# Innovative Finance Inclusion

## Solar Systems:
## Decision making factors influencing adoption by private roof-owners

**Date: September 2022**

**Author: Dr. Sharon Soroker**

**Affiliation: Tel Hai College**

**The case study is based on materials from a research proposal to the MOE (2020), which prepared with Kineret Teodorescu, Technion-Israel institute of Technology**

Co-funded by the Erasmus+ Programme of the European Union

**Project number 619453-EPP-1-2020-1-IL-EPPKA2-CBHE-JP**
This project has been funded with support from the European Commission. This publication [communication] reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein

# Abstract

Renewables, green sources of energy, are today less expensive than ever due to technological progress and cost reduction (mainly because of mass production and low cost of the key material - Silicon). The average cost of producing 1 kWh (kilowatt hour) of electricity using photovoltaic technology has dropped more than 85% within a decade, with the common estimation that the prices will continue to decline in the next decade.

In Israel, as in many other countries, rooftop solar systems are crucial for gaining a distributed energy market, based on renewables, with advantages for the transmission network (Moep report, 2020). Although installing a solar system produces an impressive return on investment for private homeowners or any rooftop owner for this matter (repayment in 6-10 years with guaranteed rate by the government for 25 years, IRR = 10% to 15% with various funding options offering an amazing ROE rates), the installation ratio is a fraction of the total potential, even in an economic environment of negligible real interest rates and plenty of finance solutions. This case study aims to rase the question on this apparently non rational behavior of private rooftop owners avoiding or delaying the installation of solar systems.

Using insights and methodologies from behavioral economics and social psychology, this case study examines practical ways for encouraging massive solar installation, which is expected to create substantial economic, environmental, and social benefits.



## Keywords

Renewables, Decision-Making, Policy, Consumer Behavior, Finance, Environment

# 1 Theoretical and technological background

The urgency of transforming the electricity production market from fossil-fuels into renewable energies is rising rapidly, as the consequences of global climate change become worldwide. In Israel, a sunny country with very limited potential for other renewables, recent works (i.e., NZO 2050, working paper; Israel Electricity Authority, 2020; Ministry of Environmental Protection, 2020) highlight solar energy as the main non-fossil energy source to answer electricity demands. Indeed, due to its geographic location, Israel has a great advantage for solar energy, with 1700 hours of sunlight producing energy yearly, compared to 1075 in Berlin or 1500 in Rome-Italy (Based on - Global Solar Atlas).

The electricity market in Israel today is based on Gas, Coal, and Renewables. Lately, the energy minister declared two main targets, shifting from coal to Gas (until 2024), and producing 30% of the country's electricity from renewable resources by 2030. Since the potential for wind energy is very limited in Israel, the renewable energy should mostly come from Solar systems. This will require to quadrupole the current solar capacity, adding 11-13Gw to the current 3-4Gw.

Relying on solar energy carries its challenges, one of which is the vast area needed to produce a considerable electrical capacity using photovoltaic (PV) technology, and the resulting threats to the ecology. Thus, when promoting PV systems in a dense, highly populated country like Israel, an extra effort must be made to exploit all built areas and disrupted lands before implementing PV systems over open areas. Installing PV systems on the rooftops of private houses is thus an essential component in the transformation to a renewable-based electricity market in Israel. Additional benefits of rooftop systems are improved energy security, reduced investment in grid infrastructure, and improved social justice by spreading the income from electricity production more evenly across the country's population.

For the last two years, Heschel Center for sustainability and the NZO[1] team are involved in various efforts to support the process to shift the Israel electricity network from a Fossil based to a Renewable-based. As part of the NZO research on the potential areas for PV installations, the PV potential for 24 different types of areas was mapped, including - private houses, office buildings, roads, Agrovoltaic (above agricultural crops), and more. Findings show that by 2050, electricity produced over housing infrastructure (private houses and apartment buildings) can be the largest single resource for PV installations equaling over 30% of the country's electricity demands.

