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Socioeconomic Factors Influencing the Prosumer's Investment Decision on Solar Power

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Abstract: This paper identifies socioeconomic factors that are supposed to impact the investment decision of private households in Germany regarding small-scale solar PV (photovoltaic) systems. In 2022, the last nuclear power plant will phase out and the end of coal-fired power plants is fixed for 2038. Thus, the legislator is mandated to foster the addition of renewable energy capacities to close the gap fossil fuels and nuclear power leaves. Some share of the renewable energies could be from private households that mainly invest in small-scale solar PV systems. To stimulate investments, it is necessary to identify factors that are important for the investment decisions of private households. Within this paper, secondary socioeconomic data for the period from 2009–2018 was compiled. In order to identify the latent variables, a factor analysis was conducted. The results state five factors that are supposed to impact the investment decisions of the prosumer in Germany.

Keywords: renewable energy; prosumer decision; factor analysis; investment decision

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1. Introduction

Recently, climate change has become a topic that is top of the agenda of legislators and civil society worldwide. At the world climate conference in Paris, 2015, most of the governments confirmed these severe problems. Today, 189 countries have ratified the Paris Agreement.

In Germany, the energy transition is in progress, meaning the expiration of nuclear power plants in the year 2022 [1]. Furthermore, in 2020, the German legislator decided to phase out coal-fired power plants by 2038 [2]. The gap that fossil fuels and nuclear power leave is supposed to be closed by renewable energies, especially wind and solar power [3]. In order to foster the renewable energy systems (RES), the renewable energy law, Erneuerbare-Energien-Gesetz (EEG) was introduced 2000 in Germany to subsidize and scale-up RES [4]. As a consequence, costs for the energy turnaround increased and the political sector was encouraged to step-down the guaranteed feed in tariffs for installations [3]. Due to the lowered subsidies and the intention of the legislator to integrate the RES, thus, also solar PV systems, into the regular electricity market system, investments decreased significantly [5]. From 2012 onward, the yearly added capacities of solar PV systems started to decrease, from 7.600 MWp (megawatt peak) in 2012 to 1.500 MWp in 2016. Since 2019, investments started to recover and reached almost 4.000 MWp [6]. Nevertheless, the current investments in solar PV systems are not enough for Germany's energy transition.

In order to increase the yearly added capacities and reach the proclaimed targets of Germany's energy transition, investments of private households could help to close the current gap. Data from December 2019 from the German Federal Network Agency reveal that approximately 34% of the investments in December 2019 falls upon small-scale solar PVs (<10 KWp) [7]. Solar plants < 10 KWp are mostly owned by private households in Germany as the legislator implemented special subsidies for private households investing in solar plants < 10 KWp [8]. In contrast to investments from companies, funds, etc., investments from private households have been quite stable over the last decade, thus, the prosumer is a stable source of newly added capacities in the field of solar PV systems.

The focal point of this paper lies in socioeconomic factors that are supposed to influence the investment decisions of the prosumer. In this regard, we considered the period from 2009–2018 for 20 independent variables. The selection of the variables was based on the transaction cost theory (TCT). To reduce the number of variables and eliminate collinearity, a factor analysis was conducted.

This paper could help to close research gaps regarding factors that impact the investment decision of private households and the implied decisions of legislators in Germany and worldwide. Firstly, as the identified factors are of a macroeconomic nature, decision makers in Germany would be able to align their policies in the field of renewable energy sources (RES) in a more precise manner. As the different states in Germany show different levels of socioeconomic factors, decision makers are supposed to align their legislation towards different regions in Germany. Secondly, the results could be applied not only in Germany, but worldwide, and help decision makers to foster the investments of private households, thus, make their inhabitants part of the energy transition.

There are vast numbers of authors and papers that are researching factors that influence the development or the perception of RES. Most of the papers are of a descriptive nature and describe a special analysis in some countries. For example, the USA, Finland and Germany [9–11]. There are just a few papers that have applied econometric models.

