



A review of US residential energy tax credits: distributional impacts, expenditures, and changes since 2006

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Abstract

The Inflation Reduction Act of 2022 recently extended two residential energy tax credits, the Residential Energy Efficient Property (REEP) credit and the Nonbusiness Energy Property (NEP) credit, through 2034 and 2032, respectively. In this paper, we provide an updated description of credit take-up and tax expenditures over the past 15 years, showing how the tax expenditure on the REEP credit has rapidly grown while the tax expenditure on the NEP credit has declined. Within the REEP credit, we document a large increase in solar electric claims over time. Additionally, we examine the income distribution of credit takers and geographic heterogeneity of credit take-up using IRS individual tax data. Both tax credits primarily benefit higher income taxpayers.

Keywords Energy tax credits · Personal income tax credits · Residential energy efficiency · Distributed renewable energy generation

Introduction

The Energy Policy Act of 2005 introduced two residential energy tax credits in the USA. The Residential Energy Efficient Property (REEP) credit provides a tax credit for residential solar electric, solar water heating, wind energy, geothermal heating, fuel cells, and biomass fuel projects. The Nonbusiness Energy Property (NEP) credit provides a credit for various energy-efficient home improvement projects.

This research was conducted while one of the authors was an employee at the United States Department of the Treasury. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors and do not necessarily reflect the views or the official positions of the United States Department of the Treasury. Any taxpayer data used in this research was kept in a secured IRS data repository, and all results have been reviewed to ensure that no confidential information is disclosed.

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In this paper, we examine how take-up of these two credits has changed over time, as well as examining how tax expenditures and the income distribution of credit takers have changed. This has important policy implications, as these credits were recently extended through 2032 (NEP) and 2034 (REEP) via the Inflation Reduction Act of 2022.¹

Several prior works examine these tax credits. Borenstein and Davis (2016) examine the income distribution of REEP and NEP credit takers using data from 2006 to 2012. They find that higher income households are most likely to claim these credits, with the top quintile having received about 60 percent of credit dollars, while the bottom three quintiles combined for only 10 percent.² Neveu and Sherlock (2016) also examine the two residential energy tax credits, focusing on 2006 through 2011. Similar to Borenstein and Davis (2016), they find that higher income taxpayers are more likely to claim these credits and also that higher income taxpayers claim higher credit amounts. In more recent work,

¹ The NEP credit was extended to 2032, and the REEP credit was extended in its current form through 2032, followed by a phase-out through 2034. Further extensions would require congressional action.

² We are not able to exactly replicate Borenstein and Davis (2016)'s results using the IRS administrative data due to limited overlap between the available time periods.

Crandall-Hollick and Sherlock (2018) examine the income distribution of residential energy tax credits in 2015, finding that three-quarters of claimants have adjusted gross incomes over \$50,000 and account for 89 percent of credit dollars claimed, despite representing just over one-third of total tax filers. Earlier work examined similar tax credits in the Energy Tax Act of 1978 (Hassett and Metcalf 1995; Hirst et al. 1983).

Other work examines the distribution of energy incentives more generally. Using data from the 2009 Residential Energy Consumption Survey, Jacobsen (2019) examines the distribution of a wide variety of energy efficiency incentives, including tax credits. He finds that tax credit incentives are highly concentrated in high-income households. In related work also using the Residential Energy Consumption Survey, Jacobsen (2023) finds that non-Hispanic white households are most likely to claim energy efficiency incentives, including energy tax credits, in large part due to their increased home-ownership rates.

However, much has changed in recent years. Prices for solar electric panels have dramatically decreased (Barbose et al. 2022). The Tax Cuts and Jobs Act of 2017 (TCJA) changed tax liability for many taxpayers (Kallen and Mathur 2021), which impacts their ability to claim these two credits. With the recent extension of these two credits in the Inflation Reduction Act, it is worth revisiting the policy discussion surrounding them with more recent, updated data.

Additionally, prior work has used publicly available Internal Revenue Service (IRS) data, which places limits on the questions that can be answered. In this paper, we supplement publicly available IRS data with administrative tax return data for e-filers. This enables us to examine the income distribution of the NEP and REEP credits separately, filling an important gap in the literature.

Overview of credits

Both the REEP and NEP credit were created by the Energy Policy Act of 2005. Both credits are nonrefundable, meaning that a taxpayer must have positive tax liability to claim them. The Internal Revenue Service (2020) notes that from 2006 to 2021, between 58.3 percent and 67.9 percent of tax filers had taxable income.³ Both REEP and NEP are credits (and not tax deductions), meaning that the taxpayer does not need to itemize to claim the credit. Both credits require tax filers to fill out Form 5695 with their tax return.

The credits differ in their qualifying activities, as well as in their maximum credit values. Notably, REEP does not have a

maximum credit value and can be carried forward; NEP has a maximum credit value and cannot be carried forward.

Residential Energy Efficient Property (REEP) credit

The REEP credit has been available every year since 2006. Initially, REEP had a maximum credit of \$2000 (or \$4000 for small wind projects); however, this maximum was eliminated in 2009. Taxpayers cannot claim a REEP credit greater than their tax liability in a given year due to the credit's nonrefundable status. Taxpayers may, however, carry forward any REEP credit in excess of their tax liability to future years.

REEP's "qualifying activities" (the term for the activities that qualify a taxpayer for this credit) have expanded over time. Originally, the qualifying activities were solar electric installations, solar water heating, and fuel cells. Small wind projects and geothermal heat pumps were added in 2008. Biomass fuel projects were added in 2021 and are slated to be removed from REEP in 2023.⁴ Battery storage projects are eligible as of 2023. Additionally, the REEP credit may be claimed for new qualifying projects in new construction and may be claimed for activities at non-primary homes.

Originally, the REEP credit was for 30 percent of the qualifying activity's costs (potentially subject to the credit maximum before 2009). Additionally, fuel cell credits have a maximum based on their kilowatt capacity.⁵ In 2020, the credit's value was decreased to 26 percent of the qualifying activity's cost. It was initially scheduled for a further reduction to 22 percent in 2023 and scheduled to be eliminated after 2023. However, the Inflation Reduction Act of 2022 extended the REEP credit through 2032 and renamed it the "Residential Clean Energy" credit. It also restored the 30 percent credit rate (starting in 2022). In 2033, it will be reduced to 26 percent of the cost of the qualifying activities and is slated to be further reduced to 22 percent in 2034 before expiration after 2034 (H.R.5376 2022).