Installing rooftop PV has many advantages for the energy system in Israel, by reducing investment in the Grid and by enabling preservation of open lands and nature. However, until now, the penetration rate of solar installation over rooftop of private houses is very low, according to the Israel Electricity Authority (IEA) (private communication). This is despite the good return of investment

1 https://heschel.org.il/en/policy/renewable-energy-nzo/

(6-10 years return of investment, with a guaranteed rate for 25 years and almost no risks), and convenient funding options by banks and private companies.

Regulatory barriers for installation of PV systems on private houses were a barrier a few years ago, but most of them were resolved in recent years. Professionals working in the field suggested other factors as barriers for a wide adoption of solar by homeowners, among them cognitive barriers, such as uncertainty regarding the market, perceived bureaucracy and complexity of the process, fear of perceived health effects (i.e., radiation), trust in the long-term commitment of authorities and the length of the deal (25 years). Other mentioned barriers are funding, aesthetic and legalization.

Today, the tariff offered to private roof-owners for producing electricity using PV systems is 0.48 or 0.45 NIS per KW (depending on the system size) guaranteed by the government for 25 years. Installing a 10KW solar system, for example, will cost around 52,500 NIS, (based on 4,500 per KW, plus VAT), the annual income will be 8,160 NIS (0.48 NIS per KW, and 1700 hours of effective sunlight). After 7 years to return the investment, the homeowner will have another 18 years of a monthly net income of more the 680 NIS. Despite of its attractiveness, the penetration rate of PV systems in Israel is only a fraction of the potential, according to regulatory officials. To date, no research identifying the causes of these low rates have been published. A preliminary research conducted in Northern-Israel Arabic society (Injaz & Heschel Center, working paper) identified several factors:

*Lack of knowledge*. 65% of the respondents were not familiar with the basic information on private PV systems, i.e., costs and ROI. When asked what the obstacles are, over 70% of the respondents named a lack of knowledge about the subject or about its the environmental importance. (Indeed, relatively little information is available in Arabic today).

*Financial barriers*. When asked what the obstacles are, 72% pointed to the absence of financial means (despite plenty of financial tools available in the market today).

*Low trust in regulatory institutions*. A third of the respondents said they have low confidence in governmental institutions to insure the returns from the systems in the long run. Another third said they think installing a system involves complicated bureaucracy.

# 2 Review of the existing literature

Research on the adoption of solar PV systems has been accelerating in recent years due to the undeciphered gap between the increased attractiveness of the technology and the low adoption rates worldwide. This “Energy Efficiency Gap”, according to which consumers under-invest in energy-efficient products compared to the expected gains associated with these investments (Gillingham & Palmer, 2014; Klein & Noblet, 2017), has been suggested to derive from behavioral biases (Frederiks, Stenner, & Hobman, 2015) such as risk aversion and framing effects (Tversky & Kahneman, 1992; Weber & Chapman, 2005), time discounting (Train, 1985; Loewenstein & Prelec, 1992), and conformism to social norms (Cialdini & Trost, 1998; Smith et al., 2012). Most theories related to adoption of new technologies (e.g., Roger's model of the innovation decision process, Rogers, 2003; Theory of Planned Behavior, TPB, Ajzen, 1991) make a distinction between external factors related to the technology itself or to the environment and internal factors such as individual differences in personality. Importantly, recent national surveys conducted in many countries around the world (e.g., the Netherland, Australia, Taiwan, the US, Pakistan etc.) suggest that while some of the above factors have a strong influence on solar PV adoption others do not. For example, changes in framing regarding risk, losses, and time failed to increase intentions to go solar (Wolske et al., 2018). In what follows, we shortly review the main factors that were found in previous studies to increase PV adoption, followed by several potential factors that were yet to be examined.

