THESIS (Chapter 1/2)

PUBLIC WILLINGNESS TO PAY FOR A U.S. CARBON TAX

AND PREFERENCES FOR SPENDING THE REVENUE

Abstract

With recent bipartisan interest in carbon taxes to reduce global warming, we query the preferences of American households using a nationally representative sample. We estimate willingness to pay (WTP) in the U.S. to reduce global warming through a tax on fossil fuels that increases household energy bills and find a mean WTP of $177 or 15-percent on average. Particularly timely, we also ask households to identify how they prefer the resulting revenues be spent and find substantial support to aid displaced coal workers, fund clean energy development, and improve the nation’s infrastructure. Based on the public’s preferred allocation, we find aggregate support of $3.47 billion for clean energy development, $3.0 billion for infrastructure, and $2.1 billion to aid displaced coal workers *per year*. The latter is more than sufficient to replace the wages of every extraction worker, even if the entire coal industry were to be phased out.

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I, Zachary Turk, conducted the statistical analysis and composition of this study. The survey questions were developed by Matthew Kotchen (thesis advisor) and Anthony Leiserowitz (thesis co-advisor) and included in a larger survey instrument implemented by Anthony Leiserowitz. I am grateful for their substantial contributions and feedback on this work. I would also like to thank Joseph Aldy and Stefano Carattini for providing feedback on the version submitted to an academic journal. I also gratefully acknowledge the financial support of the 11th Hour Project, the Energy Foundation, the Grantham Foundation, and the MacArthur Foundation in fielding the survey.

**Public Willingness to Pay for a U.S. Carbon Tax and Preferences for Spending the Revenue**

# Introduction

While a proposal for a national carbon tax is neither new nor particularly novel, it reemerged into the spotlight recently by way of a proposal by academic conservative leaders. In February 2017, the Climate Leadership Council released *The Conservative Case for Carbon Dividends*, in which the case for a carbon tax starting at $40 per ton is presented. Given the notoriety of the conservative contributors, the report gathered substantial media attention, starting at The New York Times and quickly propagating. The plan also specifically calls for carbon dividends to all Americans and project a rather large $2,000 dividend payment from the first year. This suggests a substantial cost of the policy on carbon intensive energy users which almost certainly will be passed on to the American public to some extent. Unfortunately, translating a $40 per ton carbon tax in more tangible terms accurately ex ante, say in terms of household energy bill increases, is rather difficult and relies on strong incidence assumptions. So rather than debate whether a carbon tax should be used and at what scale, we exploit recent survey work to identify the preferences of the American public for scale and expenditure preferences for such collections. We find mean national willingness to pay (WTP) through increased energy bills of $168 and distributional preferences that differ substantially from a bulk dividend. Respondents instead prefer substantial expenditures on public goods which will otherwise be underprovided. We suggest that rather than a top-down perspective on setting carbon tax rates and distributions, a bottom-up perspective be considered to match the American public’s preferences.

Beyond a commentary on the recent conservative proposal, this paper contributes to a small but growing literature on WTP to reduce global warming. For example, Greenstone (2016) which attempted a similar WTP measure gathered substantial media attention. Two of our coauthors also contributed closely related work in recent years (Aldy, Kotchen, & Leiserowitz, 2012; Kotchen, Boyle, & Leiserowitz, 2013). We add to this in estimating household WTP to reduce global warming by way of a tax on fossil fuels that increases household energy costs. Importantly, we also report on the public’s distributional preferences for resulting revenue and conclude by discussing the level of assistance implied for workers displaced by changes in energy demand resulting from the tax among other potential uses. This clearly has implications in gathering support for a global warming response, particularly from members of the public who may have earnings reduced by such a policy.

To address our question, we use a nationally representative survey of 1,226 U.S. citizens collected in late 2016. The survey queries respondents on global warming beliefs, information sources, actual and hypothetical responses to global warming, and a standard set of demographics. Importantly, it also queries on expenditure preferences for revenue generated from global warming-related taxes, a good starting point for our analysis. The question posits that congress may consider a tax on fossil fuels to help reduce global warming, then presents several expenditure categories the respondent may vote in support of or against allotting money to. Immediately following this selection, respondents are asked to allot revenue in percentage terms between their selected categories. The data provides perspective on public preference for the expenditure of such taxes. Among other things, it indicates whether respondents believe a carbon tax should be strictly compartmentalized to the global warming fiscal sphere or spent on a variety of public and compensatory matters indicating less concern over global warming versus less temporally distant concerns.

# Main results

As context, the general levels of support we find are not surprising. In a separate question in the study we query respondent preferences for policy instruments. We ask whether respondents prefer taxes, regulation, freeing the regulator to do both, doing neither, or stating they don’t know. In total, 76-percent of respondents report a preference for regulation and/or taxation on fossil fuels to reduce global warming, and of these 59.3-percent select either using a tax or both. Among those that have an opinion- excluding those that respond “don’t know”, 68.7-percent select a tax or both. This level of support for taxation is in line with the recent, and somewhat unexpected, proposal by conservative leaders for a tax on CO2 emissions.

The results of the tax allocation choice are presented in Table 1. We report both the binary response of whether respondents support expenditure of the tax on the category and an average percent allotment measure. The mean allotment to each category also including respondents who allot zero funds by not supporting the expenditure category and so represents the preferences of all respondents. By asking respondents to allocate between several expenditure schemes, we report on what sort of tax revenue uses Americans find appropriate for a carbon tax. These can loosely be divided into global warming specific- those assisting communities and individuals displaced by the tax or global warming, and the non-specific. This allows a brief exploration of respondent mental accounting- do they see a tax on fossil fuels as only appropriately spent on energy concerns or as fluid within the full set of budget concerns? Specifically, expenditure possibilities also include public goods provision- infrastructure and national debt, as well as private- reduction in other taxes or as an income source. Some results are not surprising- those that support a tax on fossil fuels also support clean energy and that the general public has little interest in reducing corporate tax burdens. More interesting and telling of the public’s concerns, however, may be other spending preferences- the public overwhelmingly supports infrastructure spending and national debt reduction from this unrelated potential tax revenue.

Of particular interest is the category “Assist workers in the coal industry that may lose their jobs as a result of the tax”. In combination with a mean willingness to pay measure, it suggests the financial scale of public support for assisting fossil fuel extractors in transitioning out of the field. While respondents place a lower priority on helping this group than developing clean energy at 16.4-percent allotment, repairing the nation’s infrastructure at 14-percent, and paying down the national debt at 12-percent, it receives substantial attention. With a mean allotment of 10.1-percent the public appears to support substantial compensation to displaced workers within the coal industry.