Nonbusiness Energy Property (NEP) credit

The NEP credit has been available on and off since 2006. It was available in 2006 and 2007, from 2009 through 2017, and from 2019 to the present; it was unavailable in 2008 and was only retroactively available for 2018.⁶ It was set to expire

⁴ However, biomass stoves will become eligible for the NEP credit in 2023.

⁵ Small wind projects briefly had a kilowatt capacity requirement in 2008 only.

⁶ The Bipartisan Budget Act of 2018, passed in February 2018, extended the credit retroactively for 2017, which likely impacted take-up that year. H.R.1865 – Further Consolidated Appropriations Act, 2020 (passed December 2019) retroactively extended the NEP credit for 2018 and 2019. While the extensions for 2017 and 2019 were passed prior

³ This statistic is specifically based on tax filers and excludes individuals who do not file a tax return. Thus, it overstates the percentage of households who may be able to claim a residential energy credit.

once again in 2022, but was extended (without any interruption in availability) via the Inflation Reduction Act of 2022 under the new name “Energy Efficient Home Improvement” credit. It is currently set to expire after 2032.

The NEP credit initially had a lifetime maximum of \$500, except for in 2009 and 2010 when its maximum was \$1500; the Inflation Reduction Act of 2022 eliminated this lifetime maximum and replaced it with an annual maximum of \$1200 for most taxpayers (McDermott 2022).⁷ Unlike the REEP credit, the NEP credit does not allow carryforward. Thus, a taxpayer must have sufficient tax liability that year to claim the NEP credit.

Depending on the qualifying activity, the NEP credit is calculated by either a percentage of the qualifying activity’s costs and/or with a maximum amount per activity; both methods are subject to the overall maximum discussed above. The percentage of cost (which historically applies to exterior windows, exterior doors, insulation, and metal or asphalt roofs) was 10 percent in 2006, 2007, and 2011 through 2022 and 30 percent in 2009 and 2010.⁸

NEP has numerous qualifying activities, many with their own maximum credit values (less than the overall maximum). They include insulation; exterior windows; exterior doors; metal or asphalt roofs (eliminated starting in 2023); natural gas, propane, or oil furnaces or hot water boilers; certain electric heat pump water heaters, electric heat pumps, central air conditioners, and natural gas, propane, or oil water heaters; and main air circulating fans for certain furnaces. Prior to the law change in 2022, these qualifying activities remained relatively constant over our sample period,⁹ with minimal changes.¹⁰ Additionally, the NEP credit originally could only be claimed for upgrades to the taxpayer’s existing main home and not for new construction or non-primary homes; starting in 2023, qualifying activities in non-primary residences became eligible for the NEP credit.

to the date on which most taxpayers were required to file, taxpayers wanting to take the NEP credit in 2018 would have needed to file an amended return to claim the credit.

⁷ The Inflation Reduction Act of 2022 also changed some of the qualifying activities and added additional reporting requirements (McDermott 2022).

⁸ The percentage increased to 30 percent again in 2023, and now applies to more qualifying activities.

⁹ See “Data” for details on the sample period, which is 2006–2020 for one of our datasets and 2014–2021 for the other.

¹⁰ Following the Inflation Reduction Act of 2022, qualifying activities are building envelope components (such as windows and doors), home energy audits, residential energy property (which includes air conditioners, water heaters, and furnaces), heat pumps, and biomass stoves or boilers.

Data

We use two Internal Revenue Service (IRS) data sources.

For credit take-up, tax expenditures, and all other aggregate measures, we use the IRS Statistics of Income (SOI) data, specifically the “Individual Income Tax Returns Line Item Estimates” for the years 2006 through 2020. This provides line-by-line estimates of both the total number of returns filed for each line item, as well as average amounts. The line item estimates are based on representative samples drawn using a stratified probability sample, and undergo numerous checks (Internal Revenue Service 2011). Unfortunately, the portions of this dataset relating to the REEP and NEP credit do not include coefficients of variation (standard errors). Data on NEP credit take-up for 2018, which would have only come from amended returns, is not available from SOI.

For the income distribution of credit takers, we use administrative data of all individual tax returns for e-filers. Our primary sample consists of all e-filers who submitted a Form 5695 in the years 2014 through 2021.¹¹ To construct income quintiles, we use a 5 percent sample of all e-filers for the same time period. Comparing to the SOI aggregates, our sample of e-filers accounts for 85 percent of credit takers in 2014, rising to 88 percent by 2020.¹² Thus, although our analysis will miss some paper filers, our sample captures the vast majority of taxpayers. Note that our data will be missing NEP credit claims for 2018—the NEP credit was available only retroactively (by filing an amended tax return) in 2018, which is not captured in our Form 5695 sample, as amended returns could not be e-filed prior to tax year 2019.

Credit take-up and tax expenditures

Figure 1 shows claims for each of the two credits since 2006, derived from SOI data.¹³

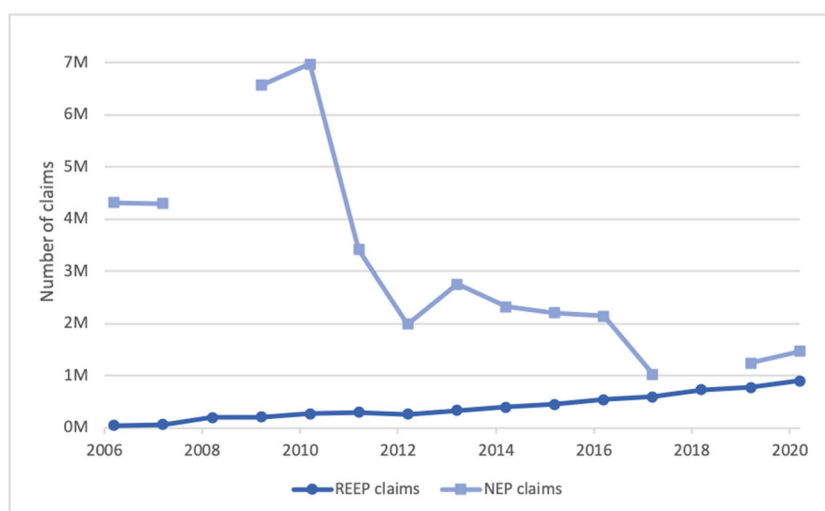
Claims for the REEP credit have been rising over time, from under 50,000 claims in 2006 to about 900,000 claims in 2020. Claims for the NEP credit have been generally declining over time. (It is important to note that the NEP credit was not available in 2008 and only retroactively available in 2018.) The high uptake in 2009 and 2010 can likely be

¹¹ We conducted line-item checks comparing the IRS administrative data to SOI aggregate data, finding them to be comparable for all years after 2014.