Bilgen, Keles and Kaygusuz (2008) conducted a case study on Turkish energy related environmental policies [12]. Ince, Vredenburg and Liu (2016) performed a panel analysis of renewable energy development in the Caribbean. Based on interviews and case studies, seventy-five factors were identified for a regression analysis. With the help of the quantitative analysis, five factors were identified as critical regarding the development of renewable energies [13]. Dui'c, da Graça Carvalho (2004) used a H2RES model on the example of an isolated island in the Madeira archipelago [14]. By using this model, they were looking for the optimization of the integration of hydrogen usage with intermittent renewable energy sources. Shahrestani, Yao, Luo, Turkeyler and Davies (2015) chose a different scientific approach to investigate the urban microclimate and their effects on urban renewable energy technology implementation [15]. An experimental design was used, measuring in a field study. This is similar to Bajic and Divić (2010), who used results of a field study measuring wind on the Adriatic coast to evaluate how wind energy technologies make sense in Croatia [16].

Some authors have applied a factor analysis in the field of RES recently. Within their studies, authors have e.g., researched factors that affect the willingness of the public to adopt RES and factors that influence innovations in the field of RES.

Makki and Mosley (2020), for example, researched the factors that affect the willingness of the public to adopt new RES technologies. According to the authors based on a literature review, 19 factors were supposed to impact the public willingness in regard to renewable energies. Afterward, an online survey was applied to collect random cross-sectional data of 416 participants by using the extracted factors. Subsequently, the key components were extracted by an exploratory factor analysis. In the end, five main categories were revealed clustering the nineteen extracted factors [17]. Another paper by He, Xu, Li and Zhao (2018), depicted factors that influence technological innovation in the field of RES [18]. Olanrewaju, Olubusoje, Adenikinju and Akintande (2019) were interested in the underlying factors of consumption of renewable energies and have conducted a panel model to dig out the relevant factors in Africa. To do so, annual data from 1990–2015 of five African countries was applied [19].

There are at least two recent studies that have researched macroeconomic factors impacting the development of RES.

Grzeszczyk, Izdebski, Izdebski and Wasinski (2021) researched the influence of socioeconomic factors on the development of RES in Poland [20]. Twenty factors, according to a factor tree analysis, were researched. The results suggests that EU as well as Polish legislation has a decisive impact on the development of RES in Poland where the EU and Polish legislation is coined by lobbying groups that either try to foster or block the extension of RES. Fatima, Li, Ahmad, Jabeen and Li (2021) tried to identify crucial factors that influence the development of RES. To do so, a content analysis as well as a modelling analysis was conducted, applying data collected via a questionnaire survey. The results state that a lack of good governance, renewable energy adaption as well as the governmental energy policies are relevant factors for the development of RES [21].

As the aforementioned studies prove, socioeconomic factors have an impact on the development of RES. According to Grzeszczyk, Izdebski, Izdebski and Wasinski (2021), the legislator is the main driver for investments within the market of RES [20]. This result is affirmed by the study of Fatima, Li, Ahmad, Jabeen and Li (2021) [21].

This paper is complementary to the stated papers, it is interested in socioeconomic factors that the legislator is able to adjust. Thus, we go one step further by assuming that the legislator has a decisive influence and the need to search for elevating screws to stimulate investments. In this context, the focal point lies on the prosumer. It is valuable to get deeper insight into the investments of private households as their demand regarding legislation is assumed to be different than from companies investing in the field of RES.

2. Materials and Methods

To select the variables that impact the investment behavior of the prosumer, TCT is applied. The main hypothesis of TCT by Williamson is the discriminating alignment hypothesis, where the governance structure serves as the dependent variable and the transactions the independent variable. This hypothesis has to be aligned in order to minimize costs [22]. We applied and modified TCT. Within this paper, transaction costs and governance structure serve as independent variables that are supposed to influence the investments of the prosumer. As seen in the study of Fatima, Li, Ahmad, Jabeen and Li, at the least, a lack of good governance has an impact on the development of RES.

In order to operationalize transaction costs and governance structure, indicators were applied to indicate either the level of the transaction costs or governance structure. According to a paper of Rindfleisch and Heide (1998) indicators are often applied to measure transaction costs and governance structure when secondary data is applied [23].

Starting with the governance structure, we assumed that three different groups of indicators are relevant when it comes to the display of the level of governance structure: demographic, social and political. The approach of different categories displaying the level of governance structure and transaction costs is also pursued by Bussolo and Whalley [24]. The authors have identified three major categories of transaction costs that are applied in the papers about political TCT.

The three subgroups are shortly explained before stating the 20 indicators.

Within this paper, the first group, demographic, entails factors such as sex, age, birth-death rates. Various authors have researched the influence of demographic factors on investment decisions and have confirmed that demographic factors matter [25]. We assumed that indicators such as BDR (Birth–Death Ratio) or EoL (Expectation of Life) were appropriate to display if a country or region displayed a positive or negative demographic trend. As the upfront investments and the payback period for solar PV systems is quite high for the prosumer, the assumption is that these indicators impact the development of RES.