## Contextual factors:

*Social norms*. A relatively strong effect of social norms was observed in various empirical studies, revealing a robust peer/neighbor effect in the context of PV adoption (e.g., Bollinger & Gillingham ,2012; Graziano & Gillingham, 2015; Noll, Dawes & Rai, 2014; Rai, Reeves, & Margolis, 2016; Richter, 2013). For example, using big data of installation in California, Bollinger and Gillingham (2012) found that any additional installation in a zip code increased adoption rate by 0.78%, probably due to visibility of panels (image motivation) and word of mouth (information transfer e.g., Rai & Robinson 2013). In addition, data from Connecticut indicate that community organizers who themselves installed solar panels recruited 62.8% more panel installations than community organizers who did not (Kraft-Todd et al., 2018).

*Social support*. the extent to which people feel their family members and friends would be supportive if they decided to go solar was found to predict interest in residential solar panels (Wolske et al., 2017). Moreover, those who believe their peers would support the decision to go solar were found to be more likely to believe that PV is beneficial (Wolske et al, 2018).

*Financial incentives and investment costs*. Across all countries, financial incentives were found to be a strong predictor of people's intentions to adopt and actual adoption of solar PV (e.g., Drury et al., 2012; Korcaj et al., 2015; Kwan, 2012; Rai, Reeves, & Margolis, 2016; Sigrin et al., 2015; Wolske et al., 2017). For example , government incentives had the strongest influence on intentions to go solar in Taiwan (Sun et al., 2020); FiT positively affected intention to adopt solar PV in Australia (Zander et al., 2019); Higher electricity prices increased PV adoption across US areas (Crago & Chernyakhovskiy, 2017; Graziano & Gillingham, 2015;); and financial determinants constructed the top rated barriers for adoption in Pakistan (Qureshi, Ullah, & Arentsen, 2017). The high upfront cost was mentioned as a significant barrier in almost all studies (e.g., Vasseur & Kemp, 2015; Zander et al., 2019), in line with recent experimental findings (Ashby & Teodorescu, 2019) demonstrating the fundamental link between switching costs and inertia biases such as the status quo bias (Samuelson & Zeckhauser, 1988) and the default effect (Dinner et al., 2011).

*Built environment*. Graziano and Gillingham (2015) found that smaller centers contribute to the adoption more than larger urban areas (housing density decreases adoption), possibly due to split incentives in multifamily properties (Bronin, 2012; Gillingham & Sweeney, 2012).

## Individual differences:

*Pro-environmental values*. Environmental concern, which mainly implies strong feelings of moral obligation to protect the environment and evaluation of one's own behavior in terms of its consequences for the environment, was positively related to the willingness to pay more for renewable energy (Palm & Tengyard, 2011), residential solar thermal technology adoption (Solangi et al., 2011), adopting the small-scale production of electricity from PV (Schelly, 2014), and general interest in adopting solar (Wolske et al., 2018).

*Innovativeness*. Schelly (2014) suggested that early adopters of residential solar electricity shared an interest in technical innovation. Indeed, individuals who tend to seek out novel goods were found to be more likely to believe that PV is beneficial and respond to a mock ad (Wolske et al., 2018) as well as to report greater intentions to install a residential solar power system (Chen, 2014), greater interest in residential solar (Wolske, Stern, & Dietz, 2017), and more positive attitude toward rooftop PV installation (Sun et al., 2020).

*"Warm glow"*. According to Andreoni (1990), people receive utility from the act of giving and contributing to a public good. In the context of solar PV adoption, some people may take pride in their contribution to "green" electricity and may accordingly experience "warm glow" (similarly to purchasing other green products, Hartmann & Apaolaza-Ibáñez, 2012). Indeed, Sun et al. (2020) found that the warm glow construct positively affected attitudes toward rooftop PV installation, which in turn predicted intentions for rooftop PV installation.

## Demographic variables:

*Age, education, and income*. PV adopters were found to be younger, more educated, and with higher average income than the general population (Graziano & Gillingham, 2015; Vasseur & Kemp, 2015; Zander et al., 2019).

