Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Department of the Environment,
Transport, Energy and Communication DETEC

Swiss Federal Office of Energy SFOE
Energy Research

Annual report from 15.02.2018-15.01.2019

Social Contagion in the Adoption of Renewables (SCAR)

---

heg
Haute école de gestion
Genève

Date: 15 January 2019

Place: Carouge-Geneva

Publisher:
Swiss Federal Office of Energy SFOE
Research Programme XY
CH-3003 Bern
www.bfe.admin.ch
energieforschung@bfe.admin.ch

Agent:
Haute Ecole de Gestion Genève
Rue de la Tambourine 17
1227 Carouge - Genève (Suisse)
https://www.hesge.ch/heg/

Authors:
Andrea Baranzini, HEG Genève, andrea.baranzini@hesge.ch
Stefano Carattini, Georgia State University, scarattini@gsu.edu
Martin Péclat, HEG Genève & University of Neuchâtel, martin.peclat@hesge.ch
Beatrice Petrovich, University of St. Gallen (IWÖ-HSG), beatrice.petrovich@unisg.ch
Rolf Wüstenhagen, University of St. Gallen (IWÖ-HSG), rolf.wuestenhagen@unisg.ch

SFOE head of domain: Anne-Kathrin Faust, Anne-Kathrin.Faust@bfe.admin.ch
SFOE programme manager: Anne-Kathrin Faust, Anne-Kathrin.Faust@bfe.admin.ch
SFOE contract number: SI/501305-01

Summary

Subsidising renewables may create a virtuous circle of adoption through the mechanisms of social contagion, which makes adoption more likely where neighbours have chosen to install a given renewable energy technology. This project aims at assessing causally the magnitude and dynamics of these peer effects in the adoption of solar energy by households and firms in Switzerland. We exploit the unique context of Switzerland, and in particular the presence of sharp language barriers, to examine the role and divers of social contagion in the adoption of renewable energy. We also apply choice experiment techniques to identify the preferred attributes potentially leading to adoption of solar photovoltaic panels by households, including the role of policy risk and other interventions.

Zusammenfassung

Die Subventionierung erneuerbarer Energien kann durch die Mechanismen der sozialen Ansteckung einen positiven Adoptionskreislauf schaffen, der die Annahme wahrscheinlicher macht, wenn Nachbarn sich für die Installation einer bestimmten Technologie für erneuerbare Energien entschieden haben. Das Ziel dieses Projekts ist es, das Ausmass und die Dynamik dieser Peer-Effekte bei der Nutzung der Sonnenenergie durch Haushalte und Unternehmen in der Schweiz kausal zu bewerten. Wir nutzen den einzigartigen Kontext der Schweiz, insbesondere das Vorhandensein scharfer Sprachbarrieren, um die Rolle und die Vielfalt der sozialen Ansteckung bei der Nutzung erneuerbarer Energien zu untersuchen. Wir wenden auch Wahlversuchstechniken an, um die bevorzugten Attribute zu identifizieren, die möglicherweise zur Einführung der Photovoltaik in Haushalten führen, einschließlich der Rolle von politischen Risiken und anderen Maßnahmen.

Résumé

Les subventions aux énergies renouvelables peuvent créer un cercle vertueux d'adoption par le biais de la contagion sociale, ce qui pourrait rendre l'adoption plus probable lorsque les voisins ont déjà choisi d'installer une technologie donnée. Ce projet vise à évaluer de manière causale l'ampleur et la dynamique de ces effets de pairs dans l'adoption de l'énergie solaire par les ménages et les entreprises en Suisse. Nous exploitons le contexte unique de la Suisse, en particulier la présence de barrières linguistiques, pour examiner le rôle de la contagion sociale dans l’adoption des énergies renouvelables. Nous appliquons également des techniques de choix discret pour identifier les attributs susceptibles de conduire à l'adoption du solaire photovoltaïque, y compris le rôle des risques politiques et autres interventions.