We also note that at first sight it may appear respondents place low priority on helping communities that are vulnerable to global warming but this may be a result of how the questions are formulated. Respondents could choose from both “Assist low-income communities that are most vulnerable to the impacts of global warming” and “Fund programs to help American communities prepare for and adapt to global warming.” These likely compete for the same social concerns and sum to a 13.9-percent allotment.

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| **Table 1 | Respondent preferences for the expenditure of revenues from a fossil fuel tax to help reduce global warming.** | | | |
|  | **Support (%)** | **Allotment (%)** | **Support ($ billions)** |
| Support the development of clean energy (solar, wind) | 79.8 | 17.3 | 3.84 |
| Fund improvements to America’s infrastructure (roads, bridges, etc.) | 77.4 | 14.5 | 3.22 |
| Pay down the national debt | 65.5 | 12.7 | 2.83 |
| Assist workers in the coal industry that may lose their jobs as a result of the tax | 71.9 | 10.4 | 2.32 |
| Reduce Federal income taxes | 59.3 | 9.9 | 2.19 |
| Return the money to all American households in equal amounts | 45.9 | 8.1 | 1.81 |
| Assist low-income communities that are most vulnerable to the impacts of global warming | 57.3 | 7.8 | 1.73 |
| Fund programs to help American communities prepare for and adapt to global warming | 54.6 | 7.2 | 1.61 |
| Reduce Federal payroll taxes (Social Security and Medicare taxes that are deducted from paychecks) | 44.2 | 7.2 | 1.60 |
| Reduce corporate taxes | 24.4 | 3.2 | 0.72 |
| Other (please specify) | 7.8 | 1.7 | 0.39 |
| Reported as survey weighted statistics. Support (%) indicates share of respondents that support using the revenue generated in the stated manner. Allotment (%) reports the mean allotment including both those that support the revenue’s use on the expenditure category and those that do not support it and would allot nothing. Support ($ billions) is the implied aggregate support for the category based on our mean WTP of $177 and U.S. Census Bureau estimate of 125,819,000 U.S. households. | | | |

To ascertain willingness to pay to reduce global warming, we then offer randomly selected annual bid amounts to respondents following recommended contingent valuation methodologies. The randomly offered bid amount ranges between $5 and $155. This is from 0.4-percent to 11.3-percent of the average residential energy bill in the United States. As point of reference, the national average monthly energy bill is $114.03 at the time of survey and we acknowledge wide variability in monthly energy expenditures, from $79.23 in New Mexico to $153.13 in Connecticut. The format of the question posed is whether the respondent supports a tax on fossil fuels to help reduce global warming that will result in an annual household energy bill increase of the bid amount. The support at each bid, in both dollar terms as presented to the panel, and as percent increases, are presented in Table 2 along with the percent of respondents that were queried and opted to support it.

We find the percent of respondents supporting the proposal exceeds 50-percent at each bid amount offered. This presents certain complications in deriving a point estimate for WTP as the mean exceeds the range of bids presented and thus relies on the functional form used in estimation to project it. However, it also suggests a lower bound on WTP of at least $155 annually, the highest bid presented, and is not unprecedented (Aldy, Kotchen, and Leiserowitz, 2012). It does, however, require additional consideration in the analysis to follow.

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| **Table 2 | Distribution of support responses by bid amount.** | | | |
| **Bid amount** | **Household bill increase (%)** | **Respondents queried (#)** | **Support (%)** |
| $5 | 0.4 | 99 | 77.5 |
| $25 | 1.8 | 104 | 63.6 |
| $45 | 3.3 | 180 | 53.3 |
| $65 | 4.8 | 222 | 52.0 |
| $85 | 6.2 | 205 | 60.5 |
| $105 | 7.7 | 184 | 52.4 |
| $135 | 9.9 | 108 | 59.3 |
| $155 | 11.3 | 119 | 61.4 |
| Five respondents refused to answer the prompt and are not included, note this did not occur more than once per bid amount. Percentage household bill increase based on the 2015 national average monthly residential energy bill of $114.03 (EIA). | | | |

Using a logit model including our randomized bid amount, the bid result as dependent variable, demographic covariates, and global warming belief indicators, we estimate the probability of supporting the tax on fossil fuels to reduce global warming. The results in Table 3 focus on the marginal effects of each variable. Model 1 presents results of a model specifying demographics, political affiliation, and bid but does not specifically address global warming beliefs which are then added in model 2. Model 3 further breaks out global warming beliefs by indicators for respondents who report being at least “very sure” in their respective global warming stance. This specification follows Kotchen, Boyle, and Leiserowitz (2013) where strength of attitudes on global warming is a statistically significant indicator of willingness to pay in support for a national clean energy standard (NCES) rather than political affiliation alone. We find a similarly absolving result- ‘republican party’ alone is not a statistically significant indicator of global warming disbelief but rather such beliefs are independent of democrat versus conservative.

Model 2 is our preferred specification for analysis of willingness to pay and the discussion extends from its results. Analyzing marginal effects, a $10 increase in household energy bills results in a 1-percent decrease in the probability of supporting a tax on fossil fuels to combat global warming for the average household. Statistically insignificant effects on support probability are found for education, gender, household size. Including controls for climate change beliefs further reduces the magnitude of their coefficient estimates. A $10,000 increase in income increases the probability of support as expected. Republicans, independents, and those claiming no party affiliation or leaning are each substantially less likely to support such a proposal than the base group democrats, with magnitudes of 11.2, 20.1, and 17.6-percent decreases, respectively. We also estimate model 4 which differs in how the variable “bid amount” is specified. Rather than as a dollar amount, we transform bids offered into percentage increases in the average energy bill in each respondent’s home state using data from the Energy Information Administration (EIA). This provides a particularly nice interpretation of the bid coefficient- a 1-percent increase in household energy bills results in a 1-percent decrease in support for the tax.

But by far the largest effect on the probability of support comes with beliefs on whether global warming is happening. Those who claim global warming is not happening, representing 12.6-percent of the population, are 25.4-percent less likely to support the proposal. In comparison, those that do believe global warming is happening, representing most the U.S. population, are instead 35.2-percent more likely to support such a proposal than the don’t know base group. These beliefs, more than any other demographic or political indicator, appear to account for the most opposition to a carbon tax among the public. Finally, the point estimates of mean WTP derived from each model are reported at the bottom of Table 3. The derivation of these and alternative measures of the preferred model are discusses in detail.