*Religiosity*. Several studies found a negative relationship between religiosity and pro-environmental tendencies (e.g., Eckberg & Blocker, 1989; Hand & Van Liere, 1984). Yet other studies did not find this effect (e.g., Biel & Nilsson, 2005; Hayes & Marangudakis, 2001).

These findings might suggest that today, with regards to Rogers model, mainly innovators install solar systems.

## Unstudied potential factors:

*Framing of forced choice vs. acceptance of an offer*. Ert and Erev (2008) found a strong sensitivity to the format of the decision: People rejected attractive gambles when framed as an offer but selected these gambles when framed as a forced choice task. The authors concluded that people use a "lemon avoidance heuristic", according to which offers that look like lemons (i.e., bad products that only appear to be good) would be rejected (Ert & Erev, 2008). This mechanism suggests, for example, that the addition of financial benefits could in fact harm acceptance rates when framed as an offer (increasing the perception of "too good to be true").

*Risk attitudes*. In economics, individual differences in risk taking, risk perceptions, and risk attitudes have been studied extensively (e.g., Weber & Milliman, 1997). In the context of solar PV adoption, only perceived risk with respect to the technology itself was examined, whereas the more general risk attitude, that was found to explain many real-life behaviors (e.g., Dohmen et al., 2011), was yet to be studied.

*Temporal discounting*. Households seem to discount the future benefits of solar PV systems (e.g., De Groote & Verboven, 2019). Yet, to the best of our knowledge, no study to date examined if and how personal discount rates and related intertemporal biases (e.g.Loewenstein & Prelec, 1992; Shavit, Roth, & Teodorescu, under review) affect intentions to go solar.

# 3 Gaps in the existing knowledge

Despite mounting interest in the adoption of solar PV systems among scientists and governments, we lack the underpinning science to help us understand what the most efficient means are to enhance solar PV adoption in Israel. This knowledge is particularly pressing in highly condense and urbanized countries, such as Israel, where the use of electricity is constantly increasing, and open lands shrink. In recent years, studies highlighted the effect of external and internal factors on intentions to go solar all over the world, however, these studies are limited in several important ways undermining their applicability to the Israeli context.

The impact of internal and external factors was mainly studied in isolation preventing direct comparisons. Moreover, the role of socio-cultural context in these effects was usually neglected. Despite being a relatively small and condensed country, Israel is unique in its heterogenic population, which includes various cultural, socio-economic, and religious groups. Thus, to understand when internal and external factors elicit stronger influence on intentions to go solar, the unique socio-cultural context of the target population should be considered.

Recently, scholars suggested the distinction between tight and loose socio-cultural contexts as a comprehensive theoretical framework for understanding the effects of internal vs. external factors on behaviors in general and on environmental behaviors in particular (Elster & Gelfand, 2020). Tight contexts have strong norms, low tolerance of deviant behavior, and severe punishment for norm violations, and loose contexts have weak norms, high tolerance of deviant behavior, and mild punishment for norm violations (Gelfand et al., 2011). Consequently, Elster and Gelfand (2020) found that pro-environmental values elicit stronger effects on environmental behaviors in loose contexts but were unrelated to these behaviors in tight contexts. Similarly, Eom and colleagues (2018, 2020) have found that pro-environmental beliefs were a stronger predictor of environmental behavior among high social class or secular groups (i.e., loose context), whereas norms were a stronger predictor of this behavior among low social class or religious groups (i.e., tight context). These and other studies on solar PV adoption, however, are either correlational or/and focus on behavioral intentions rather than on overt behaviors. To develop effective interventions that can substantially increase the installation of PV systems, it is essential to demonstrate the causal effect of internal and external factors on actual behavior. For example, it is currently unknown whether individual differences or social norms could be manipulated to increase PV adoption, and whether these manipulations are equally effective in different socio-cultural contexts.