Contents

List of abbreviations

DCE	Discrete choice experiment
FIT	Feed-in tariff
SFOE	Swiss Federal Office of Energy
Solar PV	Solar photovoltaics

1 Introduction

The transition towards a greener economy requires countries to switch from fossil to renewable sources of energy. This transition has proven to be difficult due to lock-in effects. Policymakers in most developed countries are trying to foster the adoption of renewable energies and, given the important resistance to the adoption of first-best instruments such as carbon taxes (cf. Thalmann 2004; Saelen and Kallbekken 2011; Baranzini & Carattini 2014; Carattini et al. 2016; Baranzini & Carattini 2017), some European countries, including Switzerland, heavily subsidize the adoption of renewable energy. This type of policy comes with important costs, which can represent hundreds of euros per ton of CO_2 abated (cf. Marcantonini & Ellerman 2014; Marcantonini & Valero 2015; Crago & Chernyakhovskiy 2017). Over the long run, however, such subsidies may create a virtuous circle of adoption through the mechanisms of social contagion, which makes adoption more likely where the installed base is larger. The international literature shows indeed that thanks to social contagion, the likelihood of adoption of solar photovoltaic (PV) panels is higher in neighbourhoods where the installed PV base is larger (cf. Bollinger and Gillingham 2012; Graziano and Gillingham 2015). In principle, temporary subsidies in a given region may thus lead to a higher pace of adoption even when the financial incentive is discontinued.

This project focuses on the adoption of solar PV panels by households and firms in Switzerland. It uses spatial econometrics techniques to identify the magnitude and drivers of peer effects in the adoption of solar PV and to assess how such effects may vary in presence of policy interventions. In addition, we analyse how people would respond to policy measures and other types of interventions, by relying on survey data and choice-experiment techniques. More precisely, we aim at:

1. Assessing the strength and drivers of peer effects in the adoption of solar PV in Switzerland.
2. Leveraging the exogenous presence of cultural borders in Switzerland and the countrywide implementation of a feed-in tariff to measure the effect of social spillovers (or lack thereof).
3. Exploiting the subnational variation in financial supporting schemes to evaluate their effect on PV adoption.
4. Applying choice experiment techniques to identify the preferred attributes potentially leading to adoption of solar PV, including the role of policy risk and other interventions.

In the following Sections, we present and discuss the main achievements of this project so far.

2 Assessing peer effects in the adoption of solar PV in Switzerland

2.1 Motivation and goals

To achieve the objective of 2^{O}C maximum increase in global temperatures included in the Paris Agreement of the United Nations Framework Convention on Climate Change, greenhouse gas emissions have to be drastically reduced. Consequently, governments are currently facing the challenge of turning their pledges into effective policies. Economists have long advocated the use of carbon pricing as central instrument of a climate policy package (Baranzini et al., 2017), but given the unfavourable political economy of carbon pricing, some jurisdictions have turned to subsidies for renewable energy as an alternative to first-best policies. Recent work suggests the existence of an alternative policy approach: the use of social norms. People seem indeed to follow local social norms even in global dilemmas (Carattini et al., 2017b) and the culture of cooperation that helps solving many social dilemmas seems to be also helpful in driving climate-friendly behaviour (Carattini et al., 2015). In the United States, solar panel installers have started undertaking specific initiatives to leverage social contagion, such as kerbside signs communicating the presence of a solar panel in the nearby home or demonstration sites and group pricing for neighbours (Bollinger and Gillingham, 2012).

In our paper, we analyse the adoption of PV panels in Switzerland. We hence contribute to this nascent literature studying the role of social contagion in the adoption of clean technologies. We address the following main questions: How do peer effects work in practice? Do they apply in the same way to all types of solar panels? Do they emerge only for residential adopters, does contagion also work for firms, and between households and firms?

While the literature has so far focused on residential solar PV adoption only, we also examine the behaviour of firms and farms. In addition, we investigate in detail the impact of PV characteristics, such as size and type, on the magnitude of social spillovers. Our approach works as follows. We model the number of new PV adoptions in a municipality during a quarter as a function of the average number of installed PV systems around them, using different radii to take into account the effect of distance. For each geocoded PV installation in the database, we count the number of pre-existing installations, at the time of the decision to adopt. By exploiting the lag between the time of the decision to adopt and the time of installation, we apply the identification strategy of Bollinger and Gillingham (2012), crucial to address the issue of reflection (Manski, 1993). We address the issues of homophily, and confounding from correlated unobservables, by enriching the model with municipality-specific and quarter-specific fixed effects, as well as interaction dummies between cantons, the administrative units composing the Swiss federal state, and quarters. In addition, we incorporate time-varying socio-economic controls and detailed location characteristics to account for spatial and temporal heterogeneity.

