contracts is worse, one would

[28]Our main results are unchanged if we impose a lower price bound of $10,000.

need to control for the amount, type, and other contract features such as the awarding agency. Finally, we consider the number of bids, a measure of competition.

3 The Cost of Going Green

This section presents the main result of the paper, namely estimating the cost impact of greening up individual products. We start with a naïve regression. Next, we present two separate identification strategies. Lastly, we explore whether the costs associated with greening products are transient.

3.1 Ordinary least squares specification

We start by investigating contract-level correlations between the green contract requirements and the costs of a federal government contract. In particular, we estimate the following model:

$$Cost_{c,t} = \alpha + \beta \cdot Green_{c,t} + \gamma_c + \eta_t + \epsilon_{c,t} \tag{1}$$

$Cost_{c,t}$ is our main outcome variable, an item called "federal action obligation" in the FPDS Data Dictionary. It is the log of the contract c's cost that is initially agreed upon at time t between the government and the contractor. $Green_{c,t}$ is our main regressor. $Green_{c,t}$ equals one if the contract c has any of the following five clauses: bio-based, energy efficient, environmentally preferable, FAR 52.223-4, or FAR 52.223-9. Otherwise, we define $Green_{c,t}$ to be 0.

γ_c captures four contract-specific fixed effects. First, we include fixed effects for two-digit or three-digit product and service codes. There are 168 unique types of two-digit product and service codes and 877 unique types of three-digit product and service codes. These codes range from office supplies and plumbing equipment to military equipment such as guided missiles and ammunition. Second, we include fixed effects for set-aside codes that denote the types of business that can perform the contract. These codes include 18 different types of businesses that include women- or veteran-owned small businesses. The third set of fixed effects is the primary place of performance at the county level. The last set of fixed effects is for the agencies or subagencies awarding the contract. There are 74 unique federal-level agencies and 195 unique federal-level subagencies in our data set. For example, the Department of Agriculture and the DOD are two of the 74 agencies. The US Forest Service is one of the subagencies that belongs to the Department of Agriculture and the Department of the Navy is one of the subagencies that belongs to the DOD.

η_t is time fixed effects. The time fixed effects are applied at either year level or year-month level. We apply an extensive set of fixed effects – in conservative models, even interacting time- and contract-specific fixed effects – to control for any contract-specific characteristics that can potentially contribute to different costs.

The main coefficient of interest is β, which measures how much pricier the contract becomes in response to being required to be green. Table 3 presents the results.

Insert Table 3

Model 1 in column (1) does not control for any fixed effects. Model 2 controls for year-month fixed effects, three-digit product and service code fixed effects, and set-aside code fixed effects. The models in the subsequent columns control for more restrictive combinations of fixed effects. For example, Model 7 controls for the county in which the contract is performed and triple interactions between subagency, two-digit product and service codes, and year. Despite the different set of fixed effects, the main coefficients have quantitatively similar magnitudes and statistical significance. The models imply that imposing green restrictions increases costs by 25% to 38%. In Models 1 to 7, standard errors are clustered on three-digit product and service codes.

Now, let us turn to the economic magnitude by performing a back-of-the-envelope calculation. During fiscal year 2023, the federal government spent $765 billion procuring contracts.[29] During the last 12 months of the sample, 1.2% of contracts included any green clause, meaning that not imposing green restrictions would have saved taxpayers between \$2.3 billion and \$3.5 billion.[30] Theoretically, greening up 100% of contracts would imply costs between \$153 billion and \$211 billion.

3.2 Causality: Aggregation and Bartik instrument

One might argue that our main result is driven by product quantity. Green products may be sold in greater bulk than non-green products. Thus, the contract-level costs for green products can be larger than for the non-green counterpart, explaining our result in the previous subsection.

To address this concern, we aggregate individual contracts into an agency-state-year panel. The implicit assumption behind this aggregation is that the green mandate does not change the demand for a given product or service at the agency-state-year level. If green products are bought in greater or lesser bulk than non-green products, aggregating up to the agency-state-year level will address a possible cost change driven purely by a change in quantity. We limit the sample to contracts that are procured at least 25 times by 20 distinct agencies per year. We estimate the following model,

$$Cost_{a,s,y} = \alpha + \beta \cdot Green_{a,s,y} + \iota_a + \lambda_s + \eta_t + \epsilon_{a,s,y} \quad (2)$$

$Cost_{a,s,y}$ is our main outcome variable. It is the log of money spent on government contracts by agency a in state s in year y. We simply aggregate the costs of all contracts c awarded by agency a in state s during year y, $Cost_{a,s,y} = \sum_{c\in\{a,s\},t\in y} Cost_{c,t}$. Similarly, our main explanatory variable is the percentage of contracting dollars spent on green contracts by

[29]See `https://www.highergov.com/reports/765b-federal-gov-contract-awards-2023`.

[30]Assuming a green cost premium of 25%, greening up 1.2% amounts to the costs of $\$765 - \$765/\left(1 + (1.2\% \cdot 25\%)\right) = \$2.3$. Similarly, greening up 100% amounts to \$153 billion.

agency a in state s in year y, $Green_{a,s,y}$. Again, we aggregate individual contract information, $Green_{a,s,y} = \sum_{c \in \{a,s\}, t \in y} \frac{Cost_{c,t} \cdot Green_{c,t}}{Cost_{c,t}}$. $Green_{c,t}$ is an indicator variable that equals one if the contract c has any of the following five clauses: bio-based, energy efficient, environmentally preferable, FAR 52.223-4, or FAR 52.223-9.

We include three types of fixed effects: awarding agency fixed effects ι_a, state fixed effects λ_s, and time fixed effects η_t. Robust standard errors are clustered on awarding agency and year. Table 4 presents the results.

Insert Table 4

Model 1 in column (1) implies that imposing green clauses increases contract costs by 49%, significant at 1% level. This magnitude is significantly larger than the results reported in Table 3. This difference suggests that our previous estimates are lower bounds. Potentially, green products are actually procured in smaller quantities per contract, biasing the coefficient downward in Subsection 3.1.

Although the above analysis addresses the concern regarding quantity, it does not address endogeneity in general. There are several reasons to assume that our main estimate is biased downward because of reverse causality. If procuring green is expensive and agencies try to reduce costs, one would observe green contracting only in cases when it is not (too) costly. To give three specific examples: First, agencies are mandated to purchase a certain share of products that have green clauses for their product portfolio. It seems optimal to first green up products with a lower cost. Second, agencies are allowed to not purchase green if costs are prohibitive. For example, the recent executive order issued by President Biden, Executive Order 14057, mandates that all federal agencies prioritize the procurement of sustainable products.[31] However, the order includes an exception allowing agencies to forgo sustainable options if they are unable to acquire a product or service at a reasonable price. Third, one potential reason agencies are not receiving offers that adhere to the green clauses in the

[31] Related information can be found on pages 50-51 in Executive Order 14057, "Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability," which can be downloaded at `https://www.sustainability.gov/pdfs/EO_14057_Implementing_Instructions.pdf`

solicitation may be that costs on the firm side are prohibitive. All three mechanisms suggest reverse causality, resulting in downward bias.

To address endogeneity, we employ a Bartik instrument (Bartik, 1991; Blanchard and Katz, 1992; Goldsmith-Pinkham et al., 2020; Borusyak et al., 2022). In the canonical setting, local employment growth rates are instrumented using an interaction between local industry employment shares and national industry employment growth rates.

In our context, we instrument the share of green contracts awarded by an agency in a given state and year, $Green_{a,s,y}$, using a corresponding Bartik instrument. The Bartik instrument is constructed as the interaction between the national share of green contracts per three-digit product and service code, $Green_{ps,y}$, and the share of products within each three-digit product and service code per agency, state, and year, $\omega_{ps,a,s,y}$:

$$B_{a,s,y} = \sum_{ps} Green_{ps,y} \cdot \omega_{ps,a,s,y} \quad (3)$$

To ensure that the national share of green contracts is not disproportionately influenced by a small number of agencies, we restrict our analysis to product and service codes with at least 100 sales per year from more than 20 unique agencies.

More importantly, we examine the identification assumption underlying our causal inference. Specifically, we assume that government-wide demand shocks are as-good-as randomly assigned across product and service categories. The government-wide product/service demand shock serves as a noisy estimate of latent quasi-experimental demand shocks, helping to address endogeneity concerns arising from latent differences across agencies, some of which were discussed earlier.