¹² In fact, according to SOI data, e-filers represent 86 percent of all filers in 2014, rising to 92 percent by 2020.

¹³ SOI does not provide coefficients of variation (standard errors) for the Form 5695 line item estimates, and thus, we omit error bars from all charts derived from SOI data due to this data limitation.

Fig. 1 REEP and NEP claims over time, in millions. Source: authors' construction from IRS SOI data. Note: SOI does not provide coefficients of variation (standard errors) for the Form 5695 line item estimates, and thus, we omit error bars from all charts derived from SOI data due to data limitations



explained by capturing takers who would have completed those activities in 2008 were the credit available, as well as a temporary increase in the maximum credit value and the increase in the percentage of costs claimable. The overall declining trend in uptake may be related to the NEP credit's lifetime cap: once a taxpayer has claimed the maximum \$500 credit, they can no longer claim any NEP credits in future years.¹⁴ Thus, the pool of potential credit takers may shrink over time, potentially explaining its declining uptake. It is also worth noting that the credit maximum has not been adjusted upwards for inflation, and thus, its real value (and presumably its attractiveness to taxpayers) has been declining since 2006 (outside of the 2 years with the elevated maximum credit in 2009 and 2010).¹⁵

Figure 2 shows tax expenditures on the two residential energy credits over time. In contrast to the credit claims shown in Fig. 1, here we can see that REEP makes up a disproportionate fraction of tax expenditures. Unlike the NEP credit, REEP does not have a credit maximum, and REEP credits are generally much higher in magnitude than NEP credits.¹⁶ This also highlights one of the key reasons to re-examine these two tax credits with the most recent data: REEP expenditures were lower than NEP expenditures for 2006 through 2010 (excluding 2008 when the NEP credit was unavailable), with the two credits becoming roughly even in terms of expenditure in 2011. Since 2011, expenditures on the REEP credit have outstripped NEP expenditures, and in recent years, REEP expenditures are eight to 10 times higher

than NEP expenditures. This represents a large change in the take-up and expenditures of these two credits.

Figures 3 and 4 break down the credit claims by qualifying activity for the REEP and NEP credits, respectively. For the NEP credit, there are no clear patterns of change in uptake; rather, uptake for each qualifying activity mirrors overall NEP credit uptake. For the REEP credits, solar electric claims have dramatically increased over time, while the other qualifying activities have seen smaller changes in uptake. Although we do not have data that allow us to definitively explain this change, we postulate that this may reflect the declining costs of solar electric panels (Barbose et al. 2022) that have made them more financially attractive over time.

Figure 5 breaks down REEP tax expenditures by qualifying activity.¹⁷ In addition to making up an ever-growing fraction of REEP credit claims, Fig. 5 shows that solar electric credit claims represent an even larger portion of tax expenditures. This is due to the fact that solar electric credit claims are generally larger than claims stemming from the other qualifying activities. Note that the increase in REEP tax expenditures does flatten somewhat in 2020, when the credit was reduced to 26 percent of costs (from 30 percent).¹⁸

Overall, since 2006, uptake of the residential energy credits has transitioned from being primarily lower-valued NEP credits for energy efficiency home improvements to predominantly higher-value REEP credits for solar electric

¹⁴ The changes to NEP from the Inflation Reduction Act of 2022 eliminated the lifetime cap.

¹⁵ The Inflation Reduction Act of 2022 increased the annual limit to \$1200 for most taxpayers.

¹⁶ The average REEP credit claimed between 2006 and 2020 was \$3590 (in 2023 dollars), compared to NEP's lifetime cap of \$500 (nominal) in most years.

¹⁷ In order to attribute tax expenditures to specific qualifying activities, this analysis assumes no carryforward of the REEP credit. In fact, carryforward is quite common with the REEP credit, as seen in Fig. 11. As long as discount rates are low and taxpayers eventually claim the credits they carry forward, this does not present a problem to our analysis.

¹⁸ We do not examine NEP expenditures by qualifying activity due to the fact that NEP qualifying activities having credit maximums that frequently bind.

Fig. 2 REEP and NEP tax expenditures, in billions of 2023 dollars. Source: Authors' construction from IRS SOI data

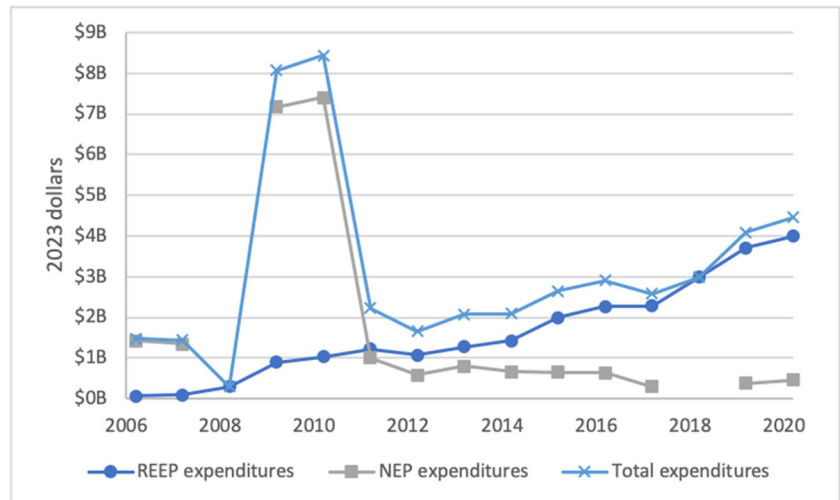


Fig. 3 NEP claims by qualifying activity over time, in millions. Source: Authors' construction from IRS SOI data