2.2 Results

We find that distance is an important determinant of social contagion: PV systems installed further away show persistently lower impact on the adoption of new PV systems than the nearest ones. In line with Graziano and Gillingham (2015), we find that the oldest nearby installations have a lower impact in the adoption choice than the most recently built PV systems. Besides providing new evidence about the influence of spatially close, pre-existing PV systems on the adoption decisions of residential owners, our analysis reveals that firms and farms also react to neighbouring PV panels, although in a lesser extent than households do. On average, an extra PV installation within 1 km increases the number of residential adoptions in the municipality by 0.11 installations per quarter, and by 0.09 for commercial adoptions. Addressing our main research questions, we investigate the variation of social spillovers with ownership, size and type of the solar panels. Our results show that, everything else equal, social contagion is primarily due to similar ownership, i.e. firms (farms) are mainly influenced by the nearby firm-owned (farm-owned) installations. Furthermore, we observe that large PV systems impact adoptions more heavily than smaller ones. In addition, we find that adoptions are more heavily stimulated by building-integrated than building-attached PV systems.

By combining the analysis of ownership, size and type, our study contributes to the understanding of the drivers behind social contagion. In particular, by looking simultaneously at size and more visible types, we are able to document the relative role of learning and visibility effects. We find that both operate in the diffusion of solar panels. Our evidence complements that of Narayanan and Nair (2013) on hybrid cars, who find with data for California that peer effects work only for Toyota Priuses, and not for the other hybrid model in their data, the Honda Civic Hybrid, suggesting an important role for visibility effects with respect to learning effects (see also Sexton and Sexton 2014).

Our results provide useful insights for practitioners and policymakers alike. Leveraging social contagion could indeed represent a valuable option for many governments and even more so for those that are currently planning to phase out subsidies to solar energy. However, an effective implementation of such strategies requires information on which agents are affected by social contagion and on how adoption decisions are influenced by the choice of others.

- ✓ Additional details can be found in the following Working paper: Andrea Baranzini, Stefano Carattini & Martin Péclat (2017): "What drives social contagion in the adoption of solar photovoltaic technology?" London, Grantham Research Institute on Climate Change and the Environment Working Paper 270, link: click here.

3 The impact of cultural borders in the diffusion of solar PV

3.1 Motivation and goals

The literature shows that social spillovers are an important driver of technology adoption in general (e.g. Arndt, 1967; Bass, 1969), and of solar PV in particular (e.g. Graziano and Gillingham, 2015; Rode and Weber, 2016). Previous studies have also highlighted the localized nature of social spillovers. However, social spillovers may be hampered by the presence of cultural barriers. That is, residents of municipalities adjacent to a language border may benefit less from social interactions with PV owners located on the other side, which may reduce the exchange of information on the technology. In presence of a cultural barrier, the pool of individuals from which to learn, at a given distance, may be smaller, limiting the power of social spillovers to address information asymmetry and reduce uncertainty on investments in solar energy.

Switzerland offers the ideal framework to analyse the effect of cultural borders on the adoption of solar PV. Language groups live in geographically distinct regions separated by sharp language borders that are exogenous to the implementation of federal policies promoting the adoption of solar PV. In 2008, Switzerland introduced a countrywide feed-in tariff (FIT) for the electricity generated from solar PV systems. By strongly modifying the profitability of PV installations, the new support scheme created a major shock to the solar PV market. We exploit the combination of these two factors to identify the role of cultural borders in affecting social spillovers and the adoption of a clean technology.

We base our analysis on the dataset provided by SFOE, which we completed with socio-economic characteristics related to the adoption of solar installations, such as age, income, level of unemployment, and green preferences, and a second set of variables measuring contextual factors that may be linked to the feasibility and profitability of PV installations, such as the type of building and solar radiation. We identify the boundary between French- and German-speaking parts as the most suitable for our research question, because it crosses Switzerland from North to South for about 270 km along regions with a large variability of population density and topography. Natural barriers are also absent from most of the boundary. Importantly, about half the length of the French-German border is located within bilingual cantons (Fribourg, Bern and Valais), which allows us to focus on the language border while keeping institutional features constant.