There are two ways to construct the national share of green contracts per three-digit product and service code, $Green_{ps,y}$. As used in Bartik (1991), we first define it as:

$$Green_{ps,y} = \sum_{s} Green_{ps,s,y} \cdot \omega_{ps,s,y} \tag{4}$$

Models 2 and 3 in Table 4 report the results. In Model 2, we report the first-stage regression. The coefficient is 71% and highly statistically significant. The F-statistic is greater than 200. Model 3 reports the result of the second-stage; the coefficient is 287 and highly statistically significant. These two estimates imply that the premium associated with green contracts is 204%. The premium estimate exceeds the "naive" estimate in Table 3, providing empirical support for a possible reverse causality.

Although the results of Models 3 and 4 are insightful, Borusyak et al. (2022) argue that the instrument constructed using Equation 4 may introduce a mechanical correlation between the regressor, $Green_{a,s,y}$, and the instrument. To mitigate this issue, we construct a leave-one-out instrument, where $Green_{ps,y}$ is defined as follows (Borusyak et al., 2022):

$$Green_{ps,y} = \sum_{s' \neq s} Green_{ps,s',y} \cdot \omega_{ps,s',y} \tag{5}$$

Models 4 and 5 in Table 4 report the related results. In Model 4, we report the first-stage regression. The coefficient is 56% and highly statistically significant. The F-statistic is greater than 200. Model 5 reports the result of the second-stage; the coefficient is 335.63 and highly statistically significant. These two estimates imply that the premium associated with green contracts is 188%. The premium estimate exceeds the "naive" estimate in Table 3, providing empirical support for a possible reverse causality.

3.3 Causality: Natural experiment

To further the claim that costs associated with green contract clauses are causal, we study a natural experiment. The ideal experiment would be that at a random point in time, a subset of agencies start procuring everything with green contract clauses, while the remaining agencies do not. Although we cannot study this optimal scenario, our setup comes close. In particular, we exploit heterogeneity in how fast different federal agencies adopt new green clauses in their respective procurement.

As explained in Subsection 2, three of five green clauses – bio-based, energy efficient, and environmentally preferable – were introduced to the FPDS Data Dictionary in October 2011. More interestingly, different agencies adopted these three clauses at different speeds. As illustrated in Figure 5, both the Department of the Interior's and the Department of Veterans Affairs' share of green contracts increased from 0% in March 2011 to above 10% in January 2011. In contrast, the DOD's share of green contracts started inching up in March 2011 but has stayed low at 2.5% or below for the subsequent four years.

Insert Figure 5

The heterogeneity in the adoption speed between different agencies can be explained by the difference in the nature of the agencies that preceded the event date. For instance, relative to the Department of the Interior and the Department of Veterans Affairs, for reasons of national security, the DOD faces much more scrutiny in adopting new policies, and this can naturally lead to further delay in adopting new green clauses. In fact, the delay in adoption speed can be driven by exemptions that the DOD receives because of its engagement in military, law enforcement, and defense acquisitions (see FAR 23.104; FAR 23.105 and 23.4).[32] This exemption can cause the DOD to appear nonchalant about greening up contracts. In 2020, the US Government Accountability Office issued a report named "Climate Resilience: Actions Needed to Ensure DOD Considers Climate Risks to Contractors as Part of Acquisition, Supply, and Risk Assessment." In this report, they write that "According to OUSD A&S officials and DOD contractor representatives with whom we spoke or from whom we obtained written comments, environmental considerations are generally not used as a key

[32] Hill and Collins (2022) find that this exemption could damage the impact of sustainable contracting.

criterion in the selection of a particular offer because such considerations would distract from the main purpose of the solicitation."[33]

We use a difference-in-difference model with the implementation of the bio-based, energy efficient, and environmentally preferable contract clauses in October 2011 as the exogenous shock. We focus on three federal agencies: the Department of the Interior and the Department of Veterans Affairs are the treatment group, while the DOD is the control group. There are two reasons why we focus on these agencies. First, they are the three top federal agencies in terms of contract dollar amounts, contributing approximately 76% during our sample period. Second, as explained in the above paragraph, there is a clear distinction between the DOD and the other two agencies in adoption speed, which helps us to identify the impact of green clauses on contracts' costs.

We use October 2011 as a point when the rate at which green clauses were adopted has significantly diverged between the DOD and the other two agencies. Previous evidence suggests that there is seasonality in the agencies' procurement practice (see Fichtner and Michel (2016); Fichtner and Albanese (2018); and Spoehr (2020)). For instance, because of the fiscal cycle, contracts purchased in September – the end of the federal fiscal year – are inherently different from those purchased in October. At the end of the fiscal year, agencies increase spending, which can affect the solicitation process, and as a result, contract quality deteriorates (Liebman and Mahoney, 2017). Unfortunately, this coincides with our event date. Because of this, a narrow event window is confounded by the end of the federal fiscal year. To alleviate this concern, we estimate the model for different time periods around the event date.

We start by documenting that the adoption of green contract clauses diverges after the event date, estimating the following model:

[33] https://www.gao.gov/assets/gao-20-511.pdf

$$Green_{c,t} = \alpha + \beta_1 \cdot Post_{c,t} + \beta_2 \cdot Post_{c,t} + \beta_3 \cdot Post_{c,t} \cdot Treat_{c,t} + \gamma_c + \eta_t + \epsilon_{c,t} \quad (6)$$

$Post_{c,t}$ is 0 if it is before October 2011 and 1 if it is on or after October 2011. $Treat_{c,t}$ is a indicator variable equaling one if the contract c is issued by an agency that adopted green clauses right after October 2011. Otherwise, it is 0.

Table 5 summarizes the estimates. Model 1 and Model 4 in Table 5 use the contracts purchased in October 2010 and in October 2011. Models 2 and 5 use the contracts purchased in November 2010 and in November 2011. The results are qualitatively and quantitatively similar to Models 3 and 6, which use a one-year window around the event date.

Insert Table 5

As shown, β_2 is statistically significantly positive and thus justifies the use of October 2011 as a shocking point. β_1 is statistically significant but economically small. This justifies the comparison between treated and nontreated agencies.

Next, we estimate the following model to identify the cost sensitivity to the green requirement.

$$Cost_{c,t} = \alpha + \beta_1 \cdot Post_{c,t} + \beta_2 \cdot Post_{c,t} + \beta_2 \cdot Post_{c,t} \cdot Treat_{c,t} + \gamma_c + \eta_t + \epsilon_{c,t} \quad (7)$$

Models 4 to 6 in Table 5 show the results. There are two main takeaways.

First, relative to the pre-period, the DOD's contract costs did not increase because of the absence of imposing green restrictions. In other words, this suggests that any cost increase for the treated agencies is due to them actively adopting green clauses. Second, relative to the pre-period, the Department of the Interior's and the Department of Veterans Affairs' contract costs increased by 13% to 29% because of imposed green restrictions. This estimate captures the price differential of average contract costs, both green and brown, for the control versus treatment group. The unconditional share of contracting that is green is roughly 14% for the treated agencies and 1% for the control agency, a differential of 13%; see Figure 5. Thus, the green cost premium per product is approximately 100% to 223% (13%/13% to 29%/13%). Similarly to Subsection 3.2, the causal estimates substantially exceed the naïve OLS estimate in Subsection 3.1.

Taken together, this section suggests that there is a sizable cost premium associated with requiring a product or service to be green. Both the instrumental variables setting as well as the natural experiment suggest that this premium is causal.

3.4 Cost Heterogeneity

This subsection tests whether the costs associated with greening products are transient. As discussed in Foster and Rosenzweig (2010), Gerarden et al. (2017), and Meles and Ryan (2022), new technology adoption involves large sum of fixed costs up front. It is not hard to imagine such fixed costs in the context of the green transition. For example, even though a heating pump is cost efficient and environmentally friendly, its adoption rate is only 7% as of 2020. Meles and Ryan (2022) attribute the low adoption of the heating pump to large initial fixed cost that includes not only installation costs, but also the initial cost of learning about the new heating pump technology. Similarly, Gerarden et al. (2017) document that adoption levels of energy efficient technologies are low and attributed to cost. Such large fixed costs up front imply that a large portion of the green cost premium is not recurring – that is, it is transient. However, it is not clear to what extent we can generalize the claim that the majority of green cost premiums are transient. For instance, fixed costs in the green transition can potentially be small compared to recurring costs (e.g., regular maintenance costs). Thus, we empirically test the claim.