The next group comprises social and political indicators. Different indicators such as the crime index and happiness index are subsumed under this group. The overall assumption is that, for example, the crime rate has an influence on the investment decision of individuals. In this context, Shanmugham and Ramya (2012) have shown that social factors have an influence on the investment decisions of individuals [26]. In addition, Ciobanu and Bahna (2015) have shown in their paper that social and political factors such as health expenditure and life expectancy matter regarding the investment decisions of individuals [27]. We assumed that investments with a long payback from the prosumer are completed in a safe and stable environment where inhabitants can save deposits and assume a social and political environment that allows investments with a long payback period.

The last group consists of the economic indicators. Because relevant upfront investments are needed to set up photovoltaic systems, factors such as household income are supposed to have an impact on the investment decisions of private households. In this regard, Geetha and Ramesh (2012) confirm the link between household income and investment decisions [25].

In the context of indicators that display the level of transaction costs, three indicators are chosen that fulfill the criteria of (a) being related to the field of renewable energies in a broader sense and (b) the data is available for the researched period.

Table 1 displays an overview about the applied indicators.

Table 1. Indicators.

Indicator	Source	Website
Demographic		
Birth–Death Ratio (BDR)	The data for this indicator is retrieved from Deutschland in Zahlen (Germany in numbers).	https://www.deutschlandinzahlen.de/tab/bundeslaender/demografie/natuerliche-bevoelkerungsbewegungen/geburtensaldo (accessed on 28 September 2021)
Expectation of Life (EoL)	The data is downloaded from a Statista pro account which could be used in the library of the University of Hamburg.	https://de.statista.com/statistik/daten/studie/820320/umfrage/lebenserwartung-in-bundeslaendern-nach-geschlecht/ (accessed on 28 September 2021)
Share of inhabitants living in cities > 100.000 in %	The data for this indicator has been retrieved in the following approach: Firstly, research on the websites of the particular German states has displayed which cities in the states entail > 100.000. In the next step, the population trend for these cities was researched on the websites of the cities for the relevant period. Afterward, within an excel sheet, the share of the people living in cities was calculated summing up all the people living in cities > 100.000 in the particular year divided by the entire population of the particular state.	The data is retrieved from the particular websites of the 16 states in Germany as well as homepages of the cities with more than 100.000 in order to retrieve the data for each year within the considered period.
Social and political		
Crime (Registered offences in Germany)	In this case, the primary data is issued by the Bundeskriminalamt (German Federal Office of Criminal Investigation).	https://de.statista.com/statistik/daten/studie/3459/umfrage/bundeslaender-nach-haeufigkeitszahl-von-straftaten-seit-2007/ (accessed on 28 September 2021)
Doctor density (number of inhabitants per doctor)	The data is extracted from Statista a report of the Bundesärztekammer (German Medical Association). The Bundesärztekammer is the head organization of the medical self-management in Germany.	https://www.bundesaerztekammer.de/fileadmin/user_upload/downloads/pdf-Ordner/Statistik2019/Stat19AbbTab.pdf (accessed on 28 September 2021)
Happiness Index	Collected from the "Glücksatlas" from a particular year. The Glücksatlas is issued by Bernd Raffelhüschen (Professor for financial economics) and Reinhard Schlinkert (director of dimap, a market research bureau). The Glücksatlas depicts the perceived happiness of inhabitants of all 16 German states.	https://www.dpdhl.com/de/presse/specials/gluecksatlas.html (accessed on 28 September 2021)
Saving deposits per capita in €	The data is retrieved from Statista. The primary source is the Bundesbank (the German central bank).	https://de.statista.com/statistik/daten/studie/203152/umfrage/spareinlagen-pro-kopf-nach-bundeslaendern/ (accessed on 28 September 2021)