To perform our analysis of the impact of the border on PV adoption, we first need to precisely identify the location of the language border. Then, we compute the distances of each PV installation to the border. To define the language border, we thus combine two datasets. The first dataset, provided by the Swiss federal statistical office, contains data on the most widely used national language at home by permanent residents. We use municipal data for 2016, municipalities representing the finest level at which this information is available. The second dataset is produced by the Swiss office of topography (swisstopo) and includes georeferenced data of municipalities’ boundaries. Based on these data, we identify municipalities as either French- or German-speaking. After having identified all pairs of contiguous municipalities whose main language is different from each other (one French- and one German-speaking), we obtain the language border as the line generated by the shared borders of these municipalities. For more precision, we increase the resolution of swisstopo's spatial data to have at least one geographical point every 50 meters along the language border. Having established the spatial separation between the two linguistic regions, we can compute the distances between the location of each PV installation and the closest border point. We aggregate these measures at the municipality level to obtain the mean Euclidean distance to the border for all PV installations located within a municipality. Starting from 2,289 municipalities, we select 733 municipalities whose PV installations are located on average less than 25 km away from the language border. This leaves us with 18,960 PV installations.

3.2 Results

Descriptive analyses show that the language border hampers the diffusion of solar PV. All else equal, we observe a positive correlation between the number of adoptions in a municipality and the mean distance of these installations from the border. That is, compared to regions further away from the border, we find a relative depression in the uptake of solar PV in proximity to the border. We measured the impact of the border on solar PV adoption by calculating semi-elasticities, i.e. percentage changes in the number of PV systems related to a one-unit change in the distance to the border. We find that the semi-elasticity estimates range from 0.017 to 0.110 when including all municipalities up to 20 and 5 km from the border, respectively. All else equal, this suggests that, as we approach the border in the last 5 km, we would expect about 11% less PV installations for each extra kilometre distance.

We then investigate the causal origin of this spatial pattern. In the spirit of difference-in-differences, we explore the effect of the language border on the adoption of solar PV after the implementation of the 2008 FIT. Our hypotheses are as follows. First, we expect the FIT to lead to more PV adoptions, as it makes solar energy financially much more attractive. Second, if the language border acts as a barrier to social spillovers, we should observe a divergence in the rate of adoption between regions close to the border and regions located further away, once the FIT is implemented. That is, we expect the rate of adoption to increase in both regions in proximity to the border and regions located further away, but we expect a significantly higher increase in the latter than the former. This is because the FIT represents a shock to the solar market, which is expected to reinvigorate social spillovers. We find that since the implementation of the FIT, municipalities closer to the border experience substantially lower adoption. The number of “missing” PV systems is non-negligible, i.e. between 5 and 6, depending on the specification. That is, the presence of the language border implies an average “loss” of 5 to 6 PV adoptions per municipality during the years 2008 to 2015. In comparison to the average number of PV adoptions per municipality in Switzerland (about 26), this represents a loss of approximately 20%.

We further investigate the mechanisms behind the effect of the language border, by considering the language skills of the municipalities' population. Indeed, people in some municipalities may be fluent in the language of the other side of the border. For these people, the border should represent less of an obstacle to social spillovers. Hence, fluency with the other language may moderate the effect of the border. That is, the effect of the border should be smaller for municipalities with a higher fraction of people fluent in both French and German. We indeed find that the impact of the border is moderated by the fluency in the language of the other side of the border of a municipality's population. The effect of proximity to the border disappears in municipalities whose population is in large part familiar with the language of the other side.

- ✓ Additional details can be found in the following Working paper: Stefano Carattini, Martin Péclat & Andrea Baranzini (2018): "Social interactions and the adoption of solar PV: evidence from cultural borders" London, Grantham Research Institute on Climate Change and the Environment Working Paper 305, link: click here.

4 Preferences for solar PV

We are still investigating this part of the project. In what follows, we present its current advancement.

4.1 Preferences for solar PV by firms

We designed a discrete choice experiment (DCE) to identify the preferred attributes potentially leading to the adoption of solar PV by firms. The survey was sent for a test to about 2,700 Geneva-based firms. 83 firms answered the full questionnaire. This implies a response rate above 3%, which represents, however, a lower-bound estimate. Our invitation to participate in the survey could not be delivered to a substantial fraction of the 2,700 firms, because of invalid emails or firewalls, implying an actual response rate much above 3%. The standard response rate in online surveys is about 10%. The final survey was developed in collaboration with SATISCAN Sàrl, a Geneva-based marketing firm.