# 4 Questions to be considered:

A. how major cultural groups of Israeli consumers that vary in their tightness/looseness evaluate solar PV systems? what might be their main barriers to adopt such systems? and how adoption rates can be enhanced using extensive interventions?
B. What has more effect, internal and external barriers? Are there different answers to different cultural groups.
C. What might be the most effective interventions to the main consumers' in order to bypass the barriers of going solar? (Experimentally identify factors that elicit strongest causal effects on intentions to go solar.
D. How to convince other costumers groups, besides innovators, to adopt PV (mainly early adopters and early majority)?
E. What might be the main barriers with the strongest impact on intentions to go solar. (e.g., low pro-environmental values, high resistance to change, past vs. future orientation).
F. For each barrier, suggest two manipulations aiming at removing it.

# 5 Implementation

Transforming Israel into a renewable-energy based nation, requires massive penetration of PV systems to duel-usage areas, first of which are rooftops of residential homes. This regime is the most immediate and visible potential yet turns out to be the hardest to achieve massive success in, partly because it requires the cooperation of hundreds of thousands of private citizens. Answers to the mentioned questions might enable the IEA, the MoE and other governmental bodies to maximize their efforts and aid them to target potential clients more accurately. The conclusions should be assimilated in campaigns for the encouragement of private roof owners to install PV systems on their property. Such campaigns could be launched by public bodies such as the Israeli Electricity authority and MoE, and targeted campaigns led by commercial companies that operate in the market today, who contact the citizens on a daily basis. Increasing the number of private PV systems, will have a positive socio-economic effect by creating durable income sources for private households (mainly with a low – average socio-economic status), and double positive environmental effect, by realization of massive renewable energies production potential while sparing open lands. Other positive implications derive from the decentralization of the electricity system, including reduction of constraints on the transmission network, improvement electrical security during emergencies, and lowering the need and dependence on fossil-based power plants. Less fossil fuel usage also means less morbidity, greenhouse gasses, and eventually lower cost of energy (specially with regards to carbon tax).

# References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179-211.

Andreoni, J. (1990). Impure altruism and donations to public goods: A theory of warm-glow giving. *The Economic Journal*, *100*(401), 464-477.

Ashby, N. J., & Teodorescu, K. (2019). The effect of switching costs on choice-inertia and its consequences. *PloS one, 14*(3), e0214098.

Biel, A., & Nilsson, A. (2005). Religious values and environmental concern: Harmony and detachment. *Social Science Quarterly, 86*(1), 178–191.

Bronin, S. (2012) Building-related renewable energy and the case of 360 state street. *Vanderbilt Law Review, 65*: 1875–1934.

Chen, K. K. (2014). Assessing the effects of customer innovativeness, environmental value and ecological lifestyles on residential solar power systems install intention. *Energy Policy*, *67*, 951-961.

Cialdini, R. B., & Trost, M. R. (1998). Social influence: Social norms, conformity and compliance.

Crago, C. L., & Chernyakhovskiy, I. (2017). Are policy incentives for solar power effective? Evidence from residential installations in the Northeast. *Journal of Environmental Economics and Management*, *81*, 132-151.

De Groote, O., & Verboven, F. (2019). Subsidies and time discounting in new technology adoption: Evidence from solar photovoltaic systems. *American Economic Review, 109*(6), 2137-72.

Dinner, I., Johnson, E. J., Goldstein, D. G., & Liu, K. (2011). Partitioning default effects: why people choose not to choose. *Journal of Experimental Psychology: Applied, 17*(4), 332.

Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., & Wagner, G. G. (2011). Individual risk attitudes: Measurement, determinants, and behavioral consequences. *Journal of the European Economic Association, 9*(3), 522-550.

Eckberg, D. L., & Blocker, T. J. (1989). Varieties of religious involvement and environmental concerns: Testing the Lynn White thesis. *Journal for the Scientific Study of Religion, 28*, 509–517.

Elster, A., & Gelfand, M. J. (2020). When guiding principles don't guide: The moderating effects of cultural tightness on value-behavior links. *Journal of Personality*. https://doi.org/10.1111/jopy.12584

Eom, K., Saad, C. S., & Kim, H. S. (2020). Religiosity Moderates the Link Between Environmental Beliefs and Pro-Environmental Support: The Role of Belief in a Controlling God. *Personality and Social Psychology Bulletin*, 0146167220948712.