Table 1. *Cont.*

Indicator	Source	Website
Spending per pupil	The data is retrieved from Deutschland in Zahlen. The primary source is the Statistisches Bundesamt (Federal Statistical Office).	https://www.deutschlandinzahlen.de/tab/bundeslaender/bildung/bildungsausgaben/staatliche-ausgaben-je-schueler (accessed on 28 September 2021)
Votes for far-right parties	The election results for the German states are retrieved from their websites.	The websites of all 16 German states are relevant.
Economic		
Constructed new flats per capita	Own calculation based on the constructed new flats per state and the population of the particular state. Both retrieved from Deutschland in Zahlen. The primary data is from Statistisches Bundesamt (Federal Statistical Office).	https://www.deutschlandinzahlen.de/tab/bundeslaender/infrastruktur/gebaeude-und-wohnen/neu-fertiggestellte-wohnungen (accessed on 28 September 2021)
Debt per inhabitant	The data is retrieved from Deutschland in Zahlen. The primary source is Statistisches Bundesamt (Federal Statistical Office)	https://www.deutschlandinzahlen.de/tab/bundeslaender/oeffentliche-haushalte/schulden/schulden-je-einwohner (accessed on 28 September 2021)
Filing of a patent per 100.000	The data is retrieved from Deutschland in Zahlen. The primary source is Statistisches Bundesamt (Federal Statistical Office)	https://www.deutschlandinzahlen.de/tab/bundeslaender/wissenschaft-forschung/patente/patentanmeldungen-je-100000-einwohner (accessed on 28 September 2021)
GDP per Capita	The data is retrieved from Deutschland in Zahlen. The primary source is Statistisches Bundesamt (Federal Statistical Office)	https://www.deutschlandinzahlen.de/tab/bundeslaender/volkswirtschaft0/bruttoinlandsprodukt/bruttoinlandsprodukt-je-einwohner (accessed on 28 September 2021)
Household income per inhabitant	The data is retrieved from Deutschland in Zahlen. The primary source is Statistisches Bundesamt (Federal Statistical Office)	https://www.deutschlandinzahlen.de/tab/bundeslaender/finanzen/einkommen-verdienste/haushaltseinkommen-je-einwohner (accessed on 28 September 2021)
Industry's share of the total employees in %	Own calculation based on the employees in the industry per state and the overall employed people of the particular state. Both retrieved from Deutschland in Zahlen. The primary source is Statistisches Bundesamt (Federal Statistical Office)	https://www.deutschlandinzahlen.de/tab/bundeslaender/branchen-unternehmen/industrie/beschaeftigte-in-der-industrie (accessed on 28 September 2021)
Share of homeowners in %	Statista	
Indicators displaying the level of transaction costs		
Remuneration per employee in the construction trade p.a. in 1000€ in Germany	The data is retrieved from Deutschland in Zahlen. The primary source is Statistisches Bundesamt (Federal Statistical Office)	https://www.deutschlandinzahlen.de/tab/bundeslaender/branchen-unternehmen/bau/entgelte-im-bauhauptgewerbe (accessed on 28 September 2021)
Research expenditures for renewable energies in relation to GDP in €/Mio €	The data is retrieved from the website föderal erneuerbar (federal renewable) which is administered by the Agentur für erneuerbare Energien (Agency for renewable energies), a German think tank.	https://www.foederal-erneuerbar.de/landesinfo/bundesland/D/kategorie/forschung/auswahl/228-forschungsausgaben_d/#goto_228 (accessed on 28 September 2021)
Spending for governmental employees per capita	The data is retrieved from Deutschland in Zahlen. The primary source is Statistisches Bundesamt (Federal Statistical Office)	https://www.deutschlandinzahlen.de/tab/bundeslaender/oeffentliche-haushalte/einnahmen-und-ausgaben-des-staates/personalausgaben-je-einwohner (accessed on 28 September 2021)

These variables, while being potentially significant descriptors of customer behavior regarding the photovoltaic market, can also be internally correlated. Therefore, our aim was to aggregate those observable variables, resulting from the content analysis based on the ideas of transaction theory into new, latent variables, presenting not the individual occurrences, but a more complex set of internally independent phenomena. This led to a decision to aggregate the observable variables into latent variables with the use of factor analysis. As this paper researches the 16 German states, indicators have been applied where the data is available for the 16 states during the researched period.

For most of the factors, the websites deutschlandinzahlen.de and statista.de (premium account) were used. These websites offer aggregated secondary data and use the German Federal Statistical Office as their primary source.