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| **Table 3 | Marginal effects from logit models of support for a tax on fossil fuels to reduce global warming that result in higher household energy bills.** | | | | | |
|  | (1) | (2) | (3) | (4) | |
|  |  | | | | (percent) |
| Bid amount | -0.000704\* | -0.000845\*\* | -0.000966\*\* | -0.00982\* | |
|  | (0.000380) | (0.000421) | (0.000426) | (0.00536) | |
| Education (years) | 0.0137\*\* | 0.0101 | 0.00801 | 0.0102 | |
|  | (0.00643) | (0.00678) | (0.00683) | (0.00679) | |
| Male (1=yes) | -0.0242 | -0.0329 | -0.0352 | -0.0320 | |
|  | (0.0331) | (0.0357) | (0.0362) | (0.0357) | |
| Household size (# people) | -0.00918 | -0.00981 | -0.00644 | -0.0101 | |
|  | (0.0124) | (0.0133) | (0.0137) | (0.0133) | |
| Income ($10,000's) | 0.00923\*\*\* | 0.00864\*\* | 0.00800\*\* | 0.00878\*\* | |
|  | (0.00329) | (0.00352) | (0.00368) | (0.00350) | |
| Age (years) | -0.000903 | -0.00107 | -0.000751 | -0.00110 | |
|  | (0.00102) | (0.00109) | (0.00111) | (0.00109) | |
| White (1=yes) | 0.0791\*\* | 0.0738\* | 0.0508 | 0.0736\* | |
|  | (0.0396) | (0.0418) | (0.0431) | (0.0419) | |
| Republican (1=yes) | -0.268\*\*\* | -0.112\*\* | -0.0648 | -0.112\*\* | |
|  | (0.0369) | (0.0436) | (0.0451) | (0.0436) | |
| Independent (1=yes) | -0.303\*\*\* | -0.201\*\*\* | -0.186\*\*\* | -0.201\*\*\* | |
|  | (0.0529) | (0.0574) | (0.0587) | (0.0572) | |
| No party (1=yes) | -0.220\*\*\* | -0.176\*\*\* | -0.152\*\* | -0.175\*\*\* | |
|  | (0.0588) | (0.0659) | (0.0693) | (0.0659) | |
| Global warming (no=1) |  | -0.254\*\*\* | -0.154\* | -0.254\*\*\* | |
|  |  | (0.0693) | (0.0826) | (0.0693) | |
| Global warming (yes=1) |  | 0.352\*\*\* | 0.247\*\*\* | 0.352\*\*\* | |
|  |  | (0.0440) | (0.0522) | (0.0439) | |
| Global warming (no, very sure=1) |  |  | -0.245\*\* |  | |
|  |  |  | (0.120) |  | |
| Global warming (yes, very sure=1) |  |  | 0.200\*\*\* |  | |
|  |  |  | (0.0422) |  | |
| Implied mean WTP | $204 | $177 | $168 | 14.4-pct | |
| The dependent variable indicates whether the respondent supports a tax on fossil fuels at the randomized bid amount presented. The bid is in dollars in models 1-3 and as a percentage increase in average household energy bills in the respondent’s state in model 4. Each model includes 1,220 observations which excludes six respondents who refused political affiliation or other questions weighted for survey representativeness. Democrat and global warming 'don't know' are the omitted categories for their respective contributions. Global warming 'no, very sure' and 'yes, very sure' include responses indicating either 'very sure' or 'extremely sure'. The mean WTP point estimates are included in Appendix A. Standard errors are in parentheses and follow conventional notation: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1 | | | | | |

Using our preferred specification, model 3, we estimate mean willingness to pay admitting the possibility of respondents having negative WTP. While model 4 has a clearer coefficient interpretation, model 3 estimates WTP using bids as they appear in the survey. Admitting the possibility of negative WTP conceptually includes the wishes of respondents who are opposed to the tax on fossil fuels to an extent that they would be willing to pay some amount to avoid the tax being imposed. Table 4 provides results from estimating mean (equal to median) willingness to pay using the standard methodologies noted. As the resulting mean WTP exceeds the highest bid amount offered in the survey, not expected ex ante, a diversity of estimation methods are undertaken to arrive at a robust picture of public support for the proposed fossil fuel tax. Regardless of method, the results derived are relatively similar in point estimate and by obtaining overlapping confidence intervals. Our mean WTP estimate of $168 is not without precedent either as Aldy, Kotchen, and Leiserowitz (2012) find similar support for a NCES at $162.

At a minimum, we find that for all bid values presented including our $155 maximum bid, more than half of respondents support the policy. This suggests a WTP lower bound of at least $155 which is not particularly different from our derived estimate. To check this, we also derive a 95-percent confidence interval using the methodology employed by Krinsky and Robb (1986). Around our $168 mean WTP we find a 95-percent confidence interval of $114 to $515 which clearly contains our conservative $155 median WTP measure. As an alternative measure, we then use the Turnbull empirical estimator (Carson, 1994a,b) to arrive at alternative lower and upper bounds of $28 and $272. This non-parametric approach allows for negative WTP by accommodating a larger density of zero WTP responses in the data without making any assumption about distributional form. Given that our mean WTP is outside the bid range, this is an important check which arrives at reassuring results. The Turnbull estimator results both bound our mean WTP result, our naïve $155 median WTP lower bound, and have substantial overlap with the Krinsky and Robb confidence interval.

As a final check on our WTP measure, we use the spike model from Kristrom (1997). This method conditionally estimates whether the respondent has a willingness to pay at all to reduce global warming through a separate query, then conditionally offers a take it or leave it bid. In a prior question in our survey we first determine whether respondents generally support a carbon dioxide emission limit to reduce global warming which notes only ambiguously that their energy costs would likely increase. Using this as our screening question, we then estimate a WTP of $136 and that 26-percent of respondents have a WTP of zero. The spike model confidence interval of $122 to $150 implies this method underestimates WTP as it does not include our naïve lower bound estimate of $155. Meanwhile, the 26-percent projection of zero WTP matches the level of support found at our minimum bid of $5. Despite this critique, we note the spike model confidence interval falls entirely within those of the Krinsky and Robb 95-percent and Turnbull confidence intervals.