We provide two sets of related analyses. We first test whether the green cost premium decreases as the product, the procuring agency, or the vendor becomes more green. If green cost premiums are transitory, the majority of the green cost premium incurs in the early stage of the green transition, thus we expect costs to decrease in the greenness of the product, the procuring agency, or the vendor. We estimate the following model:

$$Cost_{c,t} = \alpha + \beta_1 \cdot Green_{c,t} + \beta_2 \cdot D_{i,t} + \beta_3 \cdot D_{i,t} \cdot Green_{c,t} + \gamma_c + \eta_t + \epsilon_{c,t} \tag{8}$$

where $D_{c,t}$ is an indicator variable equaling one if the contract is associated with a green product, agency, or vendor. Other variables are defined similarly as in Subsection 3.1. The estimation results are in Table 6.

Insert Table 6

In Model 1, we focus on the greenness of the three-digit product and service codes. $D_{c,t}$ equals one if the share of green products within a three-digit product and service code is above the cross-sectional median computed during the previous year. The degree of greenness varies significantly across 877 different product types; see Figure 4. Our estimates suggest that imposing green restrictions increases the cost of brown products by 55%, while increasing the cost of green products by 27%. Products that are more frequently greened up may have markets that are more established and competitive, leading to lower greening-up costs.

Next, we study how the cost of green contracts varies between different agencies. There are 74 unique US federal government agencies, each of which has different mandates and characteristics. For example, as shown in Subsection 3.3, DOD needs to prioritize national security. Consequently, the green share of procurement contracts can differ by agencies. A green (brown) agency is one that has procured a number of green contracts above (below) the median in the prior year. The model shows that imposing green restrictions increases the cost of brown agencies by 55%, but does not increase the cost of green agencies. Agencies that frequently procure green products and services may have established relationships with suppliers and vendors for green contracts, and thus may face lower marginal costs of greening up. Agencies that have not procured as many green products and services, however, are likely to pay a higher initial cost (e.g., a search cost) and thus face a larger marginal cost of greening up.

Lastly, we study how the cost of green contracts varies between different vendors. There are 242,568 unique vendors, all of which have different characteristics and goals. Consequently, the green share of procurement contracts can differ by vendors. A green (brown) vendor is one that has offered a number of green contracts above (below) the median in the prior year. The model shows that imposing green restrictions increases brown vendors' prices by 41%, whereas green vendors' prices increase by only 8%. Vendors who frequently provide green products and services to the federal government have experience in producing or procuring environmentally friendly goods. As a result, they face lower marginal costs for adopting green practices compared to non-green vendors.

There are two ways to rationalize these results. First, reverse causality, as discussed in Subsection 3.2, suggests these correlations. To satisfy the greening-up mandate while also satisfying tight government budget constraints, agencies tend to start with products and services that are cheaper to green up. In addition, the results also suggest a second interpretation, namely that some portion of these costs is transient. We provide more direct evidence for the second interpretation in the next test.

The second analysis quantifies how much the green cost premium decreases as experience accumulates. If costs are transient, we would expect them to decrease with repeated green transactions. We define *Contract Number*, our main explanatory variable, as the number of times green contracts have been issued at the agency, three-digit product and service code, and state level up to the current contract.[34] The higher this number, the more green contracts have been awarded. We estimate the following model:

[34] If multiple green contracts exist within the same cohort on the same action date, all the contracts are assigned the same contract number.

$$Cost_{c,t} = \alpha + \beta_1 \cdot Green_{c,t} + \beta_2 \cdot Contract\ Number_{c,t} + \beta_3 \cdot Green_{c,t} \cdot Contract\ Number_{c,t} + \gamma_c + \eta_t + \epsilon_{c,t} \quad (9)$$

If some share of the green cost premium is transient, we would expect a negative correlation between $Green_{c,t} \cdot Contract\ Number_{c,t}$ and *Cost*, $\hat{\beta}_3 < 0$. For this analysis, an apples-to-apples comparison is critical because the costs of brown contracts may also change during the same period for several reasons, as captured by $\hat{\beta}_2$. As a result, we use a sample that consists of all green contracts and matched brown control contracts. For each green contract, we randomly with replacement select a control contract that is issued by the same agency, is within the same three-digit product and service code, awarded in the same state and during the same year. Table 7 reports the results.

Insert Table 7

The table presents three different models. Model 1 assumes linearity between contract cost and contract number. It implies that green contracts are 22% more expensive than non-green counterparts the first time they are acquired (i.e., (contract number) = 1). However, as government agencies gain more experience with green contracts, the incremental cost resulting from green restrictions decreases by 0.3%. In other words, the results imply that 100% of the premium disappears after 73 contracts.[35]

But Model 1 makes a strong, and arguably unrealistic, linear assumption. Thus, in Model 2, we log the contract number. It implies that green contracts are 32.9% more expensive than non-green counterparts the first time they are acquired (i.e., (contract number) = 1). However, as government agencies gain more experience with green contracts, the incremental cost resulting from green restrictions decreases. The results imply that 100% of the green cost premium disappears after 27 (= exp(0.329/0.1)) contracts.

[35] 0.219085 / 0.003212.

Models 1 and 2 make implicit assumptions regarding the marginal incremental cost change, linearly or exponentially decreasing. Instead, in Model 3, we use four indicators. It implies that green contracts are 31% more expensive than non-green counterparts the first time they are acquired (i.e., (contract number) = 1). As government agencies gain more experience with green contracts, the incremental cost as a result of green restrictions decreases by 9.2% over the first 10 contracts and decreases by an additional 25.6% over the next 15 contracts. The results imply that 100% of the green cost premium disappears after 25 contracts.

Taken together, all three models tell a similar story: the costs of green contracts are transitory and vanish after roughly 25 contracts. There are two caveats that may impede the conclusion that the green cost premium has no persistent component. First, this finding depends on the granularity in the cohort. In the current analysis, we count the number of repeated green contracts at the intersection of agency, three-digit product and service code, and state level. The untabulated results suggest that the transient components diminish if using a more coarse definition. This suggests that the decrease in costs is unique to repeated relationships at the granular level. Second, the first set of results in this section documents sizable heterogeneity in the green cost premium. In particular, our analysis suggests that contracts associated with brown product classes, brown agencies, or brown suppliers demand a higher green cost premium. Naturally, the results in this section are largely driven by contracts that have been greened up, as they are the larger part of the observations in the sample. Hence, it is not obvious that the same conclusion extends to contracts that demand a high green cost premium.

4 Economics of green cost premiums

In this section, we study the sources of the green costs. First, we follow the literature on government procurement and analyze contract quality and competition environment. Then, we address hypotheses motivated by the existing literature on technological changes. They state that green costs vary with the amount of regulatory burden and can be linked to supply chain frictions. We provide more details in the rest of this section.

4.1 Omitted variables: Contract quality and competition

In this subsection, we rule out two possible alternative reasons why green contracts are more costly. First, one might argue that green contracts are more expensive because they are of better quality. Second, one could argue that the implementation of green procurement restrictions narrows the field of eligible businesses that can bid for a contract. This constraint may impede healthy competition and consequently result in cost increases.

Although both are reasonable conjectures, we provide evidence that neither explains the green cost premium. We start by analyzing contract quality. We closely follow Brogaard et al. (2021) to construct proxies for contracts' quality and ask whether differences in quality can be explained by choosing green options when procuring. We estimate a model similar to Equation 9, except that we use proxies for contract quality as dependent variables. Also, given that we study contract outcomes, we add controls for contract features: its cost and maturity. Models 1 to 5 in Table 8 summarize the results.

Insert Table 8

The main message of this analysis is that green contracts seem to be of worse quality. Model 1 suggests that green contracts are 3% more likely to have modifications. Model 2 uses the log number of modifications to proxy quality. Green contracts have approximately 12% more modifications. Model 3 uses the log of final costs divided by initially agreed-upon costs, cost overrun, to proxy contract quality. Green contracts are on average 2% more costly, 13% of the variable's standard deviation than initially agreed upon. Next, Model 4 suggests that time overruns are 2% more likely for green projects. Model 5 uses the log of time overrun, the log of days the contract is completed after the initially agreed-upon date, to proxy quality.