An exploratory factor analysis (EFA) approach was used in order to group the aforementioned variables which had been identified for the purpose of the study. EFA is a statistical technique of dimension reduction used to minimize a larger number of variables into a set of internally correlated factors. The new factors represent the underlying latent characteristics present in a wider set of variables, thus, compiling sets of variables which can be partially correlated into aggregated factors representing a set of distinct characteristics [28]. EFA was initially developed as a dimension reduction technique used to prepare an application of methods such as regression while minimizing the risk of collinearity. However, it is also widely used as an exploratory technique used to analyze the internal variability of the dataset. The first step of the EFA is usually to verify the Kaiser–Meyer–Olkin (KMO) criterion and to run the Bartlett's test of sphericity to verify the possibility of applying EFA to the given dataset. If the test is significant and the eigenvalues which are the basis for the criterion are higher than 1 then the extracted factors can be taken into analysis. In this case the classic principal components analysis (PCA) method was used to extract the factors [29]. The extracted factors were analyzed based on the eigenvalues and on the total variance explained and then the internal structure of the factors was analyzed, looking at the factor loadings for each item within the factors. There is a lot of discussion regarding the minimal acceptable value of the factor loadings for the item to be considered significant [30]. We accepted a factor loading for an item higher than 0.5 as a relatively good representation of a given item within the factor. Ultimately, 20 variables were taken into account with a total of 153 observations for individual German Lands collected for the years from 2009–2017. Table 2 illustrates the descriptive statistics for the variables which include mean, standard deviation as well as minimal and maximal values.

Table 2. Descriptive statistics for the 23 variables.

Variable	Mean	Std. dev.	Min	Max
Birth–Death	−20,587	40,664	−211,756	7036
Constructed new flats per capita	0.00253	0.00096	0.00066	0.00502
Remuneration per employee in the construction trade p.a.	27,937	3696	21,199	37,770
Crime	8348	2748	4868	16,414
Debt per inhabitant in €	9037	6480	454	32,405
Doctor Density (Inhabitants per doctor)	224	31	139	276
Expectation of life in years (Boys when born)	78	1	76	80
Filing of a patent per 100.000	39	34	7	144
GDP per capita in €	33,958	9248	20,482	64,567
Happiness index	6.98	0.21	6.52	7.43
Household income per inhabitant	19,792	2098	15,845	24,421
Share of homeowner in %	43.82	11.93	14.20	63.70
Research expenditures for renewable energies in relation to the GDP in €/Mio €	32.07	30.83	0.00	138.00
Savings deposits per capita in €	19,560	7766	10,149	48,570
Industry's share of the total employees in %	12.86%	3.70%	5.37%	19.93%
Share of inhabitants living in cities >100.000 in %	35.53%	31.15%	10.20%	100.00%
Spending per pupil in €	6543	850	4900	8900
Spending per student in €	7199	1093	5081	9727
Votes for far-right parties	4.89%	5.53%	0.00%	26.20%

EFA was used to reduce the identified variables into specific aggregated factors representing characteristics important in relation to the energy market. PCA was applied in order to identify the factors. Ultimately, as shown in Table 3, 20 items were aggregated into 5 factors which explain a total of 70.71% of initial variability, meaning that the loss from the variability in the initial data is relatively insignificant and acceptable [31].

Table 3. Eigenvalues for the extracted factors.

Factors	Eigenvalue	% of Variance Explained
Factor 1	5.49	27.45%
Factor 2	4.33	21.63%
Factor 3	1.59	7.95%
Factor 4	1.67	8.36%
Factor 5	1.07	5.34%

This indicates that the process of aggregation of the initial 20 items into the 5 new variables—factors—which are now not correlated with each other, has been successful and the new factors represent the wide array of determinants of customer behavior on the photovoltaic market. The internal structure of the factors and the character of their representation and meaning is presented in the following section.

3. Results

The five identified factors represent the main groups of variables affecting the energy market in Germany. Table 4 presents the factor loadings calculated for all the items within the five factors after the application of the PCA extraction method and the varimax rotation. Only factor loadings for items significantly represented in the factor are presented in the table to increase readability. These five factors together form the internal variety of the determinants of customer behavior regarding the photovoltaic market.

Table 4. Factor loadings for the extracted factors (varimax rotation).