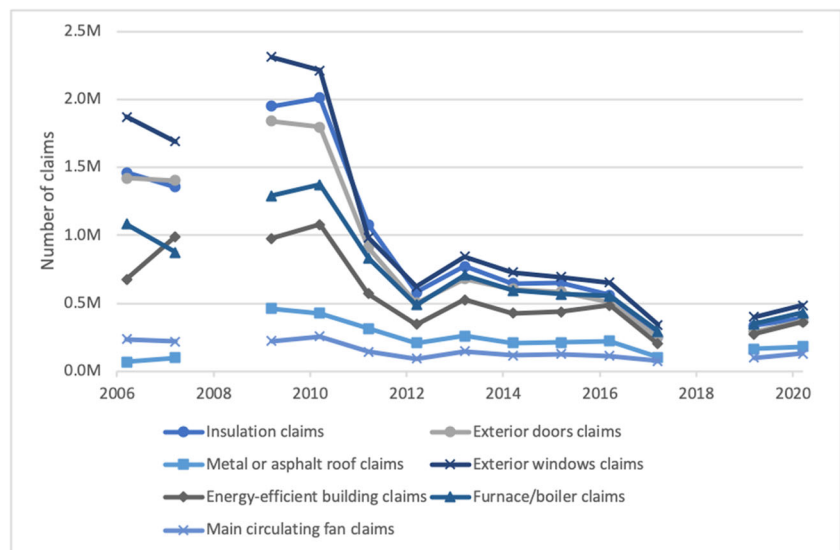


Fig. 4 REEP claims by qualifying activity over time, in thousands. Source: Authors' construction from IRS SOI data

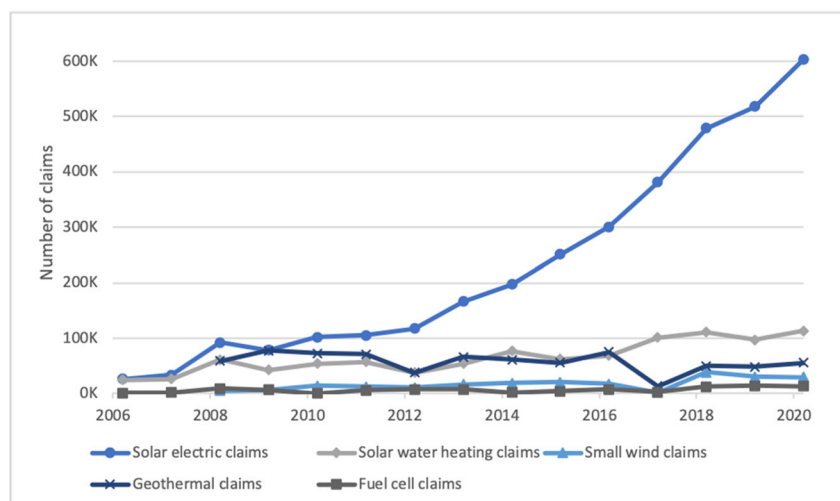
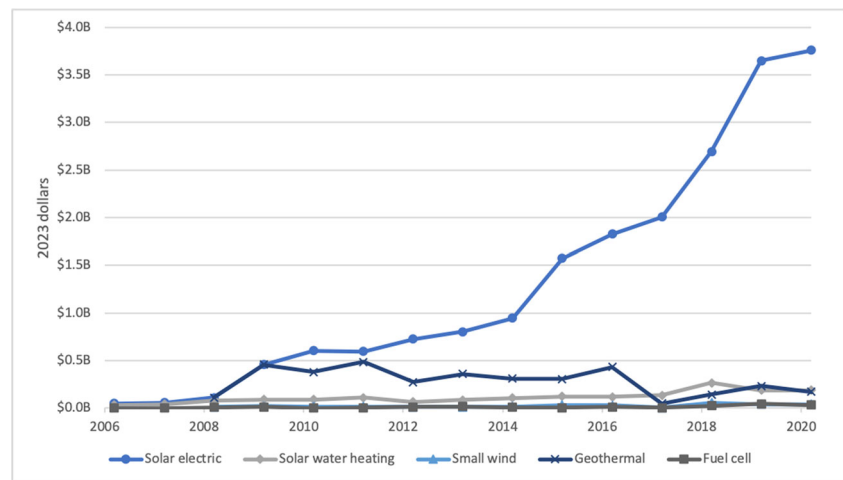


Fig. 5 REEP expenditures by qualifying activity over time, in billions of 2023 dollars. Source: Authors' construction from IRS SOI data. This figure assumes no carryforward in the REEP credit in order to attribute tax expenditures to qualifying activities



installations. This change is seen in the number of claims and is reflected more strongly in tax expenditures.

Income distribution of credit takers

The transition from NEP to REEP credits can have implications for their overall tax incidence. Both of these credits are non-refundable, meaning that taxpayers must have sufficient tax liability to claim them. For the NEP credit, this means that any taxpayers with several hundred dollars of tax liability will be able to take full advantage of the credit (due to its \$500 lifetime maximum during our sample period). The lack of maximum on the REEP credit, combined with its qualifying activities' higher costs, means that taxpayers must have higher tax liability (generally in the thousands of dollars) to take full advantage of it. Thus, the change from higher to lower take-up of NEP, and the reverse trend for REEP, could have important implications for the income distribution of credit takers. Further, changes in the tax code from TCJA have important implications for taxpayers' ability to take the REEP and NEP credits starting in 2018. Lastly, changes in costs of engaging in qualified activities, such as the decrease in costs of solar electric installations (Barbose et al. 2022), may have differentially impacted installation decisions of taxpayers across the income distribution.

Unfortunately, due to data availability, we are only able to examine the income distribution of these credits after 2014. Thus, our analysis focuses on 2014 through 2021 and omits 2006 through 2013.¹⁹

¹⁹ Note that the data used here contain all Forms 5695 e-filed between 2014 and 2021. For that reason, we do not add error bars to the charts. However, the cutoffs between income quintiles are calculated using a 5 percent sample of US tax filers and may be subject to sampling error. We expect this sampling error to be small.

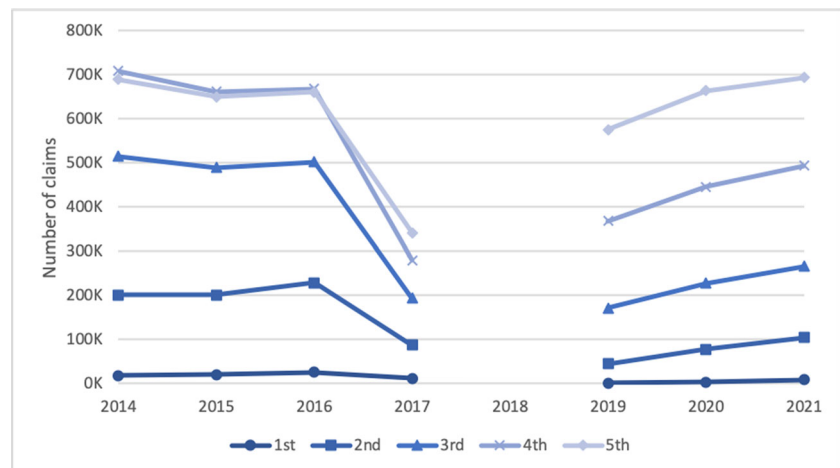
As seen in Fig. 6, prior to 2018, the NEP credit had similar take-up rates among the top two income quintiles, with slightly lower take-up in the middle quintile and lower take-up in the bottom two quintiles. After 2018, take-up dropped in all but the top income quintile, making this credit more regressive than it was previously. We conduct a Pearson's Chi square test and reject the null hypothesis that the 2017 and 2019 quintile income distributions of credit claimers are the same ($P=0.0000$). This may reflect changes in the standard deduction introduced by TCJA, which nearly doubled the standard deduction; however, our analysis is descriptive and not causal, and thus, we cannot make any definitive claims as to the cause of this change.