In the DCE part of the survey, firms are asked 12 times to choose among 3 options: two alternative PV installations or no (new) PV (status quo). PV installations differ from one another by their technical and financial characteristics. We interviewed several PV installers and experts to determine the relevant attributes and levels. We selected the following four attributes: the type of mounting system; the existence of a digital display screen; the annual cash flow; and the net price. The inclusion of attributes such as the type of mounting system and digital display screens are consistent with our interest in aesthetics and reputational effects. The levels of the attributes "cash flow" and "net price" are set to replicate the financial effects of leasing, capital subsidies, and FIT. Besides the analysis of which attributes are the most relevant for firms, the survey also includes questions aimed at confirming the influence of peers (other spatially close firms, direct competitors, etc.) in the adoption choices. A randomized intervention was also included in the survey design, providing to a randomly-selected set of respondents municipality-specific information about the descriptive norm, i.e. the amount of existing installations, around the firm's headquarter.

The survey was administered by SATISCAN Sàrl from February to July 2018. We had to stop it and terminate the contract because of a set of issues that the marketing company had, unfortunately, not expected to encounter in the realization of this study. Of the 9,342 contacted firms, only 82 answered, corresponding to an extremely low response rate of 0.9%.

4.2 Preferences for solar PV by households.

This part of the project focuses on Swiss households' preferences for investment in building-scale solar PV systems. In particular, we explore how perceived investment risk influences solar PV investment decisions by households. The role of risk is still relatively unexplored in the literature but has become very relevant, not just in Switzerland, but all over Europe, due to the phasing out of policies that provide solar investors with a stable revenue stream (e.g. feed-in tariffs) and introduction of alternative support schemes (e.g. investment grants) that imply that part of the investment risk is borne by residential solar producers. We aim to contribute to this policy debate by investigating the role of households' risk and time preferences in solar investment decisions.

We collect empirical evidence for this analysis in two stages. First, 10 semi-structured interviews with residential solar adopters, installers and experts were conducted in Fall 2018, with the aim to reconstruct the decision process for adoption of residential solar. Second, a trilingual online survey was submitted to a sample of Swiss single- and multifamily-house owners (N=1,335) who do not own a solar PV system yet. A filter question was used to identify a final sample of those house owners who are interested in purchasing a PV system for their house in the next 5 years (N=750). Survey invitations were stratified according to language region, age, gender, party preference and education, in order to reflect these variables' distribution in the Swiss population. Respondents were recruited through the panel of a leading Swiss market research agency and the survey was successfully administered in December 2018. The survey includes a DCE where respondents choose between hypothetical solar PV systems for their house, characterized by different levels of policy- and market-driven investment risk, system costs and degrees of self-consumption. Responses allow to assess investors' sensitivity to changes in these factors and how their reactions are connected to individual time and risk preferences, as well as other individual characteristics.

5 The role of local subsidies and other supporting schemes

In this part of the project, we aim at evaluating the effect of subnational subsidies and other supporting schemes on the adoption of solar PV. We performed an extensive research on existing data provided by private companies and umbrella organizations. We contacted Swissolar, Energiefranken (Faktor Verlag AG) and Subventionsbatiment (Docu Media Suisse Sarl), but none of them were able to provide us with sufficiently complete and detailed data for our needs. The databases that we could access had substantial gaps, over both the spatial and time dimensions. In addition to the lack of completeness, most of these sources simply indicate the existence of a program without providing information on its characteristics (type of subsidy, amount of the grant, eligibility requirements, etc.).

We hence decided to build a new dataset ourselves – as part of this contribution to the project. In the first step, we contacted the 26 Cantonal Energy Offices using a web-based survey to facilitate data collection. The survey contains questions about fiscal deductions for solar PV, cantonal subsidies, municipal subsidies, and other policies promoting renewable energy. Although we received responses from all the cantons, further research was needed because some responses were vague or incomplete. In a second step, we therefore combined and cross-checked the data from the survey and Swissolar, and added additional information obtained through new contacts with the taxation and energy authorities. By February 2019, we should end up with a comprehensive and structured dataset containing information about the different types of policies implemented by the 26 cantons over the years 2006 to 2018.

