

# HAVE GOVERNMENT INCENTIVES LED TO AN INCREASE IN THE ADOPTION OF SOLAR PANELS?

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**Abstract**—The Inflation Reduction Act of 2022 provides a tax credit for installations of renewable energy or battery storage that are completed between 2022 and 2034. The primary goal was to encourage citizens of the United States to reduce the use of fossil fuels and progress toward our climate goal of being carbon neutral by 2050. Numerous states have additional benefits for installing solar on top of the federal tax credit. Through the findings of this research paper, solar panel adoption increased as the Inflation Reduction Act of 2022 went into effect.

## I. INTRODUCTION

In 2021, the United States' emissions reached 6,430 million metric tons of carbon dioxide, about 15 tons per person. Electricity generation accounts for 25% of the United States' total greenhouse gas emissions (United States Environmental Protection Agency [US EPA], 2023). Generation from fossil fuels, including coal, natural gas, petroleum, and others, accounted for about 60%, nuclear energy created about 19% and renewable energy made up the remaining 21% (Energy Information Administration [EIA] 2, 2023). To produce a single kilowatt-hour of electricity in the United States, it takes 1.12 pounds of coal or 7.36 cubic feet of natural gas (EIA 1, 2023). As our greenhouse emissions increase, global warming is increasing at an alarming rate, as we are quickly approaching our 1.5 °C cap outlined in the Paris Agreement in 2016 (Dwortzan, 2023). If no changes are made soon, the world will be at risk of thawing the permafrost and releasing enormous quantities of carbon dioxide. Many nations, including the United States, have reevaluated their emissions and are aiming to reduce them through the Net Zero Emissions 2050 Scenario, which aims for the greenhouse gases that a country releases to balance with those that they are extracting from the atmosphere (Dwortzan, 2023).

To accomplish this, the United States has experimented with incentives to encourage households to install solar. Have government incentives led to an increase in the adoption of solar panels for homes and businesses?

## II. Background

Solar technologies are designed to collect solar radiation and convert it into electrical current. The most popular and well-known solar panels are photovoltaics. As light strikes the semiconductor material, the light's energy will be converted to electrons. They will flow to the front of the cell, creating voltage as there is an imbalance in electrical charges between the front and back of the surface. This energy is collected by conductors that will either hold it in a battery or use it immediately for electricity (Airis Solutions, 2022). The amount of electricity the system produces can vary based on the latitude, how much direct sunlight it receives, and the efficiency of the panels (Airis Solutions, 2022). There are different coverage types based on the expected performance of the system, varying from completely off the electrical grid to utilizing batteries to store more energy (Go Green Solar). Community solar is also becoming an increasingly popular option, being responsible for 5.8 gigawatts of solar production, powering an average of 3,750 homes. In the next five years, six gigawatts of community solar are expected to be added in the United States, allowing thousands more homes to be powered by clean energy (McDevitt, 2023).

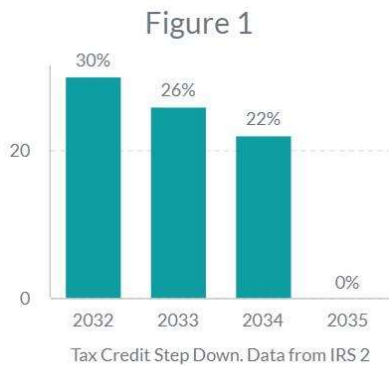
## III. HISTORY

The government has the power to encourage the adoption of solar by incentivizing installations with tax credits. A tax break went into effect in 1977 and ended in 1984. During that span of time, about 924,000 households claimed the tax credit. Thirteen years later in 1997, President Clinton announced the Solar Roofs Initiative. In 2004, they had already reached an additional 900,000 systems (Kubasek, Silverman, 2013). The Energy Policy Act of 2005 created a 30% tax credit on solar energy technology. Initially meant to expire in 2006, it was extended through many laws till 2016, before dropping to a 10% credit (Solar Energy Industries Association [SEIA] 1).

## IV. INFLATION REDUCTION ACT OF 2022

The Inflation Reduction Act of 2022 was signed into law by President Biden last year. The 10-year plan

has the intention of advancing the United States towards its climate goals. Within its contents, there are credits on installations of renewable energy including solar, wind, geothermal, fuel cells, or battery storage. This tax credit, called the Residential Clean Energy Credit, is equal to 30% of the cost of new clean energy technologies that were fully installed between 2022 and 2032. For example, if a household spends \$20,000 on the installation of solar panels on their home, they will receive a tax credit of \$6,000. This amount would then reduce their income taxes by \$6,000 that year. If their income tax does not exceed \$6,000, it will be rolled over to the next year. After 2032, the percentage falls to 26% of expenses, to 22% in 2034, and reduced to 0% at the start of 2035 (Internal Revenue Service [IRS]). This is shown in Figure 1. Anyone in the United States can claim the tax credit if they own the system and have an income tax liability (Wigness, 2023).