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| **Table 4 | Willingness to pay measures through a tax on fossil fuels to reduce global warming.** | | | | |
| Method | Lower bound ($) | Mean WTP ($) | Upper bound ($) | Source |
| Point estimate | - | 177 | - | Hanemann (1989) |
| Krinsky and Robb confidence interval | 101 | 177 | 587 | Krinsky & Robb (1986) |
| Turnbull non-parametric estimator | 28 | - | 272 | Carson et al. (1994a) |
| Spike model | 122 | 136 | 150 | Kristrom (1997) |

# Subgroup level results

WTP varies substantially between individuals, from potentially negative suggesting opposition to such a policy to large positives indicating an indifference to the price of combating global warming. This section compares willingness to pay between subpopulations in the survey. WTP is estimated by political affiliation or leaning, stated global warming beliefs, and the Global Warming’s Six Americas groups from the Yale Project on Climate Change Communication and George Mason University Center for Climate Change Communication (Leiserowitz, Maibach, & Roser-Renouf, 2009). In each case, all other variables are held at their means and the results are consolidated in Table 5.

First, WTP is estimated by political leaning. These categories represent both respondents who identify with a particular political party of indicate a preference, or leaning for one. The base group, democrats, have a mean WTP of $269 while republicans have a mean WTP $40 lower than the consolidated when climate change beliefs are held at the survey means. In fact, each group has a mean WTP that is positive under the covariates held at their means restriction. As supported by the coefficients of the results in Table 3, it is actually climate change beliefs independent of political affiliation that have the largest impact on WTP.

Following from the political affiliation result, WTP by global warming belief is estimated. For a member of the population who is otherwise average, these beliefs substantially impact WTP. Here WTP is estimated to be negative for both those who don’t believe in climate change and those who reply ‘don’t know’ to a query of their beliefs. This is an interesting result- it would be reasonable to have a willingness to pay of zero for a new policy, but a negative suggests a willingness to increase their taxes without an increase in benefits. It may also imply a belief that such a policy would cost them substantially more and so they have a WTP against the policy which they think would result in an even larger penalty. However, it would seem like an extreme suspicion to believe such an energy tax would result in greater than a $379/year, or 28-percent on average, increase.

As a third alternative, the Global Warming’s Six Americas categories, which were derived during the survey process, are substituted in place of the global warming belief indicators in the analysis. They represent a spectrum of beliefs on climate change. On one end, the Alarmed are thoroughly convinced that it is occurring and strongly in favor of policy to curtail it. On the other end of the spectrum, the Dismissive are equally convinced against global warming, its causes, and whether any action is warranted. This latter group also tend to report a belief in various forms of conspiracy theory against global warming. Due to these firmly held beliefs, they tend to be motivated to spend against such a carbon tax as it is basically seen as paying to oppose some ominous force- a strong motivator.

The results of the Six Americas alternative suggest those with global warming beliefs are entirely driving the WTP result as one would expect. Respondents who are disengaged- those who have little knowledge, interest, or belief in global warming one way of the other, also have a mean WTP of approximately zero. They then appear truly disengaged. Those that are doubtful, and particularly the Dismissive, have a large WTP on average in opposition to such a policy.

It must be noted that these WTP measures should be interpreted as net of any rebates. As the Climate Leadership Council’s proposal includes large cash rebates, if the rebate exceeds the cost to the Dismissive audience, many may very well come to support the policy. The Dismissive subgroup requires such a rebate in excessive of the added cost of at least $361, or a 26-percent offset in energy bills on average, to overcome their reservations. Unfortunately, making such predictions of how the conservative proposal will impact the Dismissive and other groups is beyond the capacity of the current survey to answer. It is an interesting question, however, that may warrant later work.

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| **Table 5 | Willingness to pay by subgroup** | | |
|  | mean WTP ($) | Share of respondents (%) |
| Political affiliation or leaning |  |  |
| Democrats | 269 | 43.8 |
| Republicans | 137 | 36.5 |
| Independents | 35 | 8.4 |
| No party | 65 | 11.2 |
|  |  |  |
| Global warming beliefs |  |  |
| Yes | 342 | 70.1 |
| No | -379 | 12.6 |
| Don't know | -81 | 17.3 |
|  |  |  |
| Six Americas indicator |  |  |
| Alarmed | 435 | 18.4 |
| Concerned | 318 | 34.0 |
| Cautious | 77 | 22.8 |
| Disengaged | -2 | 5.2 |
| Doubtful | -173 | 10.5 |
| Dismissive | -361 | 9.1 |
|  | | |

# Discussion and conclusion

The primary result, a mean WTP of $177, informs on mean support for the proposed measure in the United States. In combination with the distributional preferences noted in Table 1, it estimates support for climate change mitigation and compensatory measures. We first focus on aggregate support to assist workers in the coal industry that may lose their jobs as a result of the tax.

Using our mean WTP measure of $177 and data on the number of U.S. households from the Current Population Survey (U.S. Census Bureau, 2016), we estimate national aggregate household WTP of $21.14 billion to help reduce global warming. Of this, our study suggests the public prefers roughly $2.14 billion be used to assist displaced coal workers. The Bureau of Labor Statistics (BLS) estimates total coal mining sector jobs at 69,460 including all managerial, transport, and front office jobs. As an estimate of sectoral employment of workers requiring a higher degree of retraining to transition, we also use the BLS measure of 15,900 workers specifically in extraction roles (BLS, 2015). Our aggregate WTP estimate then implies public support of $30,736 for every single person, or $134,270 per extraction worker to assist displaced workers *every year* in the extreme case that the entire sector is regulated out of the workforce. Clearly then, support for any displaced coal workers is even more substantial as it is unlikely that such a tax would eliminate the entire sector.

By the same method, our study finds $3.47 billion in support for further clean energy development and $3.00 billion in support of infrastructure development from this potential revenue stream alone. It is important to put our aggregate support measures in appropriate context. While clean energy development support of $3.47 billion is small in comparison to the share spent in the American Recovery and Reinvestment Act (ARRA) of $92 billion by some estimates (Mundaca and Richter, 2015), the ARRA is foremost a stimulus measure. A more appropriate comparison may be to individual programs such as the Department of Energy’s Advanced Energy Manufacturing Tax Credit which promotes investment in clean energy manufacturing. Initially funded at $2.3 billion by ARRA, an additional $150 million later came available in a second phase (Department of Energy, 2013). Our estimate of *per year* support for clean energy projects could fund several of these sorts of adjustments to clean energy outlays. This same argument is applicable to the often-presented infrastructure spending deficit of $1 trillion. The $3.0 billion *per year* of public support by way of a carbon tax could address specific pressing deficits and effectively make a big impact on critical projects.