Although both the REEP and NEP credits are available to filers who do not itemize, the change in standard deduction changed tax liability for many taxpayers (Kallen and Mathur 2021). In particular, an increase in the percentage of taxpayers with zero tax liability would have made the residential energy credits newly unavailable to some taxpayers. Kallen and Mathur (2021) find that the percentage of taxpayers with no positive tax liability increased in all of the bottom eight income deciles following TCJA. These changes made numerous households—particularly in the middle of the income distribution—newly unable to claim the nonrefundable NEP credit.²⁰

Further, note that changes in the deductibility of state and local taxes, namely the \$10,000 deduction cap, increased federal tax liability for many homeowners in areas with higher property taxes. While this increased liability may have incentivized some homeowners to increase their take-up of REEP or NEP credits, it also made homeownership relatively more costly, potentially crowding out adoption of some qualify-

²⁰ Note that due to the ability to carry forward the REEP credit, taxpayers with zero tax liability but an expectation of future tax liability would still have an incentive to claim any qualifying costs for the REEP credit.

Fig. 6 Number of NEP claims by income quintile, in thousands. Source: Authors' construction from IRS individual tax returns for e-filers



ing activities or limiting growth in the pool of homeowners eligible to claim these credits. It is beyond the scope of this analysis to test for the exact channels in which TCJA impacted taxpayers' credit take-up behavior. However, future research could further decompose and empirically test for these distinct channels.

Figure 7 shows the average value of NEP credits claimed by income quintile, for taxpayers who claimed the NEP credit. Average credit value is lower in the lowest quintile, but relatively similar in all other quintiles. This likely reflects the maximum credit values available for different qualifying activities, as the NEP credit claims tend to be clustered around those values.²¹

Figure 8 shows REEP claims by income quintile. Claims have risen dramatically in the top three income quintiles since 2014. The second lowest income quintile saw a drop in claims in 2018, possibly related to changes to the standard deduction. We conduct a Pearson's Chi Square test and reject the null hypothesis that the quintile income distribution of credit claimers is the same in 2017 and 2018 ($P=0.0000$). Claims in the lowest income quintile are negligible in all years. Figure 9 shows average claim values for each income quintile. These are sharply rising in income in all years, with the overall pattern remaining relatively steady across years. Higher claims in higher income quintiles likely reflect a combination of higher tax liability in higher income quintiles and more ability to engage in high-cost qualifying activities. For instance, higher income taxpayers may be more likely to live in larger homes with larger roofs, meaning they are able to install larger (and therefore more expensive) solar electric arrays. They likely also have higher wealth and liquidity, meaning they can afford to engage in more expensive solar electric

²¹ In addition to the overall lifetime maximum credit of \$500 during our sample period, various qualifying activities have individual maximums, such as \$50 for "advanced main air circulating fan[s]" and \$150 for "qualified natural gas, propane, or oil furnace or hot water boiler[s]."

(or other) projects. Finally, higher-income households are more likely to be homeowners, a requirement for these credits. These factors, combined with their higher tax liability, enable them to claim generally higher credit amounts.

Figure 10 shows tax expenditures on the REEP and NEP credit by income quintile. Between 49 percent and 67 percent of tax expenditures on these credits go to the highest income quintile for each of the years in our sample. No more than 0.2 percent of tax expenditures go to the lowest income quintile in any year in our sample, making these credits regressive.²² This is not surprising, given that most credit takers will be homeowners, and homeownership itself is correlated with income.

Carryforwards also vary by income quintile, as shown in Fig. 11. Figure 12 shows the percentage of returns eligible to take a REEP credit (either from a new qualified activity or from a previous carryforward) that take a carryforward into the next year by income quintile, thereby adjusting for lower credit take-up in lower income quintiles.²³ Because taxpayers in the lower income quintiles have lower or no tax liability, carryforwards are much more common and, in some cases, can persist for years.

Although our ability to analyze long-term carryforwards is limited by our relatively short sample period (2014 to 2021), during that time period, 77.1 percent of new claimants never carry forward, 15.3 percent carry forward for 1 year, 3.7 percent carry forward for 2 years, 1.6 percent carry forward for 3 years, and 2.4 percent carry forward for more than 3

²² The second lowest quintile receives between 0.8 percent and 5 percent of tax expenditures, the middle quintile between 7 percent and 16 percent, and the second highest quintile between 25 percent and 30 percent of tax expenditures in any given year in our sample.

²³ The denominator in Fig. 12 includes both new REEP claimants and taxpayers who had a REEP carryforward from the previous year. The numerator includes any eligible return that carried any positive amount into a future tax year.

Fig. 7 Average value of NEP claims by income quintile, in 2023 dollars. Source: Authors' construction from IRS individual tax returns for e-filers

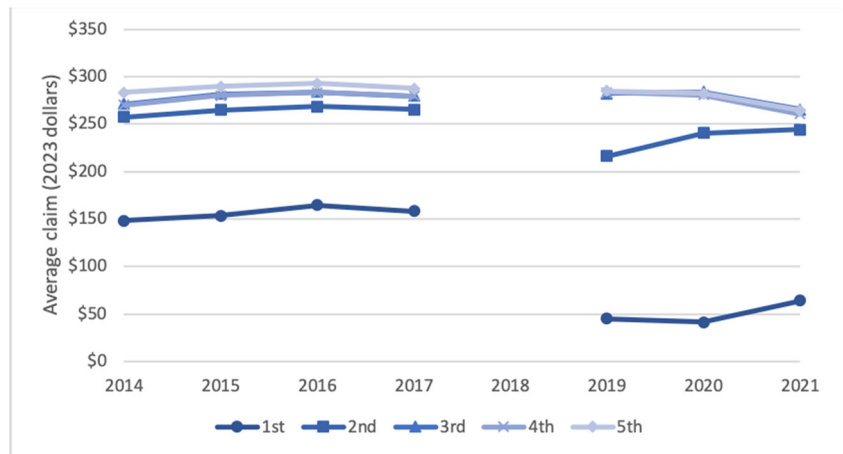


Fig. 8 Number of REEP claims by income quintile, in thousands. Source: Authors' construction from IRS individual tax returns for e-filers