The estimate suggests that the time overrun of green contracts is 2% longer than the time overrun of other contracts. Model 6 uses an indicator variable equaling one if the contract is canceled as a proxy for quality. We find no difference between green and brown contracts. We would like to note that contracts are rarely canceled in our sample. Only 0.34% of the contracts were canceled. Together, these results help rule out the possibility that quality improvement is the reason behind cost increases. In contrast, the results suggest that green contracts of equal quality might be even more costly than estimated in Subsection 3.1.

Second, we ask whether green procuring negatively affects competition. Recognizing the potential adverse effects on competition, the federal government actively discourages conditions or actions that unjustifiably limit the acquisition of commercial products or services or impede competition in agency contract activities (FAR Subpart 6.502(b)(1)(iv)). This line of argument also has empirical support in the literature. Focusing on military innovation sought by the US government, Howell et al. (2024) show that the design of government competition can explain its effects on competition. In particular, they differentiate open approaches in which firms can suggest innovations versus closed (conventional) approaches for which the government specifies in detail what it is after. Crucially for our analysis, the authors find that in the latter case, competition decreases because of a strong incumbent advantage. Arguably, the green clauses in government contracting are narrow, and hence one might have expected the same outcome – a decrease in competition.

To empirically test the impact that green restrictions have on competition, we use log of number of bids as an outcome variable to proxy the competition.[36] Table 8 summarizes the results. Contrary to what one might have expected, imposing green restrictions on procurement contracts does not reduce competition. The result implies that costly green government contracts are not the result of lower competition.

[36]We would like to point out that data on bidding firms that did not receive a contract are unavailable. We have filed several FOIA requests to obtain these data. These requests were either unanswered or denied, saying that these data are not recorded.

4.2 Regulation

In this subsection, we explore the heterogeneity in the premium associated with strictness of green regulation. The green transition in our empirical setup is encouraged by a set of federal-level regulations (see Subsection 2.1 for more details). Parente and Prescott (1994) point out regulatory constraints as one of the potential reasons behind costly technology adoption. The extent to which Parente and Prescott (1994)'s claim remains valid in the context of the green transition is unclear. The cost of the green transition includes various components. Green regulation may conceivably increase certain cost elements while decreasing others (e.g., reduced energy expenses stemming from the adoption of energy-efficient products). Therefore, we empirically examine whether there exists a positive correlation between the stringency of green regulations and the associated green cost premium.

We empirically test the prediction as follows. As explained in Subsection 3.1, our main regressor $Green_{c,t}$ equals one if the contract c has any of the following five clauses: bio-based, energy efficient, environmentally preferable, FAR 52.223-4, or FAR 52.223-9. In this subsection, we show how the results vary, if at all, if we deviate from this definition. We summarize our results in Table 9.

Insert Table 9

Models 1 through 5 define the regressor based on only one of the five categories mentioned. All five clauses have statistically significant positive impacts on the cost. Notably, FAR 52.223-9's cost sensitivity is the strongest and FAR 52.223-4's is the weakest.

Model 6 simultaneously includes all five clauses. Most of the clauses remain statistically significant. This is consistent with our observation that most of the clauses seem to carry new information even after controlling for the other clauses (Table 2 Panel B). One outlier is FAR 52.223-4: although FAR 52.223-4 individually carries a positive green cost premium (statistically significant) as shown in Model 4, its contribution to the green cost premium gets diminished when the other four clauses are included. This can be explained by the observation that FAR 52.223-4 is highly correlated with other green clauses, in particular with FAR 52.224-9: 100% of the FAR 52.223-9 contracts contain FAR 52.223-4 whereas only 36.7% of FAR 52.223-4 contracts contain FAR 52.223-9. Overall, the results imply that almost all clauses carry an individual green cost premium. Model 6, which includes all clauses jointly, supports this interpretation.

In Model 7, we use an alternative definition of greenness by counting the number of individual clauses. This additive measure has two related interpretations. First, it represents the complexity of requiring the contract to comply with multiple green clauses. Second, because we also include the $Green_{c,t}$ indicator variable in the specification, we can address whether the cost is associated with the extensive margin – whether or not a contract includes any green clause – and/or the intensive margin – the additive complexity component. Our results show that compliance with an additional green clause leads to a 28% increase in the cost, suggesting that each individual green clause is associated with a cost premium. Model 8 supports this view by using yet another transformation, individual indicator variables for the number of individual clauses.

4.3 Supply chain frictions

In this subsection, we explore supply chain frictions as an explanation for the existence of the green cost premium. We use proximity as a proxy for supply chain frictions. Empirically, we ask if the green cost premium depends on whether or not the contract was procured by a local supplier.

Geographic proximity has been pointed out as a key factor in the diffusion of new technologies (Skinner and Staiger, 2007; Foster and Rosenzweig, 2010; Griffith et al., 2011; Holmes, 2011). For example, Holmes (2011) shows that Walmart benefits from multiple stores in close proximity thanks to savings in distribution costs. Following a similar logic, one may argue that the green cost premium stems from underdeveloped distribution networks. Acquiring goods from farther away increases both transportation costs and monitoring costs.

Thus, one may predict that the green cost premium is greater if the vendor is not located at the place of contract execution.

In contrast, local vendors can imply higher costs, especially when the procurement process is constrained. In 2018, the procurement process faced two constraints: a reduction in the green share and a preference for local goods. As shown in Figure 2 and 3, there appears to be a structural break in sustainable procurement in 2018: the share of green contracting plummets. After 2018, the use of green contracts is below pre–2018 levels and only starts to increase in the last two years of the sample. This structural break coincides with the tenure of President Donald Trump. His administration had a more critical attitude toward environmental standards and a clear preference for locally produced goods. Schooner and Speidel (2020) report that "the Trump administration revoked and replaced [executive orders (EO) by the Obama administration] with an EO that subordinated energy and environmental performance to actions that reduce waste, cut costs, enhance the resilience of federal infrastructure and operations, and enable more effective accomplishment of [the government's] mission…" A specific example is the revoking of the Clean Power Plan within his first day of office (Heitz et al., 2023). Second, Trump's administration preferred local production. For example, on April 18, 2017, President Trump issued Executive Order 13788, "Buy American and Hire American."[37] There is anecdotal evidence that this executive order prompted procurement to do the same: buy local regardless of cost.[38,39]

As a result, we perform the analysis in this subsection for two separate periods, before and after 2018. We start by asking whether green contracts are less often supplied by local suppliers. In particular, we estimate the following model:

[37] https://www.federalregister.gov/documents/2017/04/21/2017-08311/buy-american-and-hire-american

[38] https://www.governing.com/archive/gov-procurement-hometown-vendors-local-preference.html

[39] One caveat is that "[the] federal government does not allow any locality to use local preference on projects that depend on federal dollars for their funding." Untabulated results partially suggest otherwise. In particular, while before 2018 around 30% of green contracts were procured locally, that share increased to 80% in 2022.

$$Local\,Supplier_{c,t} = \alpha + \beta \cdot Green_{c,t} + \gamma_c + \eta_t + \epsilon_{c,t} \tag{10}$$

where $Local\,Supplier_{c,t}$ equals one if the supplier and where the contract is executed share the same five-digit zip code.[40] The estimates in Model 1 suggest that green contracts are less likely to be obtained from local suppliers.

Insert Table 10

Next, we study how the geographical proximity between the supplier and where the contract is executed impacts the contract costs. To this end, we estimate the following model:

$$\begin{aligned} Price_{c,t} = {} & \alpha + \beta_1 \cdot Green_{c,t} + \beta_2 \cdot Local\,Supplier_{c,t} \\ & + \beta_3 \cdot Local\,Supplier_{c,t} \cdot Green_{c,t} + \gamma_c + \eta_t + \epsilon_{c,t} \end{aligned} \tag{11}$$

Model 2 documents the green cost premium for the sample under consideration as the benchmark. Model 3 shows that the close proximity between the supplier and the location where the contract is executed decreases the cost of the contract by 19%. In addition, close proximity has an even greater cost impact when contracts are green. If the suppliers are local and the contracts are green, the contract cost decreases by an additional 27.5%. This implies that the green cost premium, accounting for contractor location, amounts to 47.1% which is greater than in our main Table 3 Model 3. We interpret this evidence as indicating that search friction significantly contributes to the elevated costs of green contracts during the early part of the sample.