Eom, K., Kim, H. S., & Sherman, D. K. (2018). Social class, control, and action: Socioeconomic status differences in antecedents of support for pro-environmental action. *Journal of Experimental Social Psychology*, *77*, 60-75.

Ert, E., & Erev, I. (2008). The rejection of attractive gambles, loss aversion, and the lemon avoidance heuristic. *Journal of Economic Psychology, 29*(5), 715-723.

Frederiks, E. R., Stenner, K., & Hobman, E. V. (2015). Household energy use: Applying behavioural economics to understand consumer decision-making and behaviour. *Renewable and Sustainable Energy Reviews*, *41*, 1385-1394.

Gelfand, M. J., Raver, J. L., Nishii, L., Leslie, L. M., Lun, J., Lim, B. C., ... & Aycan, Z. (2011). Differences between tight and loose cultures: A 33-nation study. *Science*, *332*(6033), 1100-1104.

Gillingham, K., & Palmer, K. (2014). Bridging the energy efficiency gap: Policy insights from economic theory and empirical evidence. *Review of Environmental Economics and Policy*, *8*(1), 18-38.

Gillingham, K., Sweeney, J. (2012) Barriers to the implementation of low carbon technologies. *Climate Change Economics, 3*, 1–25.

Graziano, M., & Gillingham, K. (2015). Spatial patterns of solar photovoltaic system adoption: the influence of neighbors and the built environment. *Journal of Economic Geography, 15*(4), 815-839.

Hand, C. M., & Van Liere, K. D. (1984). Religion, mastery-overnature, and environmental concern. *Social Forces, 63*(2), 555– 570.

Hartmann, P., & Apaolaza-Ibáñez, V. (2012). Consumer attitude and purchase intention toward green energy brands: The roles of psychological benefits and environmental concern. *Journal of Business Research*, *65*(9), 1254-1263.

Hayes, B. G., & Marangudakis, M. (2001). Religion and attitudes towards nature in Britain. *The British Journal of Sociology, 52*(1), 139–155.

Klein, S. J., & Noblet, C. L. (2017). Exploring Sustainable Energy Economics: Net Metering, Rate Designs and Consumer Behavior. *Current Sustainable/Renewable Energy Reports*, *4*(2), 23-32.

Kraft-Todd, G. T., Bollinger, B., Gillingham, K., Lamp, S., & Rand, D. G. (2018). Credibility-enhancing displays promote the provision of non-normative public goods. *Nature*, *563*(7730), 245-248.

Loewenstein, G., & Prelec, D. (1992). Anomalies in intertemporal choice: Evidence and an interpretation. *The Quarterly Journal of Economics*, *107*(2), 573-597.

Palm, J., & Tengvard, M. (2011). Motives for and barriers to household adoption of small-scale production of electricity: examples from Sweden. *Sustainability: Science, Practice and Policy*, *7*(1), 6-15.

Noll, D., Dawes, C., & Rai, V. (2014). Solar community organizations and active peer effects in the adoption of residential PV. *Energy Policy*, *67*, 330-343.

Qureshi, T. M., Ullah, K., & Arentsen, M. J. (2017). Factors responsible for solar PV adoption at household level: A case of Lahore, Pakistan. *Renewable and Sustainable Energy Reviews*, *78*, 754-763.

Rai, V., Reeves, D. C., & Margolis, R. (2016). Overcoming barriers and uncertainties in the adoption of residential solar PV. *Renewable Energy*, *89*, 498-505.

Rai, V., Robinson, S. (2013) Effective information channels for reducing costs of environmentally-friendly technologies: evidence from residential PV markets. *Environmental Research Letters, 8*: 14–44.

Samuelson, W., & Zeckhauser, R. (1988). Status quo bias in decision making. *Journal of Risk and Uncertainty, 1*(1), 7-59.