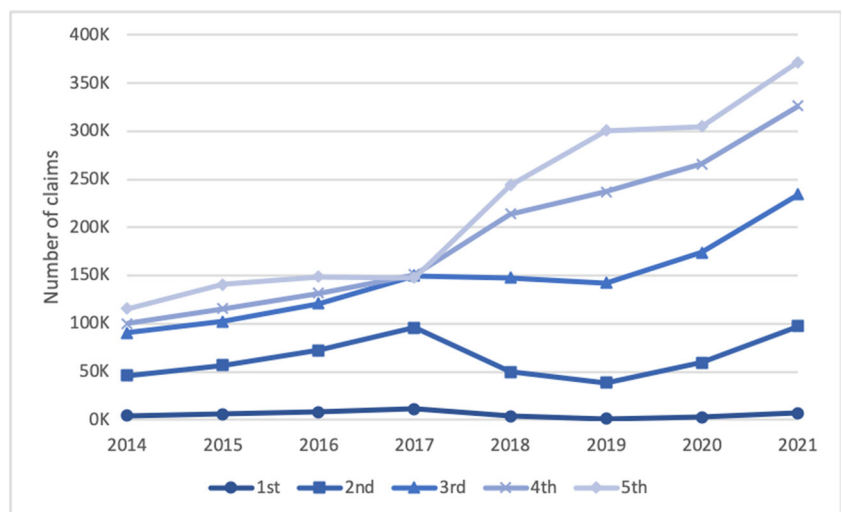


Fig. 9 Average value of REEP claims by income quintile, in 2023 dollars. Source: Authors' construction from IRS individual tax returns for e-filers

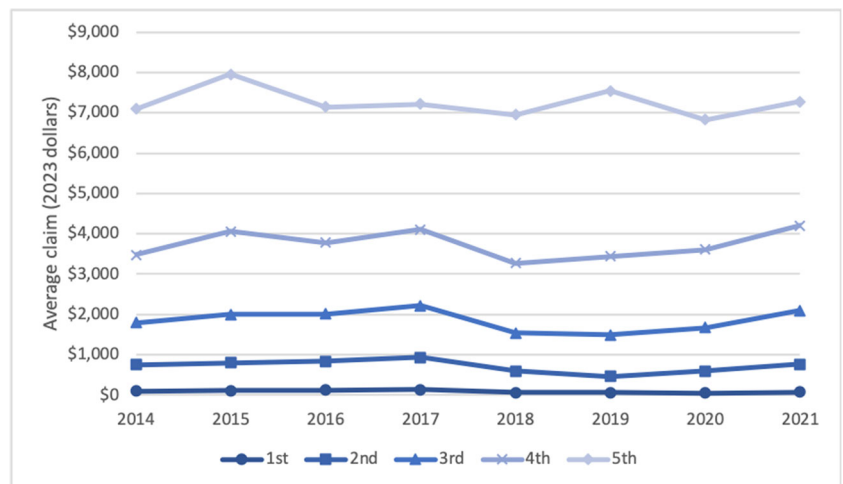


Fig. 10 Tax expenditures on REEP and NEP credit by income quintile, in billions of 2023 dollars. Source: Authors' construction from IRS individual tax returns for e-filers

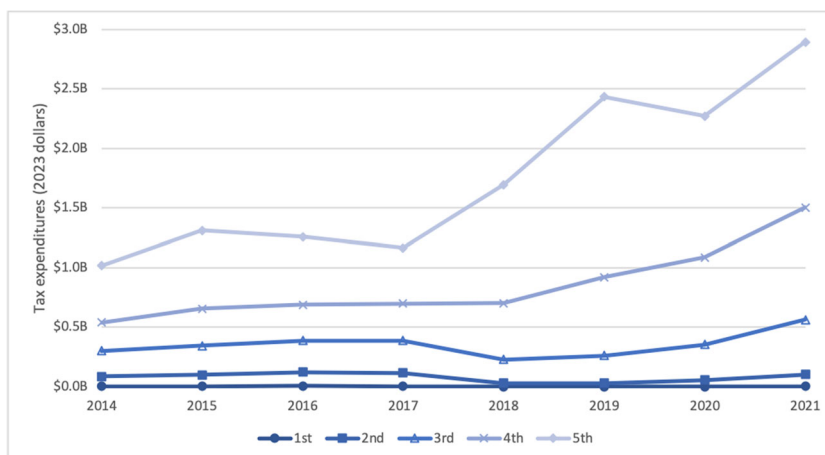


Fig. 11 Carryforwards by income quintile (REEP only), in thousands. Source: Authors' construction from IRS individual tax returns for e-filers

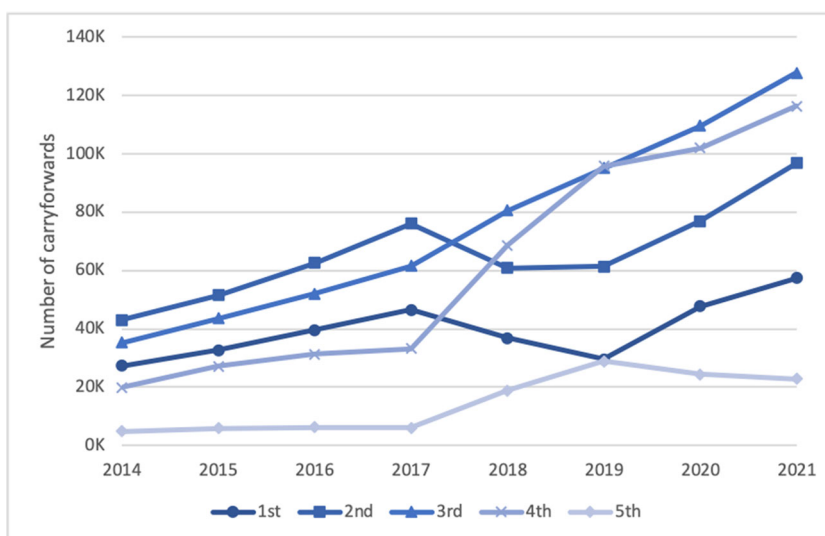


Fig. 12 Percentage of returns eligible to take a REEP credit that take a carryforward, by income quintile. Source: Authors' construction from IRS individual tax returns for e-filers