# Methodology

The results section precedes methodology in this paper to mirror the format of the journal it was submitted to. In the analysis, a nationally representative survey of 1,226 US citizens collected between 18 November and 05 December 2016 is used. The survey was developed by a coordinated effort between the Yale Project on Climate Change Communication (YPCCC) and the George Mason University Center for Climate Change Communication. It was then collected by research firm GfK. In addition to recruiting panel members to represent the U.S. population, sampling weights are assigned to ensure representativeness against the U.S. Census Bureau’s March 2016 Current Population Survey. Table 6 reports respondent summary statistics which include standard demographics, political affiliation, and global warming belief indicators. Kotchen, Boyle, and Leiserowitz (2013) find after controlling for global warming beliefs, political affiliation does not significantly influence willingness to pay for a similar measure and so we test this in our analysis and find a similar effect.

We note the survey developed asks several questions about respondent beliefs on global warming prior to the survey questions used in this study but does not intentionally present a basis, scientific or political, to influence views. As such, we query the public’s beliefs and preferences as they stand while acknowledging that preceding questions in the survey may update respondent beliefs as the survey occurs. This is a rather unavoidable tradeoff, but one which we think minor in comparison to the breadth of data collected to inform this study and YPCCC products in development. For reference, data on the breadth of the survey is also available (Leiserowitz et al. 2016). We also must acknowledge the potential for anchor bias from the bid amounts chosen. This implies the respondent arrive at their beliefs on the severity of the issue based on the bid presented to them. This is an important point when comparing to Greenstone (2016) where smaller bid amounts are presented (and on a monthly rather than annual scale) and finds markedly lower support for a similar prompt. Given the scale of energy price increases that may occur with the sort of carbon tax proposed by Baker et al. (2017), we believe our bid amounts are appropriate or even lower than what may occur. This implies anchor bias leading to an underestimate of mean WTP, if any effect.

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| **Table 6 | Summary statistics of respondent demographics.** | | |
|  | **Mean** | **Standard Deviation** |
| Education (years) | 13.56 | (2.93) |
| Male (1=yes) | 0.48 | (0.50) |
| Household size (# people) | 2.85 | (1.59) |
| Income ($10,000's) | 7.60 | (5.89) |
| Age (years) | 47.28 | (17.40) |
| White (1=yes) | 0.64 | (0.48) |
| Republican (1=yes) | 0.37 | (0.48) |
| Democrat (1=yes) | 0.44 | (0.50) |
| Independent (1=yes) | 0.08 | (0.28) |
| No party (1=yes) | 0.11 | (0.32) |
| Global warming 'don't know' | 0.17 | (0.38) |
| Global warming 'no' | 0.13 | (0.33) |
| Global warming 'yes' | 0.70 | (0.46) |
| Global warming 'no, very sure' | 0.53 | (0.50) |
| Global warming 'yes, very sure' | 0.64 | (0.48) |
| Reported as survey weighted statistics for sample representativeness using standard methodologies. The reported statistics for global warming 'no, very sure' and global warming 'yes, very sure' are conditional on the respondent answering no or yes to believing in global warming (n=169 and 863), respectively. The number of all other observations are 1226 except for political affiliation where one respondent declined to respond. | | |

Among the range of questions on global warming we ask whether respondents support or oppose a tax on fossil fuels that will impact them through higher energy bills and how they would like to see the revenue spent. Three questions are central to our study. In order, we first prompt respondents on distributional preferences across categories:

*Congress may consider a tax on fossil fuels (coal, oil, and natural gas) to help reduce global warming. If implemented, how would you like to see the tax money used?*

*“I would like to see the money used to…” (Please respond either “yes” or “no” for each option).*

Respondents are then given the eleven choices from Table 1 where the eleventh is a text entry “Other” option and order presented is randomized save for “Other” which always appears last. Immediately following, respondents are prompted to note their distributional preferences for revenues:

*Displayed below are the ways you said you would like to see fossil fuel tax money spent. What percentage of the total fossil fuel tax revenues would you like to see used for each option?*

*Enter a number between 0% and 100% for each option. Please make sure your total equals 100%.*

where only the expenditure options the respondent had previously chosen remain. The respondents are provided a running total and requirement that their distribution sums to 100-percent to aid computation. Some of the categories presented would reduce the public’s tax burden by offsetting other taxes not directly related to fossil fuels and global warming, while others are related to mitigating the effects of both climate change and the fossil fuel tax.

The final core question of our analysis supports development of the WTP estimate. Respondents are asked about their willingness to pay to reduce global warming via a tax on fossil fuels following a standard dichotomous choice methodology as recommended for contingent valuation (Arrow et al):

*If a tax on fossil fuels (coal, oil, and natural gas) to help reduce global warming, were to cost your household* ***[insert randomized bid amount]*** *more* ***each year*** *in higher energy bills, would you support or oppose it?*

The randomized bid amounts offered are $5, $25, $45, $65, $85, $105, $135, and $155 where the middle four are presented at twice the frequency. This distribution was chosen as we ex ante expected a mean willingness to pay measure near the mean of our bid spectrum.

To estimate willingness to pay we then employ a dichotomous choice model estimated as the set of logit specifications reported in Table 3. In each, the dependent variable is a binary representation of whether the respondent supports (support=1) or opposes the tax policy at the randomly assigned bid amount which is an independent variable in the specification. The models also include standard demographics (education, gender, income, etc.) and political affiliation. Model 2 adds indicators of whether the respondent believes global warming is happening as collected with the prompt:

*Recently, you may have noticed that global warming has been getting some attention in the news. Global warming refers to the idea that the world’s average temperature has been increasing over the past 150 years, may be increasing more in the future, and that the world’s climate may change as a result.*

*What do you think: Do you think that global warming is happening?*

We use a response of “don’t know” as the base case (16-percent of respondents) and include “yes” and “no” as indicator variables. In our preferred specification, we also add dummy variables indicating how sure respondents are that global warming is or is not happening. Respondents that did not answer “don’t know” to the previous prompt are queried how strongly they believe their stated position and those who indicate either “very sure” or “extremely sure” are denoted in these additional variables.

