NBER WORKING PAPER SERIES

ADDRESSING BIASES THAT IMPACT HOMEOWNERS' ADOPTION OF SOLAR PANELS

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Working Paper 28678
http://www.nber.org/papers/w28678

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
April 2021

Support for this research comes from a grant from the Alfred P. Sloan Foundation (G-2018-11100/SUB18-04), the Travelers–Wharton Partnership for Risk Management, and the Wharton Risk Management and Decision Processes Center. Our thanks to Alex Gelber, Geoff Heal, Alice Hill, Steve Kimbrough, Robert Rabinowitz, Naresh Raheja and Lisa Robinson for their helpful comments on an earlier draft of the paper and to Carol Heller for her comments and editorial assistance. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 28678
April 2021
JEL No. H31,Q42,Q54

ABSTRACT

Solar power is now economically competitive with fossil fuels in many countries, yet relatively few homeowners have installed solar panels on their property. A principal reason for this behavior stems from cognitive biases—such as myopia, inertia and herding—that cause consumers to avoid investing in long-term measures, even those that are financially attractive to them and produce social benefits such as reducing the long-term consequences of climate change. A behavioral risk audit can demonstrate ways to address these cognitive biases, in concert with short-term economic incentives and social influences. We focus on the installation of solar panels, an issue that has relevance to residents in the United States and the European Union, and to property owned by businesses and governments.

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Nature of the Problem

Today, we face the challenge of significantly reducing greenhouse gas emissions to avoid major climate-related disasters in the coming years. Experts tell us that by 2050 we can expect massive property losses from floods, hurricanes, tropical cyclones and wildfires, in addition to negative health impacts, if we do not address climate change now. To illustrate, an analysis of 136 major coastal cities around the world reveals that sea level rise will cause average annual flood losses to increase to between $1.2 and $1.6 trillion by 2050.[1] The World Health Organization estimates that there will be 250,000 additional deaths every year between 2030 and 2050 due to climate change. In addition, climate change will cause numerous other adverse effects on human health and health systems.[2] Climate change scenarios are far worse if one stretches the time horizon to 2100.[3]

Since electricity generation is responsible for 27% of US greenhouse gas emissions, a case can be made for expanding the use of renewable energy technologies, such as solar and wind, to reduce the impacts of climate change now. In particular, solar technology has greatly advanced over the past decade and is an economically viable option for replacing fossil fuels as an energy source. Today, electricity costs per kilowatt hour in the U.S. from using coal are between 6 cents and 16 cents whereas community solar[4] is between 7 cents and 18 cents, reflecting cost competitiveness between solar and coal.[5] Economies of scale, increased competition, improved institutional arrangements like straightforward permitting processes, technological innovations,

and supply chain efficiencies promise to drive the cost of solar energy down by another 15-20% over the next decade.[6] A recent study by Wood Mackenzie indicates that by 2022, solar will be cheaper than any other form of power generation in 44 states, and in every state by 2030.[7] Homeowners can take advantage of the Solar Investment Tax Credit and apply a 26% credit to their federal income taxes on the installation cost of a solar panel system. After these tax credits, the cost to install solar panels is between $11,144 and $14,696 for an average-sized house in the United States.[8] Furthermore, a study by Zillow in 2019 revealed that houses with solar-energy systems sold for 4.1% more on average than comparable houses without solar power. For the median-valued house, that translates to an additional $9,274.[9]

A December 2020 survey of voters in the U.S. by Yale University and George Mason University[10] reveals that most respondents support policies that would encourage the adoption of energy efficient measures—notably, solar panels on houses, schools, and other buildings—to assist in reducing CO_2 emissions. Nevertheless, according to a survey by the Pew Research Center in October 2019, only 6% of residents in the United States get their power from solar. [11] Similarly, relatively few homeowners in the European Union had their houses supplied by solar energy in 2019. The European Union had the solar capacity to produce 295 mega-watts of solar energy per capita, slightly more than the United States, which generated 231 mega-watts per capita. This indicates similar levels of solar utilization. By comparison, Australia had the solar capacity to produce 637 mega-watts per capita and Japan had the solar capacity to produce 498 mega-watts per capita.[12]

Characterizing Cognitive Biases and Heuristics

Almost 75 years ago, Herbert Simon coined the term *satisficing,* with the observation that people rarely make decisions optimally.[13] He noted that our cognitive limitations lead us to utilize heuristics or rules-of-thumb that are adequate for solving most choice problems. Since then, a large number of controlled experiments and field studies in psychology and behavioral economics have focused on individuals' decision processes under conditions of risk and uncertainty. Findings from many of these studies are summarized by Daniel Kahneman[14] by contrasting two modes of thinking:

Intuitive thinking operates automatically and quickly with little or no effort and no voluntary control. It is often guided by emotional reactions that have been acquired by personal experience. In the case of climate change, individuals have had limited experience, so they have a difficult time imagining the adverse impacts it will have on their lives. Thus, many individuals are not concerned with investing in measures that will reduce greenhouse gas emissions.

Deliberative thinking allocates attention to effortful and intentional mental activities where individuals undertake benefit-cost tradeoffs that incorporate long-term consequences. If the impacts of future climate change factor into an individual's decision processes, installing solar panels are likely be viewed as an attractive investment, not only because of its financial benefits but also because of its accompanying societal benefits.

Theoretical and empirical studies have identified cognitive biases that characterize intuitive thinking. Some of these biases may cause homeowners to underestimate or ignore the direct economic benefits of investing in solar, as highlighted in Table 1.