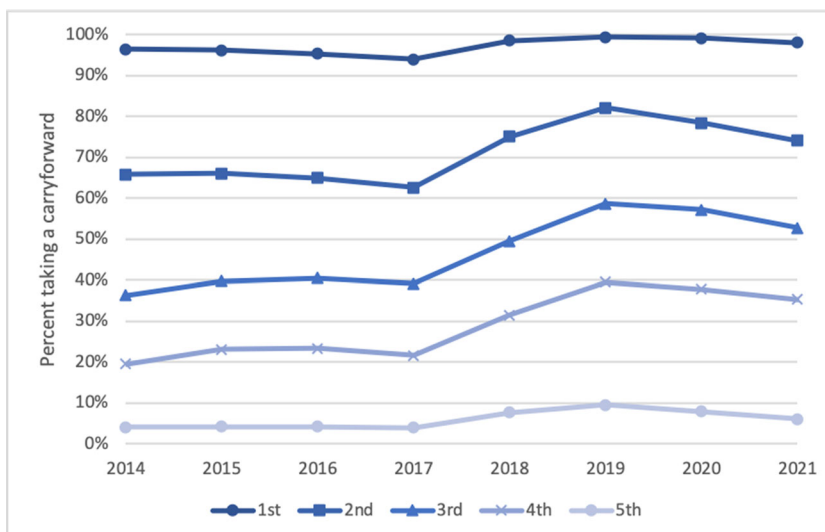
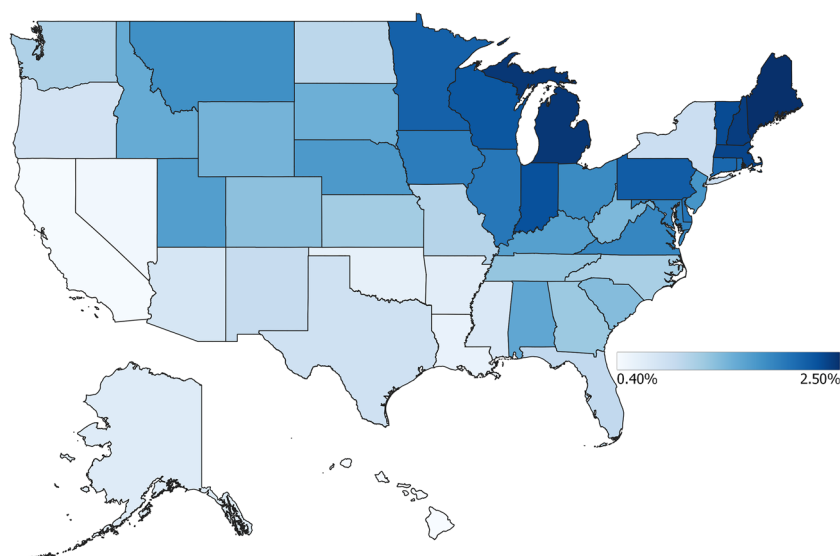


Fig. 13 Average uptake (per tax filer) for the NEP credit, averaged over 2014–2021 (excluding 2018). Source: Authors' construction from IRS individual tax returns for e-filers



years.²⁴ As expected, however, we find that taxpayers in the lowest income quintile use carryforwards at a higher rate and tenure than those in higher income quintiles, with over half of taxpayers that undertake a new qualifying activity carrying the credit forward at least 1 year,²⁵ and 12 percent carrying it forward more than 3 years. On the other hand, those in the top income quintile only carry a credit forward 4 percent of the time, and less than 1 percent carry any portion of that credit forward more than 1 year.

Overall, these two credits remain regressive, with a disproportionate portion of both claims and tax expenditures benefiting higher income taxpayers. In recent years, this discrepancy has grown.

State-by-state variation

State-by-state variation in energy credit take-up has been examined in previous work. Namely, Neveu and Sherlock (2016) (using data from 2006 through 2011) find that credit take-up rates are higher in states with colder winters and that credit claim amounts are higher in states with higher electricity prices. Related earlier work by Hirst et al. (1983) finds similar results using state-level data on the energy tax credits from the Energy Tax Act of 1978. They find that heating degree days and household fuel expenditures are both predictive of credit take-up. We supplement this previous

analysis by examining state-by-state variation in REEP and NEP uptake using more recent data.

Figures 13 through 16 show the across-state variation in REEP and NEP uptake.

Figure 13 shows average uptake per tax filer for the NEP credits from 2014 through 2021 (excluding 2018, when the NEP credit was only retroactively available). Average uptake ranges from 0.4 percent in Hawaii to 2.5 percent in Maine. Regionally, the NEP credit was most popular in the colder, northern states, especially the upper Midwest and Northeast.

Figure 14 shows average uptake per tax filer for REEP; uptake rates here range from 0.15 percent in North Dakota to 2 percent in Hawaii. Regionally, REEP is more popular in southern states, especially the Southwest. However, there are pockets of high uptake in other parts of the country as well, such as Vermont and Hawaii.

Conclusion and policy implications

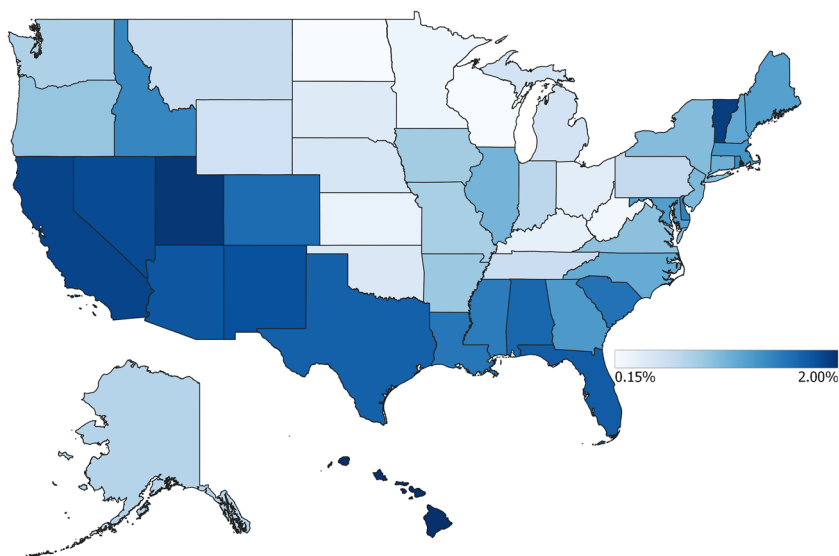
The Inflation Reduction Act of 2022 recently extended the two US residential energy tax credits through 2032 (NEP) and 2034 (REEP). We examine and describe trends in credit take-up, tax expenditures, and the income distribution of credit takers over the past 15 years. This provides valuable information for policy makers and researchers, including information on the trajectory of the policy's costs, its geographic spread, its incentivized activities, and the income distribution of credit takers.