In Models 4 to 6, we repeat the same analysis for the period after 2018. Compared

[40] Other definitions such as three-digit zip codes or counties yield similar results.

to the period before 2018, green contracts are equally less likely to be procured by local suppliers and carry the same average premium; see Models 4 and 5. However, Model 6 tells a new story, namely that local suppliers are the ones that demand the highest premium. In light of the substantial changes in the use of local suppliers after 2018 – that is, 30% of green contracts were sourced locally before 2018 and 80% of them were sourced locally after 2022 – we interpret this evidence as such: after 2018, the government displayed a significant preference for local contractors. This excessive demand for local contracts is not matched by equal supply, which imposes additional costs.

Taken together, we interpret the evidence in this section to be consistent with the hypothesis that search frictions are a partial explanation of the green cost premium.

5 Conclusion

This paper examines the green cost premium paid by customers and its underlying economic drivers. Using a large panel of nearly identical US federal procurement contracts – some green, some not – we estimate a premium of 25-38%. Accounting for potential biases using a Bartik instrument and a natural experiment reveals an even higher premium, reaching up to 188%. The green premium varies significantly across agencies and product types, driven in part by environmental characteristics and institutional experience. Much of the added cost reflects upfront investments to meet sustainability standards, along with regulatory complexity and supply chain frictions, rather than differences in contract size, quality, or competition. These findings suggest that a successful green transition depends not only on investors' willingness to pay for it, as emphasized in prior literature, but also on customers' readiness to bear higher costs of sustainable goods.

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Department of Energy

FY 2020 OMB SCORECARD FOR EFFICIENT FEDERAL OPERATIONS/MANAGEMENT

GOAL ASSESSMENT	METRICS	PERFORMANCE RATING*	OTHER PROGRESS INDICATORS	
FACILITY ENERGY EFFICIENCY	Change in energy intensity (Btu/GSF) compared to FY 2003:	-38.9%	FY 2003: 222,627 Btu/GSF; FY 2019: 138,741 Btu/GSF; FY 2020: 136,014 Btu/GSF	
	Change in energy intensity (Btu/GSF) from prior year:	-2.0%	Average cost of energy per site-delivered million Btu:	$19.75
EFFICIENCY MEASURES/ INVESTMENT	EISA-covered facilities evaluated for efficiency opportunities:	99.9%	Implementation cost of ECMs identified for potential investment ($M):	$1,266.7
	Utilized performance contracting in FY 2020 to achieve energy, water, building modernization, infrastructure goals?	No	Direct investment in FY 2020 ($M):	$19.9
			ESPC and UESC investment in FY 2020 ($M):	$0.0
			Annual Btu saved per $1 of investment in 2020:	7,062
RENEWABLE ENERGY USE	Renewable electricity used (as a percentage of total electricity use):	21.2%	Renewable electricity + non-electric renewable energy used (as a percentage of total electricity use):	23.6%
WATER EFFICIENCY	Change in potable water intensity compared to FY 2007:	-34.3%	FY 2007: 68.3 Gal/GSF; FY 2019: 45.9 Gal/GSF; FY 2020: 44.9 Gal/GSF	
	Change in potable water intensity from prior year:	-2.2%	Cost of potable water per thousand gallons:	$4.04
HIGH PERFORMANCE SUSTAINABLE BUILDINGS	Percent of owned buildings (eligible) meeting the sustainability criteria:	13.8%	Buildings meeting sustainability criteria:	236
	Percentage point difference from prior year:	1.1	Total count of eligible buildings:	1,705
	Percent of GSF (eligible) meeting the sustainability criteria:	11.6%	GSF meeting sustainability criteria (thou.):	9,414
	Percentage point difference from prior year:	1.1	Total eligible GSF (thou.):	81,379
TRANSPORTATION/ FLEET MANAGEMENT	Change in petroleum fuel use in covered fleet compared to FY 2005:	-43.5%	Alternative fuel use as a percentage of total covered fleet fuel use:	22.8%
	Change in petroleum fuel use in covered fleet compared to prior year:	-9.5%	Percentage of covered AFV acquisitions (w/bonus credits):	202.4%
SUSTAINABLE ACQUISITION	Percentage point difference of sustainable contract actions from prior year:	-0.4	Number of applicable contract actions w/ sustainable clauses, FY20:	1,626
			Number of applicable contract actions w/ sustainable clauses, FY19:	1,553
	Percentage point difference of value of contracts with sustainable requirements from prior year:	0.1	Value of applicable contract actions w/ sustainable clauses, FY20:	$20,276.0M
			Value of applicable contract actions w/ sustainable clauses, FY19:	$18,758.0M
Change in Agency Scope 1 and 2 GHG emissions from 2008:		**-51.9%**		

*Due to the COVID-19 pandemic, the data as reported may appear anomalous and represent exogenous factors beyond the agency's control. The impact on agency performance has not been fully evaluated at this time.

Sources: Agency submitted data from Annual Energy Data Report, EISA 432 Compliance Tracking System, Federal Real Property Profile, Federal Automotive Statistical Tool, FPDS

Btu = British thermal units
GSF = Gross square foot (or feet)
MBtu = Million Btu
ESPC = Energy Savings Performance Contracts
UESC = Utility Energy Savings Contracts

ECM= efficiency/conservation measure
AFV = alternative fuel vehicle
FPDS = Federal Procurement Data System
GHG = greenhouse gas

Figure 1: Department of Energy OMB Scorecard for FY 2020

This figure displays the scorecard that the Department of Energy reported to the Office of Management and Budget for fiscal year 2020.

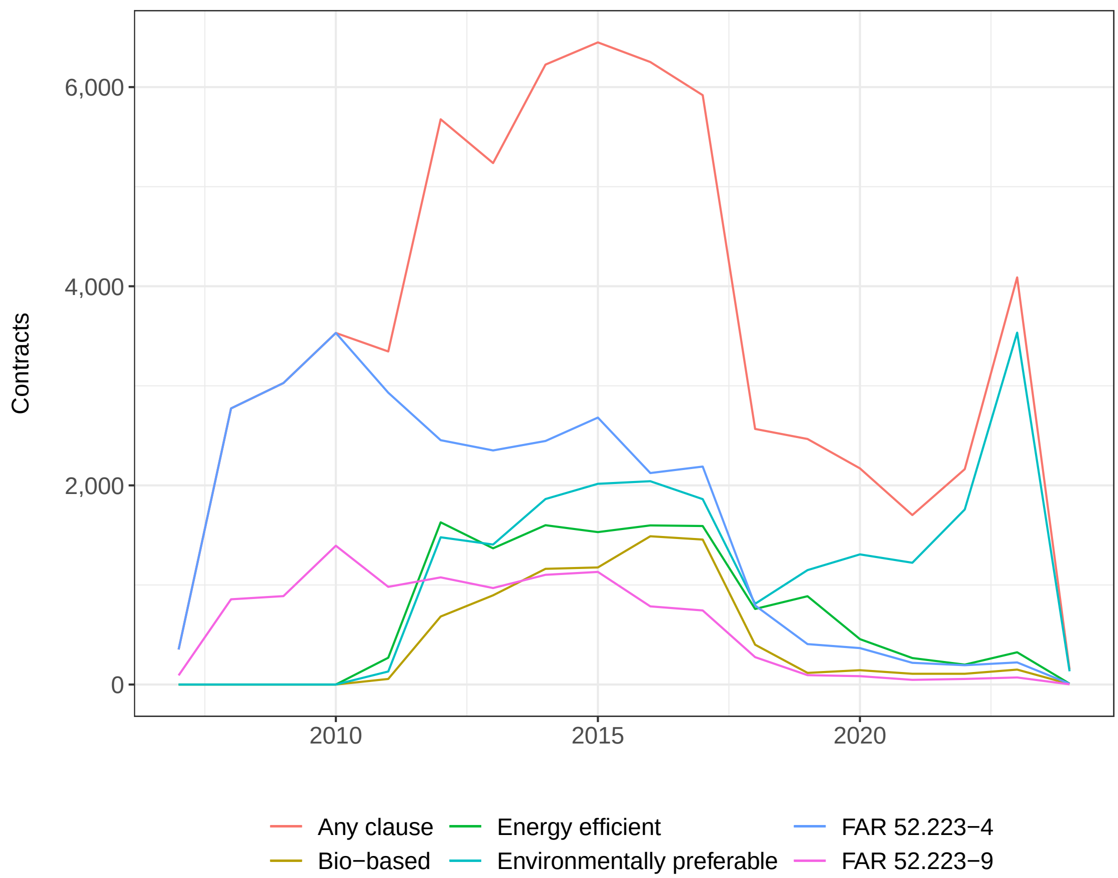

Figure 2: Number of contracts with green clauses
This figure displays a time-series variation in the number of green contracts. The x-axis depicts individual years. The y-axis reports the number of contracts that included a given green contracting clause.