#### V. STATE INCENTIVES

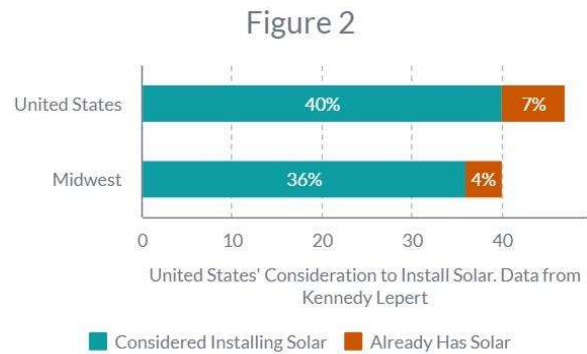
Not only does the United States have a tax credit for installations, but individual states have their own rebates or incentives for solar. In Minnesota, there are more than 100 incentives and rebates, including no sales or property tax (Database for State Incentives for Renewable and Efficiency [DSIRE USA], 2023).

Many states have adopted the same tax exemptions for solar. In Maine, a rebate from 2005 to 2008 led to a large increase in the adoption of solar panels. Similar situations have happened in other states like New Jersey, Washington, and Florida. Using tax exemptions and rebates, states can persuade citizens to adopt solar. In the United States, 40% of the population has considered installing solar, while 7% already has. In the Midwest, that number falls slightly to 36% have considered, and 4% already have (Leppert, Kennedy, 2022), demonstrated in Figure 2.

#### VI. JOB CREATION

Worldwide, there are almost four million people employed throughout the manufacturing, sales, installation, and maintenance of the solar industry. About 230,000 of which are in the United States (Ruiz,

2023). In Minnesota, there are about 4,000 (Minnesota Department of Natural Resources [MN DNR], 2021). Globally, solar heating and cooling employs another 820,000 people. There are now three times as many jobs in the solar industry than there were in 2012 (Ruiz, 2023). In the United States last year, the solar industry created more new jobs than any other energy subsector.



#### VII. BENEFITS

Globally, 4.4% of global energy creation comes from solar (Ruiz, 2023). Adopting solar photovoltaic systems into the distribution grid will lower carbon consumption in the electricity sector. Solar systems installed before 2020 reduced over 860 million metric tons of carbon from electricity generation in the United States (International Energy Association [IEA], 2022). In 2010, renewable energy made up 8% of our energy production, solar energy produced only 1% (Kubasek, Silverman, pg. 336). Today, renewables are responsible for 21% of our electrical production, solar accounting for 3.5% (EIA 2, 2023). In Minnesota, a quarter of the state's power came from renewable sources in 2018, a large majority of it being sourced from wind (DSIRE USA, 2023). Today, there are 3.2 million homes that have solar installed (Ruiz, 2023). As the solar industry grows by 22% each year (SEIA 2), the prices are dropping, and the numerous credits, rebates, and incentives, makes the price per watt even cheaper. The average American home purchases 10,632 kilowatt-hours each year, about 886 kWh per month (Airis Solutions, 2022). As one solar panel on average generates about 0.17 to 0.35 kWh, it would take about 20 panels to fully power the average home (Watkins, 2023). Installation of solar panels was at an average cost of \$0.381 per kilowatt hour in 2010. Today, not only are solar panels significantly more efficient, but the price has dropped to about \$0.057 per kilowatt hour. After 8-12 years, the solar energy system should start making a profit for the average household (Ruiz, 2023).

#### VIII. CONCLUSION

The sun emits 173,000 terawatts of solar radiation on the Earth. Worldwide, electrical demand only adds

up to 2.9 terawatts (University of Michigan, 2023). Only 0.3% of land would need to be covered with solar panels to provide enough energy for the world (Bellini, 2023). The United States' electrical demand could be met by covering 0.6% of land with solar panels (University of Michigan, 2023). In 2013, the world's solar capacity was at about 125 gigawatts. Since then, the world has reached 850.2 gigawatts of solar energy (Ruiz, 2023). Since the increase in solar adoption was during the same period as government incentives, we can conclude that the incentives were successful in their goal of increasing clean energy capacity.

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