From our logit model estimates we then derive WTP by a number of methodologies. Our primary result follows Hanemann’s specification (Hanemann, 1984, 1989) for admitting the possibility of negative WTP or opposition to the policy proposed. This methodology finds the mean WTP or bid amount that results in respondents being indifferent between supporting the policy or not on average. To derive this, the coefficient estimates of our preferred specification are multiplied by their mean values, excluding the bid coefficient, and then added to the constant. Divided by the coefficient on bid, this presents mean (equal to median) WTP without excluding those with negative values. We also estimate a confidence interval using the Krinsky and Robb (1986) simulation method as adapted for such uses. This method makes no assumption of confidence interval symmetry around our point estimate and instead suggests a rather large upper bound in this estimation.

As we found a mean WTP of $168, our result clearly relies on projection beyond our bid range based on using the logit specification and thus warrants caution. As a non-parametric alternative, we use the Turnbull non-parametric estimator (Carson, 1994a) which estimates possible mean WTP without resorting to our logit specification. At a minimum, this estimator establishes a robust lower bound estimate inclusive of any mass of respondents with zero WTP. This estimate includes both our $155 maximum bid that a majority queried support and our $168 mean WTP estimate. We then, as an additional check use Kristrom’s spike model (1997). We first determine whether the respondent is willing to pay at all to help reduce global warming and would then conditionally offer a bid amount to the respondent. For our screening question, we use a survey prompt presented to respondents prior to the other questions used in this study:

*How much do you support or oppose the following policy?*

*Set strict carbon dioxide emission limits on existing coal-fired power plants to reduce global warming and improve public health. Power plants would have to reduce their emissions and/or invest in renewable energy and energy efficiency. The cost of electricity to consumers and companies would likely increase.*

Respondents are given the options to either somewhat or strongly support or oppose the given policy and it is taken that any support of the policy indicates at least some willingness to pay. We note this is not a 100-percent equivalent prompt- it presents a scenario of government oversight but without suggesting a tax will be imposed. Some respondents may be particularly opposed to such a framework while others may instead strongly oppose our primary prompt based on a tax scenario. For perspective, in another question we query whether respondents prefer taxes or regulation (or are indifferent, uninformed, or opposed to both) and find respondents strictly prefer taxes or regulation in similar shares: 11-percent and 16-percent, respectively. We also note that in total respondents prefer either tax, regulation, or both in 75-percent of cases which is similar to the share supporting our near-costless bid of $5 (77.5-percent support). However, due to the potential mismatch of screening and estimation questions, we estimate Kristrom’s spike model as a check on our WTP rather than as a primary result. The spike model result of $136 is like our main estimate, however, and finding that 26-percent of respondents have zero WTP or less is similar to the general support to tax and/or regulate, consistent with our other results.

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# Appendix A: Coefficient estimates from multinomial regressions

While Table 3 reports the marginal effects of the variables included in the model, the coefficients are need to compute mean WTP. These coefficient results are included as they, along with the summary statistics, allow replication of the WTP results in this paper.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Table A1 | Coefficient estimates for the logit model results in Table 3.** | | | | |
|  | (1) | (2) | (3) | (4) |
| Bid amount | -0.00291\* | -0.00348\*\* | -0.00399\*\* | -0.0405\* |
|  | (0.00157) | (0.00174) | (0.00177) | (0.0221) |
| Education (years) | 0.0566\*\* | 0.0418 | 0.0331 | 0.0419 |
|  | (0.0265) | (0.0279) | (0.0282) | (0.0280) |
| Male (1=yes) | -0.100 | -0.136 | -0.146 | -0.132 |
|  | (0.137) | (0.147) | (0.150) | (0.147) |
| Household size (# people) | -0.0380 | -0.0405 | -0.0266 | -0.0415 |
|  | (0.0512) | (0.0550) | (0.0565) | (0.0549) |
| Income ($10,000's) | 0.0382\*\*\* | 0.0357\*\* | 0.0331\*\* | 0.0362\*\* |
|  | (0.0137) | (0.0145) | (0.0153) | (0.0145) |
| Age (years) | -0.00374 | -0.00441 | -0.00311 | -0.00452 |
|  | (0.00423) | (0.00452) | (0.00459) | (0.00451) |
| White (1=yes) | 0.325\*\* | 0.303\* | 0.209 | 0.302\* |
|  | (0.162) | (0.170) | (0.176) | (0.171) |
| Republican (1=yes) | -1.110\*\*\* | -0.461\*\* | -0.267 | -0.460\*\* |
|  | (0.158) | (0.179) | (0.185) | (0.179) |
| Independent (1=yes) | -1.257\*\*\* | -0.813\*\*\* | -0.755\*\*\* | -0.814\*\*\* |
|  | (0.243) | (0.239) | (0.242) | (0.238) |
| No party (1=yes) | -0.894\*\*\* | -0.711\*\*\* | -0.615\*\* | -0.708\*\*\* |
|  | (0.246) | (0.270) | (0.281) | (0.270) |
| Global warming (no=1) |  | -1.038\*\*\* | -0.623\* | -1.039\*\*\* |
|  |  | (0.298) | (0.335) | (0.299) |
| Global warming (yes=1) |  | 1.473\*\*\* | 1.014\*\*\* | 1.472\*\*\* |
|  |  | (0.200) | (0.220) | (0.199) |
| Global warming (no, very sure=1) |  |  | -1.001\* |  |
|  |  |  | (0.520) |  |
| Global warming (yes, very sure=1) |  |  | 0.843\*\*\* |  |
|  |  |  | (0.186) |  |
| Constant | 0.271 | -0.610 | -0.587 | -0.646 |
|  | (0.511) | (0.548) | (0.555) | (0.547) |
| F-statistic | 8.87 | 15.93 | 13.97 | 15.84 |
| The dependent variable indicates whether the respondent supports a tax on fossil fuels at the randomized bid amount presented. The bid amount is in dollars in models 1-3 and as a percentage increase in average household energy bills in the respondent’s state in model 4. Each model includes 1,220 observations which excludes six respondents who refused political affiliation or other questions and are weighted for survey representativeness. Democrat and global warming 'don't know' are the omitted categories for their respective contributions. Global warming 'no, very sure' and 'yes, very sure' include responses indicating either 'very sure' or 'extremely sure'. F-statistics reported rather than R-squared because the conditions necessary to calculate the latter are violated with survey data. Standard errors are in parentheses and follow conventional notation: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1 | | | | |