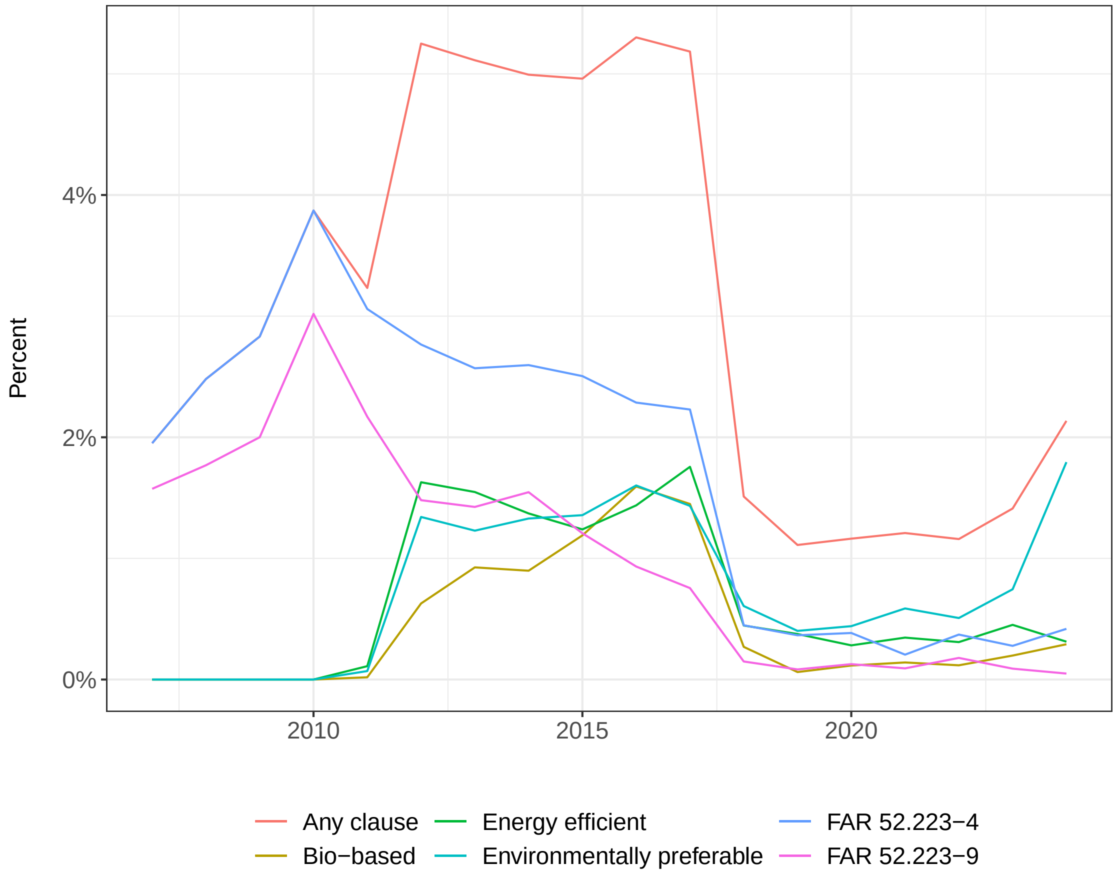

Figure 3: Share of contracts with green clauses
This figure displays a time-series variation in the use of green contracts. The x-axis depicts individual years. The y-axis reports the share of contracting dollars that included a given green contracting clause.

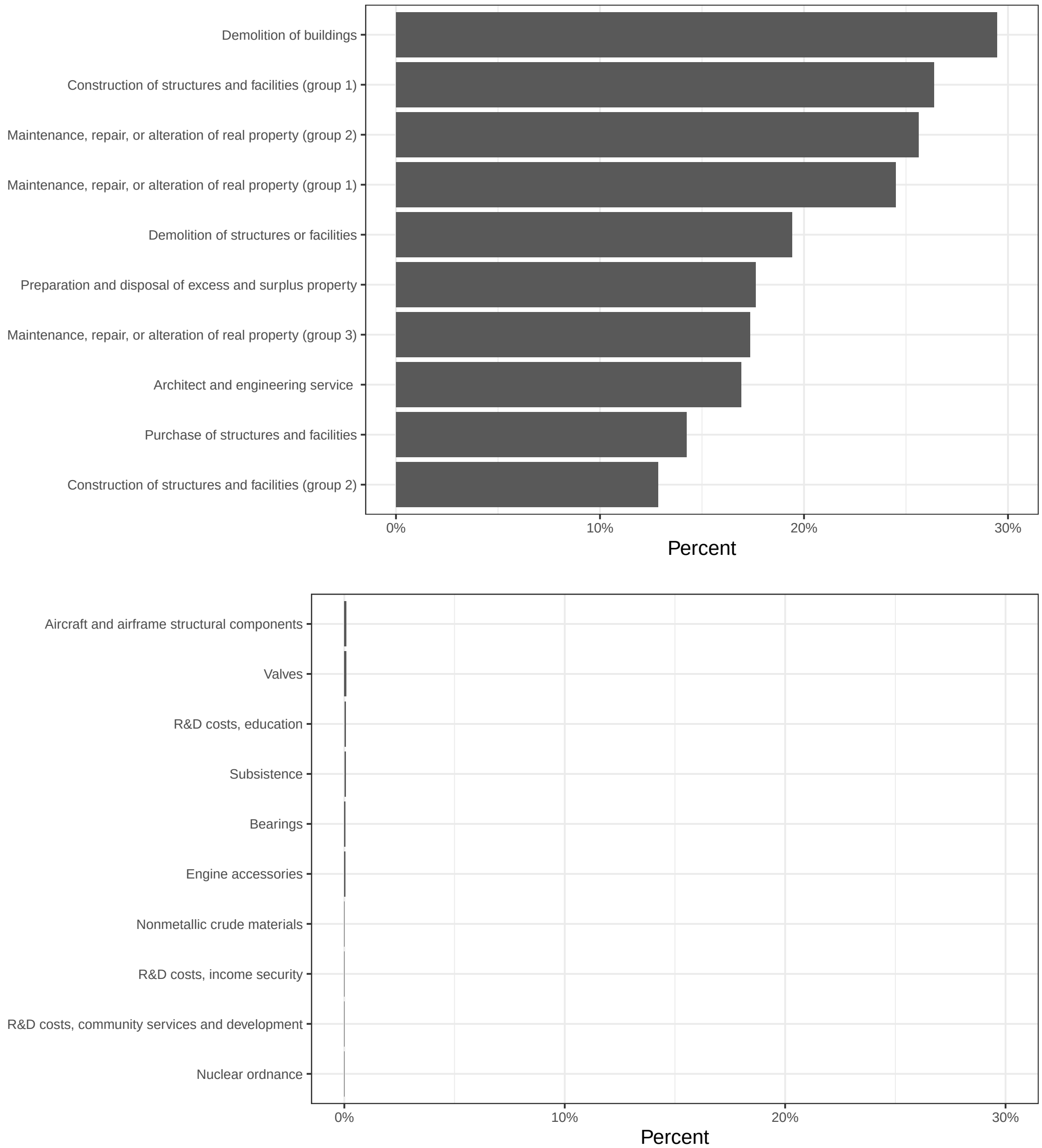

Figure 4: Product type heterogeneity

For each two-digit product and service group with more than 100 unique contracts, we compute the dollar-weighted share of contracts with any green clause. The upper panel presents the ten most-green groups while the lower panel presents the ten least-green groups.

Figure 5: Adoption of green clauses around October 2011
This figure displays time-series variation in the use of the newly introduced green clauses around October 2011. Each line focuses on an individual agency, either the Department of Defense (non-adopter), Department of the Interior (adopter), and Department of Veterans Affairs (adopter). The x-axis depicts individual quarters. The y-axis reports the share of contracting dollars that included a given green contracting clause.