Table 1: Biases that Discourage Investment in Solar Panels

- ***Myopia*** – the tendency to focus on overly short future time horizons when appraising immediate costs and the potential benefits of investments
- ***Inertia*** – the tendency to maintain the status quo
- ***Herding*** – the tendency to base choices on the observed actions of friends and neighbors

Addressing Biases via the Behavioral Risk Audit

A behavioral risk audit characterizes how individuals are likely to perceive risks and why they might not focus on the likelihood and consequences in the same way that experts do. Successful strategies to address these biases will work with, rather than against, people's risk perceptions and natural decision biases.[15]

The behavioral risk audit draws on the principles of *choice architecture* [16] so individuals understand that converting from fossil fuels to solar energy can significantly reduce greenhouse gas emissions; however, they may still find ways to procrastinate installing solar panels. It is therefore important to also provide economic incentives that meet households' immediate needs and create social norms that lead homeowners to undertake these measures now.

Addressing the myopia bias

As noted above, individuals tend to focus on short time horizons when making decisions. More specifically, many homeowners compare the high upfront costs of installing solar panels with the benefits of lower electricity costs over the next two or three years and conclude that the purchase of solar panels is not an attractive financial investment. A Power Purchase Agreement (PPA) overcomes this bias: a solar provider installs and maintains solar panels on a residential property free of charge with the owner then buying the power produced at a rate that is typically far lower than the retail rate charged by the local utility. An empirical study by the North Carolina Clean Energy Technology Center in 2019 revealed that by switching to solar power, property owners in the 50 largest cities can expect to save on average between $44 and $187 per month, implying a savings of $10,560 to $44,880 over the 20-year lifetime of the solar power equipment.[17]

Addressing the inertia bias

When people are unsure about the best course of action, there is a tendency to maintain the status quo, even when a more desirable alternative exists.[18] One way to address this uncertainty is to make consumers understand that they will be financially better off by adopting the offered alternative. For example, the PPA provider could provide a guarantee to homeowners that if the retail price of electricity ever fell below the PPA's contracted price, then the customer would be charged the lower price. As this is highly unlikely to happen, there is little risk to the seller.

This option could be introduced as the default, which would serve as the final choice unless buyers went to the trouble of opting out in favor of some other alternative. Field and controlled experiments in behavioral economics reveal that consumers are likely to stick with the default option.[19]

In this case, real estate developers can present solar power as the default option by informing buyers that solar panels will be installed on the roof of a new house unless the owners decide that they would prefer not to have them. At the same time, the developer can provide an economic incentive for the buyer to agree to this energy efficient measure via a PPA that highlights the financial attractiveness of solar power.

Germany has utilized "green choice" defaults as a way of increasing the number of consumers who adopt solar and other renewable energies (e.g., wind, thermal and biomass). Electric power customers in two German communities were automatically enrolled in clean energy programs, with 90% opting for the default green energy provider. It should be noted that their electricity costs would have been lower had they opted out of the default and decided to stay with the original provider.[20] In a similar controlled German study, researchers examined the impact of nudges, or defaults, on customers' voluntary purchases of renewable energy contracts. Their analysis of the data revealed that the implementation of an opt-out default increased the voluntary purchase of green energy contracts by 60%.[21] A recent analysis in Germany found that when customers were automatically enrolled in renewable energy programs and then given the ability to opt out, they tended to stick with the default, especially those concerned with the problem of climate change.[22] The absence of default options in the United States is likely to be a contributor as to why renewables accounted for only 11% of the country's electricity consumption in 2019 compared to 40% in Germany.

Local governments can play an important role in utilizing default options to encourage their residents to adopt solar energy through Community Choice Aggregation (CCA) programs in the states that have passed enabling legislation. For example, the city of Lancaster, CA had a 94% acceptance rate with a default option. Local governments who establish CCAs can select an alternative energy supplier, providing their communities with more control over their electricity by allowing them to incorporate renewable energy into their portfolios. Thus, households receive the benefits of solar energy—lower electricity costs and reduced carbon gas emissions—without having to install panels on their home or property.

Addressing the herding bias

Given the tendency to imitate the behavior of friends and neighbors, one of the most cost-effective means of encouraging individuals to install solar panels is to create a social norm. If a homeowner observes solar panels on all their neighbors' roofs, they may follow suit. Early-adopters in the community who are highly respected may encourage others to follow their example.

Social norms can be complemented by well-enforced regulations. In this regard, California has acknowledged solar energy's long-term economic benefits with a regulation that as of January 1, 2020, all new single and multifamily residences be constructed with solar panels. The California Energy Commission, which approved this legislation, estimates that the monthly mortgage payment on a house will increase by $40 a month but that the owner will save an average of $80 a month on electricity.[23] Because the cost of the solar panels is included in the mortgage, the owner's costs are effectively lowered from the moment they purchase the house. Thus, this

policy also addresses the *myopia bias* by spreading the cost of solar panels over time while reducing buyers' budgetary concerns about the financial impact of a new house with solar panels.

States and municipalities can use other financial incentives to motivate homeowners to install solar panels. For example, in a *regret lottery,* similar in structure to the 1989 Dutch Postcode Lottery, every house in the region would be given a lottery ticket, but only those with solar panels would be eligible to win prizes. Homeowners who do not have solar panels would not win a prize, even if their lottery number were drawn. Field studies and experimental data reveal that individuals who did not qualify for a prize would feel considerable regret if their number were drawn.[24]

Summary and Conclusions

Cognitive biases may cause homeowners to avoid undertaking measures to mitigate greenhouse gas emissions. A behavioral risk audit can play a role in showing property owners the short-term financial benefits of investing in solar panels and the resulting long-term global benefits of reducing greenhouse gas emissions. Local governments can develop programs and policies that help residents overcome their biases and address the climate change challenge using economic incentives. To further enable the switch to solar energy there is a need for research and development that may result in innovations such as inexpensive storage batteries to deliver energy during times when there is no sunlight.[25]

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