# Appendix B: Multinomial logit regression on policy preferences

As an additional contribution, a survey prompt querying policy instrument preference- whether respondents prefer a tax to regulation, both, or neither is used to explore policy tool preference. A multinomial regression on respondent’s categorical preference is used where the base case is the reply “don’t know”. The results in Table B1 then suggest characteristics related to either support or opposition of different policy tools used to regulate energy sector emissions. We specify the dependent variable as the respondent’s stated policy preference to reduce global warming collected with the prompt:

*Governments can reduce the pollution that causes global warming in two main ways:*

1. *Regulate pollution (legally require companies to limit the amount of pollution they emit)*
2. *Tax pollution (require companies to pay a tax on the pollution they emit, which encourages them to reduce their emissions)*

*In general, which of these two approaches to reducing the pollution that causes global warming do you prefer, if either?*

The respondent is then presented options to control pollution levels by regulating, taxing, doing both, neither, or opting that they don’t know. In both the prompt and reply options the order of whether “regulate pollution” or “tax pollution” appears first is randomized while the other reply options always follow. The results in Table B1 suggest education and male gender contribute to a higher probability of having a policy preference, either for or against the policy tools. Political affiliation also behaves approximately as expected- republicans and independents are more likely to prefer taking no regulatory or tax option and those claiming no party oppose government action. Global warming beliefs also influence policy preference.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Table B1 | Multinomial logistic model of regulation preference.** | | | | |
|  | (1) | (2) | (3) | (4) |
|  | Do neither | Regulate pollution | Tax pollution | Do both |
| Education (years) | 0.230\*\*\* | 0.160\*\*\* | 0.171\*\*\* | 0.128\*\*\* |
|  | (0.0616) | (0.0536) | (0.0589) | (0.0481) |
| Male (1=yes) | 1.225\*\*\* | 0.602\*\* | 0.642\*\* | 0.588\*\*\* |
|  | (0.325) | (0.249) | (0.278) | (0.223) |
| Household size (# people) | 0.0528 | -0.0228 | 0.0384 | 0.0765 |
|  | (0.115) | (0.0924) | (0.100) | (0.0852) |
| Income ($10,000's) | 0.0310 | 0.0195 | -0.00414 | -0.0186 |
|  | (0.0332) | (0.0261) | (0.0272) | (0.0237) |
| Age (years) | 0.0292\*\*\* | 0.0112 | 0.00935 | 0.0169\*\* |
|  | (0.00969) | (0.00807) | (0.00858) | (0.00723) |
| White (1=yes) | 0.876\*\* | 0.700\*\* | 0.400 | 0.904\*\*\* |
|  | (0.414) | (0.278) | (0.307) | (0.239) |
| Republican (1=yes) | 1.298\*\* | 0.0388 | 0.321 | -0.567\*\* |
|  | (0.534) | (0.309) | (0.353) | (0.273) |
| Independent (1=yes) | 1.084\* | -0.454 | -0.625 | -0.578 |
|  | (0.637) | (0.435) | (0.545) | (0.383) |
| No party (1=yes) | 0.647 | -0.986\*\* | -1.185\*\* | -1.080\*\*\* |
|  | (0.803) | (0.441) | (0.551) | (0.353) |
| Global warming (no=1) | 1.415\*\*\* | 0.0346 | 0.207 | -0.118 |
|  | (0.490) | (0.464) | (0.519) | (0.446) |
| Global warming (no, very sure=1) | 1.303\*\* | -0.533 | -0.234 | 0.322 |
|  | (0.588) | (0.702) | (0.919) | (0.675) |
| Global warming (yes=1) | 1.010\*\* | 1.124\*\*\* | 1.323\*\*\* | 1.447\*\*\* |
|  | (0.446) | (0.336) | (0.396) | (0.293) |
| Global warming (yes, very sure=1) | -0.341 | 0.508 | 0.576 | 1.101\*\*\* |
|  | (0.533) | (0.346) | (0.368) | (0.312) |
| Constant | -8.779\*\*\* | -3.948\*\*\* | -4.490\*\*\* | -3.171\*\*\* |
|  | (1.357) | (1.052) | (1.123) | (0.843) |
| Observations | 10.4% | 16.7% | 10.8% | 48.5% |
| In the multinomial model, the base case is respondents selecting “don’t know” representing 13.6-percent of responses. Observations for each column are the percent of respondents selecting the regulation preference out of 1,226 respondents. Standard errors are in parentheses and follow conventional notation: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1 | | | | |

Table B2 repeats the process where only respondents who have an opinion- those not selecting “don’t know” as a response, are not included in the model. This clarifies interpretation of the coefficients.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table B2 | Multinomial logistic model of regulation preference.** | | | |
|  | (1) | (2) | (3) |
|  | Regulate pollution | Tax pollution | Do both |
| Education (years) | -0.0468 | -0.0361 | -0.0811 |
|  | (0.0521) | (0.0578) | (0.0495) |
| Male (1=yes) | -0.700\*\* | -0.654\*\* | -0.722\*\* |
|  | (0.310) | (0.330) | (0.294) |
| Household size (# people) | -0.119 | -0.0542 | -0.0280 |
|  | (0.118) | (0.128) | (0.110) |
| Income ($10,000's) | -0.0284 | -0.0519\* | -0.0674\*\*\* |
|  | (0.0260) | (0.0273) | (0.0234) |
| Age (years) | -0.0157\* | -0.0176\* | -0.0101 |
|  | (0.00925) | (0.00970) | (0.00881) |
| White (1=yes) | -0.318 | -0.596 | -0.128 |
|  | (0.419) | (0.435) | (0.407) |
| Republican (1=yes) | -1.348\*\*\* | -1.075\*\* | -1.953\*\*\* |
|  | (0.508) | (0.536) | (0.485) |
| Independent (1=yes) | -1.628\*\*\* | -1.811\*\*\* | -1.789\*\*\* |
|  | (0.628) | (0.693) | (0.574) |
| No party (1=yes) | -1.400 | -1.606 | -1.528\* |
|  | (0.938) | (1.024) | (0.918) |
| Global warming (no=1) | -1.382\*\*\* | -1.194\*\* | -1.522\*\*\* |
|  | (0.505) | (0.564) | (0.482) |
| Global warming (no, very sure=1) | -1.911\*\*\* | -1.639\*\* | -1.111\*\* |
|  | (0.621) | (0.727) | (0.510) |
| Global warming (yes=1) | 0.107 | 0.302 | 0.450 |
|  | (0.440) | (0.487) | (0.428) |
| Global warming (yes, very sure=1) | 0.864\* | 0.938\* | 1.459\*\*\* |
|  | (0.484) | (0.501) | (0.464) |
| Constant | 4.861\*\*\* | 4.313\*\*\* | 5.718\*\*\* |
|  | (1.327) | (1.417) | (1.262) |
| Observations | 19.4% | 12.5% | 56.2% |
| In this model, the base case is respondents selecting “do neither” which represent 12.0-percent of 1,059 responses. This regression only includes respondents who indicate having an opinion by not selecting “don’t know” as their response. Standard errors are in parentheses and follow conventional notation: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1 | | | |