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Birth–Death					0.77
Constructed new flats per capita	0.67				
Remuneration per employee in the construction trade p.a.		0.88			
Crime	0.84				
Debt per inhabitant in €		0.79			
Doctor Density (Inhabitants per doctor)					
Expectation of life in years (Boys when born)	0.86				
Filing of a patent per 100.000	0.59			0.58	
GDP per capita in €	0.81				
Happiness index	0.80				
Household income per inhabitant	0.97				
Share of homeowner in %					
Research expenditures for renewable energies in relation to the GDP in €/Mio €					
Savings deposits per capita in €	0.61				
Industry's share of the total employees in %		−0.54		0.65	
Share of inhabitants living in cities >100.000 in %		0.95			
Spending per pupil in €			0.70		
Spending per student in €			0.68		
Spending per government employee in €		0.80			
Votes for far-right parties				−0.68	

Specifically, five factors which present the variability of these determinants from five different perspectives have been aggregated from the initial list of 20 items.

The first factor represents 27.45% of the initial variability and the items which are grouped together within it include: constructed new flats per capita, crime rate, life expectancy, patents filed, GDP per capita, happiness index, household income per inhabitant and the savings deposit. Given the general characteristics of the items presented in the factor it can be said to describe the overall socioeconomic level of a given region.

The second factor represents 21.63% of the total variance and groups together factors such as: remuneration per employee in the construction trade, debt per inhabitant, the industry's share of the total employees, spending per government employee and share of inhabitants living in cities above 100,000 citizens. This would indicate that this factor represents the urbanization level of a given region,

The third factor, which bulks together nearly 8% of the total variance demonstrates the education effort of a given region, grouping just two items: spending per pupil and spending per student, without any other items included.

Factor four groups together two very characteristic features of the industrialization of the region: the share of employees working in the industry sector as well as the number of patents filed per capita. The innovation represented by the patents is traditionally correlated with industry-heavy regions. Interestingly enough, within this factor, the share of citizens voting for far-right parties is also represented, with an opposite sign, representing an inverse correlation. This is a characteristic of Germany itself, where the far-right parties are traditionally more supported in the more rural and agricultural regions.

Lastly, the fifth factor, standing for slightly above 5% of the total variance consist of of one significant item, which is the birth–death variable, demonstrating that it seems to be heavily independent of all the other variables and warranting a variability of its own.

4. Conclusions

Based on the factor analysis, it could be stated that there are socioeconomic factors that impact the investment decisions of the prosumer in Germany. The first, second and fourth factors especially, could be interesting to analyze considering this paper. The findings of Grzeszczyk, Izdebski, Izdebski and Wasinski (2021), and Fatima, Li, Ahmad, Jabeen and Li. support this result.

The first factor could be seen as the quality of life. A lower level of the general quality of life is supposed to have an impact on the investment decision of private households. Looking on the underlying indicators reveal that these ones are difficult to adjust for the legislator in the short term. Thus, the legislator in Germany, and, of course, in other countries should intend to stimulate investments from regions and private households with a lower level of quality of life to distribute the subsidies in a more equitable way. Otherwise, the subsidies paid by the state are cumulated from regions and private persons with a higher level of quality of life. Thus, instead of adjusting the underlying indicators to stimulate investments of the prosumer in solar PV systems, the legislator should apply the result to allocate funds to regions and private households depicting a lower level of quality of life and, thus, help to increase the quality of life.

The implications from the second factor are quite important as urbanization worldwide is accelerating. As private households are mostly able to invest in solar PV systems if they own their own property, the high number of renters in cities poses a barrier for further investments. Therefore, the legislator must make sure that inhabitants that are renting a house or apartment can invest in the energy transition as well.

Until now, investments from prosumers in Germany mostly come from the south of Germany where the quality of life is high, and many inhabitants live in their own properties in rural areas. In contrast, inhabitants living in cities with a low level of freestanding houses and a lower level of property owners have been excluded from investments in solar PV systems. Thus, the increasing number of inhabitants accompanied by sharp increases in property prices states a huge barrier for investments of the prosumer. In order to overcome this barrier, the legislator should adjust the legislation regarding the opportunity of tenants to participate in the energy transition. Some German states like Hamburg announced making it mandatory for new buildings to integrate solar PV systems and to offer the tenants the possibility to participate.

The fourth factor could be named industrialized regions. In Germany, the most important industrialized regions are located in the south of Germany. Within this region, the combination of well-paid industrial jobs and rural areas with a high level of homeowners seem to be a driver for investments in solar PV systems from private households. Similar to factor one, the risk of a high level of cumulated investments in particular regions diminish the targets of the legislator to broaden the number of participants that take part in the energy transition. But, as the acceptance for this long-lasting project is quite important, the legislator should think about special programs for deindustrialized regions that have lost added value during previous years due to the phase-out of coal-fired power plants and the decrease in the coal, iron and steel industry.

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