We find that over the past 15 years, US residential energy tax credits have transitioned away from primarily lower-valued NEP credits for energy-efficient home improvements and towards higher-valued REEP credits for solar electric arrays. This trend has implications for the ongoing dissem-

²⁴ Note that this analysis is limited to tax filers whom we observe for 4 or more years.

²⁵ Note that this is a different statistic than that reported in Fig. 12: here, the denominator is taxpayers who undertook a new qualifying activity that year; Fig. 12 uses a denominator of taxpayers undertaking a new qualifying activity plus taxpayers with a prior year carryforward.

Fig. 14 Average uptake (per tax filer) for the REEP credit, averaged over 2014–2021. Source: Authors’ construction from IRS individual tax returns for e-filers



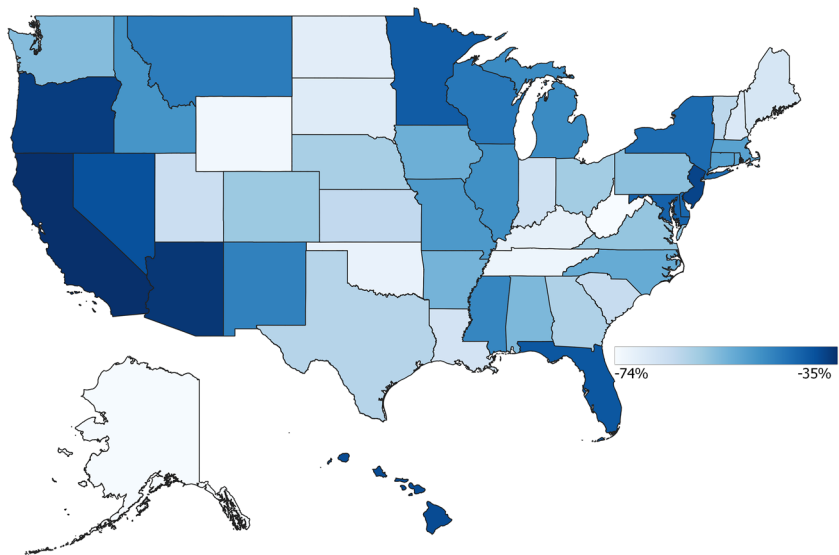
ination of distributed renewable energy generation systems, such as residential rooftop solar electric arrays.

Since 2011, real tax expenditures on these credits have more than doubled, reaching \$5 billion (2023 dollars) in 2021; it remains to be seen how tax expenditures on these credits will continue to evolve over the next 10 years. Both tax credits are regressive, with over 57 percent of tax expenditures going to the top income quintile and only 0.02 percent going to the bottom quintile in 2021.

Appendix A: Additional results

Here, we examine growth rates in uptake across states in the 2014 through 2021 time period (excluding 2018 for NEP). Figure 15 shows (negative) growth rates for NEP; all states

Fig. 15 Growth rate in NEP uptake (per tax filer) from 2014 to 2021 (excluding 2018). Source: Authors’ construction from IRS individual tax returns for e-filers

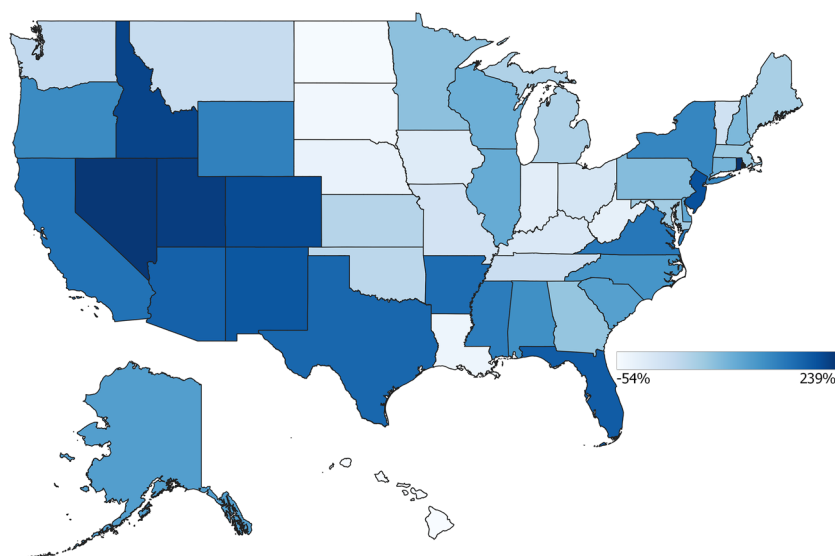


saw decreases in NEP take-up, ranging from a 74 percent decrease in West Virginia to a 36 percent decrease in California. Regionally, the West Coast (including Hawaii) and portions of the Mid-Atlantic had the smallest decreases.

Figure 16 shows growth rates in REEP uptake across states. Here, there is substantial heterogeneity. Eleven states saw decreases in uptake, with Hawaii having the largest decrease of 53.5 percent. The remaining states saw increases in uptake, with 11 states seeing increases of over 100 percent, including an increase of 239 percent in Rhode Island. Regionally, the highest growth rates were seen in the Mountain West, and the largest decreases in the Great Plains and the Midwest.

Availability of data and materials The raw data required to reproduce findings derived from IRS SOI data can be found at <https://www.irs.gov>.

Fig. 16 Growth rate in REEP uptake (per tax filer) from 2014 to 2021. Source: Authors' construction from IRS individual tax returns for e-filers



[gov/statistics/soi-tax-stats-statistics-of-income](https://www.irs.gov/statistics/soi-tax-stats-statistics-of-income). The raw data required to reproduce other findings are confidential and cannot be shared.

Declarations

Conflict of interest The authors declare no competing interests.

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