# Appendix C: Respondent preferences expanded table

In the main body, we present respondent preferences for the distribution of fossil fuel tax revenue. Prior, we presented the percent that support the category and the mean allotment from all respondents including those with zero interest in the category. Here we also present the distributional preferences of only those respondents who support the category. This is the middle column “Conditional allotment (%)” which are the distributional preferences, conditional on the respondent first replying that the support the category.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table C1 | Respondent preferences for the expenditure of revenues from a fossil fuel tax to help reduce global warming.** | | | |
|  | **Support (%)** | **Conditional allotment (%)** | **Allotment (%)** |
| Support the development of clean energy (solar, wind) | 79.8 | 20.5 | 17.3 |
| Fund improvements to America’s infrastructure (roads, bridges, etc.) | 77.4 | 18.0 | 14.5 |
| Pay down the national debt | 65.5 | 18.4 | 12.7 |
| Assist workers in the coal industry that may lose their jobs as a result of the tax | 71.9 | 14.0 | 10.4 |
| Reduce Federal income taxes | 59.3 | 15.3 | 9.9 |
| Return the money to all American households in equal amounts | 45.9 | 15.6 | 8.1 |
| Assist low-income communities that are most vulnerable to the impacts of global warming | 57.3 | 12.7 | 7.8 |
| Fund programs to help American communities prepare for and adapt to global warming | 54.6 | 12.1 | 7.2 |
| Reduce Federal payroll taxes (Social Security and Medicare taxes that are deducted from paychecks) | 44.2 | 14.2 | 7.2 |
| Reduce corporate taxes | 24.4 | 11.2 | 3.2 |
| Other (please specify) | 7.8 | 23.1 | 1.7 |
| Reported as survey weighted statistics. Support (%) indicates share of respondents that support using the revenue generated in the stated manner. Conditional allotment (%) reports the mean allotment by the respondents who support its use on the category and so does not include the preferences of respondents who do not want money spent in the indicated way. Allotment (%) is the mean revenue allocation accounting for both respondents that do and do not support the revenue's use on the expenditure category. | | | |

# Appendix D: State-level average household energy bill data

As we also present bid amounts in terms of average household energy bill increases in table 2 and estimate a supplemental model in this form in column 4 of table 3, we share household energy data by state in this section. To this data, publicly available from the EIA (2015), we add the implied increase in average state energy bills from a policy set at the derived mean WTP measured. Our estimated mean WTP of $177 implies an average annual energy bill increase of 12.9-percent. This varies substantially, however, from 18.6-percent in New Mexico to 9.6-percent in Connecticut.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table C1 | Average household energy bill by state** | | | |  | |  | |  |
| State | Average monthly energy bill ($) | Increase based on $177 WTP (%) | State | | Average monthly energy bill ($) | | Increase based on $177 WTP (%) | |
| Alabama | 142.48 | 10.4% | Montana | | 89.03 | | 16.6% | |
| Alaska | 119.64 | 12.3% | Nebraska | | 101.96 | | 14.5% | |
| Arizona | 124.67 | 11.8% | Nevada | | 116.47 | | 12.7% | |
| Arkansas | 110.22 | 13.4% | New Hampshire | | 114.90 | | 12.8% | |
| California | 94.59 | 15.6% | New Jersey | | 110.04 | | 13.4% | |
| Colorado | 83.42 | 17.7% | New Mexico | | 79.23 | | 18.6% | |
| Connecticut | 153.13 | 9.6% | New York | | 111.32 | | 13.3% | |
| Delaware | 131.18 | 11.2% | North Carolina | | 125.51 | | 11.8% | |
| District of Columbia | 109.21 | 13.5% | North Dakota | | 104.96 | | 14.1% | |
| Florida | 132.16 | 11.2% | Ohio | | 112.25 | | 13.1% | |
| Georgia | 129.46 | 11.4% | Oklahoma | | 110.87 | | 13.3% | |
| Hawaii | 152.12 | 9.7% | Oregon | | 96.24 | | 15.3% | |
| Idaho | 95.01 | 15.5% | Pennsylvania | | 116.62 | | 12.6% | |
| Illinois | 89.91 | 16.4% | Rhode Island | | 114.50 | | 12.9% | |
| Indiana | 111.51 | 13.2% | South Carolina | | 144.04 | | 10.2% | |
| Iowa | 98.53 | 15.0% | South Dakota | | 108.68 | | 13.6% | |
| Kansas | 110.58 | 13.3% | Tennessee | | 128.51 | | 11.5% | |
| Kentucky | 114.72 | 12.9% | Texas | | 136.00 | | 10.8% | |
| Louisiana | 120.02 | 12.3% | Utah | | 80.92 | | 18.2% | |
| Maine | 86.75 | 17.0% | Vermont | | 95.33 | | 15.5% | |
| Maryland | 139.91 | 10.5% | Virginia | | 130.58 | | 11.3% | |
| Massachusetts | 119.26 | 12.4% | Washington | | 87.64 | | 16.8% | |
| Michigan | 93.61 | 15.8% | West Virginia | | 111.59 | | 13.2% | |
| Minnesota | 92.32 | 16.0% | Wisconsin | | 94.26 | | 15.6% | |
| Mississippi | 137.24 | 10.7% | Wyoming | | 91.19 | | 16.2% | |
| Missouri | 115.80 | 12.7% | U.S. Total | | 114.03 | | 12.9% | |
| 2015 average monthly residential energy bill data from the U.S. Energy Information Administration, retrieved from: http://www.eia.gov/electricity/sales\_revenue\_price/index.cfm | | | |  | |  | |  |