Schelly, C. (2014). Residential solar electricity adoption: What motivates, and what matters? A case study of early adopters. *Energy Research & Social Science*, *2*, 183-191.

Shavit, Y., Roth, Y., & Teodorescu, K (under review). Intertemporal decisions from experience.

Smith, H. J., Pettigrew, T. F., Pippin, G. M., & Bialosiewicz, S. (2012). Relative deprivation: A theoretical and meta-analytic review. *Personality and Social Psychology Review*, *16*(3), 203-232.

Solangi, K. H., Islam, M. R., Saidur, R., Rahim, N. A., & Fayaz, H. (2011). A review on global solar energy policy. *Renewable and Sustainable Energy Reviews*, *15*(4), 2149-2163.

Sun, P. C., Wang, H. M., Huang, H. L., & Ho, C. W. (2020). Consumer attitude and purchase intention toward rooftop photovoltaic installation: The roles of personal trait, psychological benefit, and government incentives. *Energy & Environment*, *31*(1), 21-39.

Train, K. (1985). Discount rates in consumers' energy-related decisions: a review of the literature. *Energy (Oxford)*, *10*(12), 1243-1253.

Tversky, A., & Kahneman, D. (1992). Advances in prospect theory: Cumulative representation of uncertainty. *Journal of Risk and Uncertainty*, *5*(4), 297-323.

Vasseur, V., & Kemp, R. (2015). The adoption of PV in the Netherlands: A statistical analysis of adoption factors. *Renewable and Sustainable Energy Reviews*, *41*, 483-494.

Weber, B. J., & Chapman, G. B. (2005). Playing for peanuts: Why is risk seeking more common for low-stakes gambles?. *Organizational Behavior and Human Decision Processes*, *97*(1), 31-46.

Weber, E. U., & Milliman, R. A. (1997). Perceived risk attitudes: Relating risk perception to risky choice. *Management Science, 43*(2), 123-144.

Wolske, K. S., Stern, P. C., & Dietz, T. (2017). Explaining interest in adopting residential solar photovoltaic systems in the United States: Toward an integration of behavioral theories. *Energy Research & Social Science*, *25*, 134-151.

Wolske, K. S., Todd, A., Rossol, M., McCall, J., & Sigrin, B. (2018). Accelerating demand for residential solar photovoltaics: Can simple framing strategies increase consumer interest?. *Global Environmental Change*, *53*, 68-77.

Zander, K. K., Simpson, G., Mathew, S., Nepal, R., & Garnett, S. T. (2019). Preferences for and potential impacts of financial incentives to install residential rooftop solar photovoltaic systems in Australia. *Journal of Cleaner Production*, *230*, 328-338.

Israel Ministry of Environmental Protection, *estimation of PV in the urban area of Israel, 2020.* https://www.gov.il/BlobFolder/reports/potential_for_solar_production_on_existing_structures_jan_2020/he/climate_change_and_energy_efficiency_potential_for_solar_production_on_existing_structures_jan_2020.pdf

*Israel Electricity Authority, Incising renewables electricity goal to the year of 2030, draft for the public, June 2020.*

https://www.gov.il/BlobFolder/rfp/shim_2030yaad/he/Files_Shimuah_yaad_2030n_work_n.pdf

The case study is based on materials from a research proposal to the MOE (2020), which prepared with Kineret Teodorescu, Technion-Israel institute of Technology.

## Disclaimer

*The content contained in this document is provided only for educational and informational purposes and reflects the author's opinion only. The publication of the document shall not constitute or be deemed to constitute any representation by the publisher that the data presented therein are correct or sufficient to support the conclusions reached or that the experiment design or methodology is adequate. The publisher attempts to ensure that content is accurate and obtained from reliable sources but does not represent it to be error-free and makes no statement, representation, warranty, or guarantee of the accuracy, reliability of the information and content contained in this document. Publisher will not be liable for damages of any kind arising from the use of this document, including but not limited to direct, indirect, incidental punitive and consequential damages.*