Table 1: Overview of five green clauses

We designate a particular contract as green if it contains at least one of the five green clauses: bio-based, energy efficient, environmentally preferable, FAR 52.223-4, or FAR 52.223-9. This table provides an overview of these five clauses. The first column shows the name of the clauses. The second column provides a description. The third column shows the issuing agency. The fourth column shows the date that the clause was first introduced to the FPDS Data Dictionary. The last column shows the related legislation and logos, if available

Name	Description	Issuing agency	First date	Legislation
FAR 52.223-4	Recovered material certification: This certifies that the percentage of recovered materials content for EPA-designated items to be delivered or used in the performance of the contract will be at least the amount required by the applicable contract specifications or other contractual requirements	EPA	2005	Resource Conservation and Recovery Act of 1976
FAR 52.223-9	Estimate of percentage of recovered material content for EPA-designated products: on completion of this contract, the contractor should estimate the percentage of the total recovered material content for the items delivered and/or used and submit this estimate to the agency	EPA	2005	Resource Conservation and Recovery Act of 1976
Bio-based: FAR 52.223-1; FAR 52.223-2	This certifies that bio-based products (within categories of products listed by USDA) will comply with the applicable specifications or other contractual requirements.	USDA	October 2011	Farm Security and Rural Investment Act of 2002; Energy Policy Act of 2005
Energy efficient: FAR 52.223-15	Identified by the ENERGY STAR Program or Federal Energy Management Program (FEMP).	EPA, Department of Energy	October 2011	National Energy Conservation Policy Act of 1978
Environmentally preferable: FAR 52.223-10, 52.223-13, 52.223-14, 52.223-16, 52.223-17	This prescribes policies for acquiring environmentally preferable products and services. Includes EPEAT-registered, nontoxic, or less-toxic alternatives.	EPA	October 2011	Resource Conservation and Recovery Act; National Energy Conservation Policy Act; Pollution Prevention Act of 1990 ; Farm Security and Rural Investment Act of 2002

Table 2: Summary statistics

This table provides summary statistics for government contracts. The sample consists of all US government procurement contracts awarded competitively between October 2007 and February 2024. Panel A reports summary statistics while Panel B reports the simultaneous use of different green clauses.

Panel A: Summary statistics

	All contracts			Green contracts		Non-green contracts	
	Mean	Std.Dev.	Obs.	Mean	Std.Dev.	Mean	Std.Dev.
Cost	26,436.19	104,906.96	5,772,981	81,765.90	229,714.40	25,814.95	102,478.32
Green contracts (in %)	1.11	10.48	5,772,981	100.00	0.00		
Bio-based contracts (in %)	0.14	3.71	5,772,981	12.40	32.96		
Energy efficient contracts (in %)	0.22	4.65	5,772,981	19.48	39.61		
Environmentally preferable contracts (in %)	0.36	5.98	5,772,981	32.32	46.77		
FAR 52.2234 contracts (in %)	0.50	7.08	5,772,981	45.35	49.78		
FAR 52.2239 contracts (in %)	0.18	4.29	5,772,981	16.61	37.22		
Number of modifications	0.29	3.35	5,772,981	1.44	12.86	0.27	3.08
Cost overrun	0.01	0.16	5,772,981	0.05	0.27	0.01	0.16
Time overrun	0.33	1.27	5,772,981	0.90	2.01	0.32	1.25
Cancellation	0.00	0.00	5,772,981	0.00	0.00	0.00	0.00
Number of bids	4.01	3.98	5,772,981	3.10	2.95	4.02	3.99

Panel B: Simultaneous use of green clauses

	Observations	Share that includes green clause				
		Bio-based	Energy efficient	Environmentally preferable	FAR 52.2234	FAR 52.2239
	Number	%	%	%	%	%
All contracts	5,772,981	0.14	0.22	0.36	0.50	0.18
Bio-based contracts	7,950	100.00	17.12	18.75	29.27	0.00
Energy efficient contracts	12,488	10.90	100.00	9.07	14.85	0.00
Environmentally preferable contracts	20,714	7.20	5.47	100.00	9.37	0.00
FAR 52.2234 contracts	29,068	8.01	6.38	6.67	100.00	36.63
FAR 52.2239 contracts	10,647	0.00	0.00	0.00	100.00	100.00

Table 3: Main regression – the costs of green contracts

This table investigates the costs associated with green contract clauses. The dependent variable is the log of a contract's costs. The main independent variable is an indicator whether a contract includes at least one green clause. The sample consists of all US government procurement contracts awarded competitively between October 2007 and February 2024. Coefficients are reported in percentages. Robust standard errors are clustered on three-digit product and service (p&s) codes and reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

	Dependent variable: log(cost)						
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables							
Intercept	808.5***						
	(12.2)						
Green	133.0***	30.5***	25.5***	37.6***	25.5***	24.6***	26.8***
	(22.1)	(10.4)	(8.4)	(6.5)	(5.9)	(4.3)	(4.2)
Fixed effects							
Month		Yes	Yes	Yes			
Three-digit p&s code		Yes	Yes	Yes	Yes		
Set-aside code		Yes	Yes	Yes	Yes		
County			Yes	Yes	Yes	Yes	Yes
Agency				Yes			
Agency × year					Yes	Yes	
Agency × three-digit p&s code						Yes	
Agency × two-digit p&s code × year							Yes
Fit statistics							
Observations	5,772,981	5,772,981	5,772,981	5,772,981	5,772,981	5,772,981	5,772,981
R^2	0.00	0.41	0.48	0.52	0.53	0.53	0.53

Table 4: Causality – Bartik instrument

This table investigates the cost premium associated with green contract clauses on agency, state, and year level. The panel aggregates individual contracts to an agency-state-year level. The dependent variable is the total money spent on contracts. The main explanatory variables is the share of contracting dollars spent on green contracts. Models 2 and 4 report the first-stage of an IV regression using a Bartik instrument. The instrument is constructed by multiplying the national share of green contracts per three-digit product and service (p&s) code with the share of products within each three-digit product and service code per agency, state, and year. In Model 4, we employ a leave-out estimator following Borusyak et al. (2022). Coefficients are reported in percentages. Robust standard errors are clustered on awarding agency and year, and reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

	OLS	IV first-stage	IV second-stage	IV first-stage	IV second-stage
Dependent variables:	log(cost)	Green	log(cost)	Green	log(cost)
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
Green	49.23**		287.00***		335.63***
	(19.58)		(48.16)		(77.92)
Bartik instrument		0.71***			
		(0.09)			
Bartik instrument (leave out)				0.56***	
				(0.14)	
log(number of contracts)	1.06***	0.00	1.05***	0.00	1.05***
	(0.02)	(0.00)	(0.03)	(0.00)	(0.03)
Fixed-effects					
Year	Yes	Yes	Yes	Yes	Yes
State	Yes	Yes	Yes	Yes	Yes
Awarding agency	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	14,705	14,705	14,705	14,705	14,705
R^2	0.77	0.19	0.74	0.17	0.73
F-statistics		903.1		491.8	

Table 5: Causality – natural experiment

This table explores the effect of introducing new green clauses (bio-based, environmentally preferable, and energy efficient) on contract costs in three government agencies in 2011. The main dependent variables are an indicator whether a contract includes a green clause and the log costs associated with the contract. Post is an indicator whether the new green clauses are introduced. Treat is an indicator whether the awarding agency is an adopter of green contract clauses in this period. The sample consists of all US government procurement contracts awarded competitively by the Department of Defense (non-adopter), the Department of Veterans Affairs, and the Department of the Interior, with the exception of contracts with a FAR 52.2239 and FAR 52.2234 clause. Individual models consider different time around the introduction of the new green clauses as indicated. Coefficients are reported in percentages. Robust standard errors are clustered on three-digit product and service (p&s) codes and reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Dependent variables:	Green			log(cost)		
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
Post	0.2*	0.1***	0.4***	1.2	-1.0	2.2
	(0.1)	(0.1)	(0.1)	(1.7)	(2.0)	(2.3)
Post × treat	2.5**	2.9***	3.9***	15.9**	29.2***	12.6***
	(1.0)	(0.8)	(0.5)	(7.4)	(10.6)	(4.8)
Sample period						
October 2010 & October 2011	Yes	No	No	Yes	No	No
November 2010 & November 2011	No	Yes	No	No	Yes	No
October 1, 2010 to October 1, 2012	No	No	Yes	No	No	Yes
Fixed effects						
Month	Yes	Yes	Yes	Yes	Yes	Yes
Two-digit p&s code	Yes	Yes	Yes	Yes	Yes	Yes
Set-aside code	Yes	Yes	Yes	Yes	Yes	Yes
County	Yes	Yes	Yes	Yes	Yes	Yes
Awarding agency	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics						
Observations	27,274	26,115	368,458	27,274	26,115	368,458
R^2	0.25	0.20	0.08	0.30	0.36	0.29