On the basis of the data collected so far, we find that approximately two thirds of the cantons have implemented some form of subsidy at some point since 2006. Most of the programs are investment subsidies (one-off and capacity-based investment grants), which cannot be cumulated with a federal subsidy. The other programs are production based subsidies (FIT), many of which are “bridges” for the time spent on the waiting list for the federal FIT. The FIT bridges represent a particularly interesting case to our analysis since the installations who registered to these cantonal programs are in the solar

PV database provided by SFOE. We also observe that PV installations are not tax-deducible in only two cantons in 2018 (Lucerne and Grisons).

We are planning to exploit the spatial and time heterogeneity of these sub-national subsidies to analyse how they impact the number of adoptions and the total installed capacity. The existence of neighbouring cantons, one with subsidies to photovoltaics and another one without them, and the fact that some programmes have been introduced and stopped at different times, should also allow us to analyse inter-cantonal and intertemporal benefits of specific policies, which could have been generated by social spillovers. Following the literature (see e.g. Hughes and Podolefsky, 2015; Borenstein, 2017), we plan to carry out the analysis using municipality-level panel data for solar PV, socio-economic and environment variables. This will allow to control for observable and unobservable factors that influence solar adoption. On the basis of our estimates of the additional PV installations due to the different cantonal policies, we also plan to compare the cost-effectiveness of the different subnational interventions. However, this analysis may be approximative since we could not gain access to either data on the total cost of cantonal subsidies or information on the exact number and size of installations that have benefited from them.

6 Evaluation 2018 and outlook for 2019

The very rich database that we created allows us to perform points 1, 2 and 3 of the project. Our results show that there are peer effects in the adoption of solar PV in Switzerland and that cultural borders hamper the extent of social spillovers. In 2018, we performed five main tasks:

- Following several suggestions by three anonymous referees, we integrated a number of fundamental new elements in the revised version of our paper “What drives social contagion in the adoption of solar photovoltaic technology?" In particular, to confirm the impact of visibility in peer effects, we included two additional datasets from which we determine the pitch of the roof, the number of floors, as well as the geographical isolation of each PV-equipped building. We also performed numerous robustness checks of our results, including different empirical models and an analysis at the neighbourhood level.
- We assessed the impact of the unique language boundary between French- and German-speaking Switzerland and wrote a paper entitled “Social interactions and the adoption of solar PV: evidence from cultural borders”. We submitted the paper for publication in an international peer-reviewed Journal.
- We designed the questionnaire for the DCE survey on firms to identify the preferred attributes potentially leading to the adoption of solar PV in the private sector. The administration of the questionnaire by SATISCAN Sàrl took much more time than planned and the result was particularly disappointing in terms of response rate and sample size, to the point that we had to terminate the contract.
- We updated data on subsidies and other measures supporting solar PV. To obtain a database as comprehensive, accurate and usable as possible, we have cross-referenced the data from our survey of the existing cantonal policies with several other sources and made additional contacts with cantonal authorities. In particular, we were particularly careful in identifying all existing programs at the cantonal level, to avoid under- or over-estimation of the impacts of the subsidies in our future analyses. We have also formatted the data for use in the first months of 2019 and already developed a classification of the different types of programs to allow their effect to be investigated separately.

- In the context of the adoption of solar PV by households, we started a new collaboration with Rolf Wüstenhagen and Beatrice Petrovich, University of St. Gallen (IWÖ-HSG). In Fall 2018, we conducted 10 semi-structured interviews with Swiss households, PV installers and experts to reconstruct the decision process for adoption of residential solar. In December 2018, a trilingual online survey was administered to 1,335 Swiss single- and multifamily-house owners who do not own a solar PV system yet, and a DCE was conducted with those 750 respondents who are interested in purchasing one for their house in the next 5 years.

The outlook for 2019 is the following:

1. If needed, revise the paper "Social interactions and the adoption of solar PV: evidence from cultural borders" following reviewers' comments.
2. Perform the analysis of subsidies to solar PV. Results included in the Final Report (June 2019).
3. Analyse data from the DCE survey on firms. Results included in the Final Report (June 2019).
4. Analyse data from the DCE survey on households. A working paper with preliminary results will be prepared in Spring 2019, with the aim to submit to a peer reviewed academic journal in Summer 2019. The results will also be included in Beatrice Petrovich's Ph.D. dissertation. Results included in the final Report (June 2019).