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table 6: Cross-sectional variation

This table investigates heterogeneity in the costs associated with green contract clauses. The dependent variable is the log of a contract's costs. The main independent variable is a indicator variable equaling one if a contract includes at least one green clause interacted with another indicator variable equaling one if the contract is associated with a green product, firm, or agency. A green product, firm, or agency is defined as having a share of green contracts above the median in the prior year. The sample consists of all US government procurement contracts awarded competitively between October 2007 and February 2024. Coefficients are reported in percentages. Robust standard errors are clustered on three-digit product and service (p&s) codes and reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Dependent variable:		log(cost)	
Model:	(1)	(2)	(3)
Variables			
Green	55.2***	55.3***	40.8***
	(6.7)	(8.8)	(7.2)
D(green product type)	10.8***		
	(2.6)		
Green × D(green product type)	-28.3***		
	(10.7)		
D(green agency)		56.2***	
		(3.7)	
Green × D(green agency)		-56.1***	
		(9.8)	
D(green firm)			13.3***
			(2.3)
Green × D(green firm)			-32.6***
			(8.2)
Fixed effects			
Month	Yes	Yes	Yes
Three-digit p&s code	Yes	Yes	Yes
Set-aside code	Yes	Yes	Yes
County	Yes	Yes	Yes
Awarding agency	Yes	Yes	Yes
Fit statistics			
Observations	4,976,366	4,978,779	4,978,779
R^2	0.52	0.52	0.52

Table 7: Time-series variation

This table investigates whether the costs associated with individual green contracts decrease over time. The dependent variable is the log of a contract's costs. Our main explanatory variable, the contract number, captures how many green contracts have been issued at the agency, three-digit product and service (p&s) code, and state level up to the current contract. The higher this number, the more similar green contracts have been awarded. The sample consists of all green contracts and a set of control contracts. For each green contract, we randomly with replacement select a control contract that is issued by the same agency, is within the same three-digit p&s code, awarded in the same state and during the same year. The sample consists of all US government procurement contracts awarded competitively between October 2007 and February 2024. Coefficients are reported in percentages. Robust standard errors are clustered on three-digit product and service (p&s) codes and reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Dependent variable:		log(costs)	
Model:	(1)	(2)	(3)
Variables			
Green	22.0***	32.9***	31.0***
	(4.0)	(3.7)	(3.0)
Contract number	-0.1		
	(0.1)		
Contract number × green	-0.3*		
	(0.2)		
log(Contract number)		-1.1	
		(1.2)	
log(Contract number) × green		-10.1***	
		(2.5)	
Contract number (1,10]			0.3
			(1.9)
Contract number (10,25]			3.9
			(3.0)
Contract number (25,50]			6.9
			(5.7)
Contract number (50+)			-13.4
			(8.2)
Contract number (1,10] × green			-9.2***
			(3.0)
Contract number (10,25] × green			-25.6***
			(4.6)
Contract number (25,50] × green			-42.3***
			(8.8)
Contract number (50+) × green			-45.1***
			(14.7)
Fixed effects			
Month	Yes	Yes	Yes
Three-digit p&s code	Yes	Yes	Yes
Set-aside code	Yes	Yes	Yes
County	Yes	Yes	Yes
Awarding agency	Yes	Yes	Yes
Fit statistics			
Observations	73,820	73,820	73,820
R^2	0.40	0.40	0.40

Table 8: Contract quality and competition

This table investigates the effect of green contract clauses on quality and competition. The dependent variables are log of number of modification, cost overrun, time overrun, an indicator variable equaling one if the contract was canceled, and the log of received bids. The main independent variable is an indicator variable equaling one if a contract includes at least one green clause. The sample consists of all US government procurement contracts awarded competitively between October 2007 and February 2024. Coefficients are reported in percentages. Robust standard errors are clustered on three-digit product and service (p&s) codes and reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Dependent variables:	Modification > 0	log(modifications)	Cost overrun	Time overrun > 0	log(time overrun)	Cancellation	log(nr. bids)
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables							
Green	3.2***	12.0***	2.1**	2.3***	2.0**	0.1	-3.0
	(0.9)	(1.6)	(0.8)	(0.7)	(0.9)	(0.1)	(2.6)
log(cost)	2.4***	7.9***	-0.1	1.7***	2.0***	0.1***	1.5***
	(0.1)	(0.4)	(0.1)	(0.1)	(0.2)	(0.0)	(0.4)
log(maturity)	3.2***	10.2***	1.3***	1.1***	4.6***	0.1***	0.5
	(0.3)	(0.5)	(0.2)	(0.2)	(0.4)	(0.0)	(0.5)
Fixed effects							
Month	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Three-digit p&s code	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Set-aside code	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Awarding agency	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics							
Observations	5,772,981	741,318	5,772,981	5,772,981	389,730	5,772,981	5,772,981
R^2	0.21	0.32	0.12	0.13	0.26	0.02	0.22

Table 9: Individual clauses

This table investigates the costs associated with individual green contract clauses. The dependent variable is the log of a contract's costs. The main independent variable is an indicator variable equaling one if a contract includes a given green clause. In particular, we consider clauses for bio-based, energy efficient, environmentally preferable, FAR 52.2234, and FAR 52.2239 contracts. The sample consists of all US government procurement contracts awarded competitively between October 2007 and February 2024. Coefficients are reported in percentages. Robust standard errors are clustered on three-digit product and service (p&s) codes and reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

	Dependent variable: log(cost)							
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables								
Bio-based	24.7*					13.8		
	(13.7)					(13.5)		
Energy efficient		23.8**				20.4**		
		(9.5)				(8.8)		
Environmentally preferable			58.0***			57.3***		
			(8.1)			(8.0)		
FAR 52.2234				32.8***		1.1		
				(8.1)		(7.0)		
FAR 52.2239					66.4***	67.8***		
					(11.8)	(11.7)		
Nr. of clauses							28.4***	
							(4.0)	
D(One clause)								29.5***
								(6.8)
D(Two clauses)								66.2***
								(10.7)
D(Three clauses)								40.1***
								(12.1)
D(Four clauses)								69.2***
								(7.9)
Fixed effects								
Month	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Three-digit p&s code	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Set-aside code	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Agency	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics								
Observations	5,772,981	5,772,981	5,772,981	5,772,981	5,772,981	5,772,981	5,772,981	5,772,981
R^2	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52

Table 10: Search friction

This table investigates whether the premium of green contracts relates to non-local sourcing. The dependent variable is either the contract's costs (federal action obligation) or an indicator variable if the contract was delivered by a local supplier. Suppliers are local if the contract is executed at the same five-digit zip code as the contractor's location. The sample consists of all US government procurement contracts awarded competitively between October 2007 and February 2024. Coefficients are reported in percentages. Robust standard errors are clustered on three-digit product and service (p&s) codes and reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

	Pre–2018			Post–2018		
Dependent variables:	Local supplier	log(cost)	log(cost)	Local supplier	log(cost)	log(cost)
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
Green	-5.2***	36.9***	47.1***	-3.7**	35.2**	4.1
	(1.0)	(6.2)	(6.3)	(1.7)	(14.2)	(17.0)
Local supplier			-19.0***			-44.1***
			(2.1)			(5.8)
Green × local supplier			-27.5***			49.8***
			(8.4)			(11.1)
Fixed effects						
Month	Yes	Yes	Yes	Yes	Yes	Yes
Three-digit p&s code	Yes	Yes	Yes	Yes	Yes	Yes
County	Yes	Yes	Yes	Yes	Yes	Yes
Awarding agency	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics						
Observations	3,608,531	3,608,753	3,608,531	2,164,226	2,164,228	2,164,226
R^2	0.46	0.48	0.48	0.44	0.55	0.55