7 Publications [within the project]

Andrea Baranzini, Stefano Carattini & Martin Péclat (2017): "What drives social contagion in the adoption of solar photovoltaic technology?" London, Grantham Research Institute on Climate Change and the Environment Working Paper 270, link: click here.

Stefano Carattini, Martin Péclat & Andrea Baranzini (2018): "Social interactions and the adoption of solar PV: evidence from cultural borders." London, Grantham Research Institute on Climate Change and the Environment Working Paper 305, link: click here.

Gwen Spencer, Stefano Carattini & Richard B. Howarth (2019), "Short-term Interventions for Long-term Change: Spreading Stable Green Norms in Networks", *Review of Behavioral Economics*, forthcoming

8 References

Arndt, J. (1967). Role of Product-Related Conversations in the Diffusion of a New Product. Journal of Marketing Research, 4(3):291-295

Baranzini, A., van den Bergh, J. C. J. M., Carattini, S., Howarth, R. B., Padilla, E., and Roca, J. (2017). Carbon pricing in climate policy: Seven reasons, complementary instruments, and political economy considerations. Wiley Interdisciplinary Reviews: Climate Change.

Baranzini, A. and S. Carattini (2017). Paying Enough Taxes Already? Testing the Acceptability of Carbon Taxes with Survey Data. Environmental Economics and Policy Studies, 19:197–227.

Baranzini, A. and S. Carattini (2014). Taxation of Emissions of Greenhouse Gases. In B. Freedman (Ed.), Global Environmental Change, in Handbook of Global Environmental Pollution, pp. 543-560. Springer Netherlands.

Bass, F. M. (1969). A New Product Growth for Model Consumer Durables. Management Science, 15(5):215-227.

Bollinger, B. and K. Gillingham (2012). Peer Effects in the Diffusion of Solar Photovoltaic Panels. Marketing Science, 31 (6):900-912.

Borenstein, S. (2017). Private net benefits of residential solar PV: the role of electricity tariffs, tax incentives, and rebates. Journal of the Association of Environmental and Resource Economists, 4(S1), S85-S122.

Carattini, S., Baranzini, A., and Roca, J. (2015). Unconventional determinants of greenhouse gas emissions: The role of trust. Environmental Policy and Governance, 25(4):243–257.

Carattini, S., Baranzini, A., Thalmann, P., Varone, F., and Vöhringer, F. (2017a). Green taxes in a post-Paris world: Are millions of nays inevitable? Environmental and Resource Economics, 68:97–128.

Carattini, S., Baranzini, A., Thalmann, P., Varone, F., and Vöhringer, F. (2016). Green taxes in a post-Paris world: Are millions of nays inevitable? Technical Report 243, Grantham Research Institute on Climate Change and the Environment, London School of Economics and Political Science.

Carattini, S., Levin, S., and Tavoni, A. (2017b). Cooperation in the climate commons. Technical Report 259, Grantham Research Institute on Climate Change and the Environment.

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.

Graziano, M. and K. Gillingham (2015). Spatial patterns of solar photovoltaic system adoption: the influence of neighbours and the built environment. Journal of Economic Geography.

Hughes, J. E., & Podolefsky, M. (2015). Getting green with solar subsidies: evidence from the California solar initiative. Journal of the Association of Environmental and Resource Economists, 2(2), 235-275.

Manski, C. F. (1993). Identification of endogenous social effects: The reflection problem. The review of economic studies, 60(3):531–542.

Marcantonini, C. and A. D. Ellerman (2014). The implicit carbon price of renewable energy incentives in Germany. RSCAS Working Paper 2014/28, European University Institute.

Marcantonini, C., & Valero, V. (2015). Renewable energy incentives and CO_2 abatement in Italy. RSCAS Working Paper 2015/20, European University Institute.

Narayanan, S. and Nair, H. S. (2013). Estimating causal installed-base effects: A bias-correction approach. Journal of Marketing Research, 50(1):70–94.

Rode, J. and Weber, A. (2016). Does localized imitation drive technology adoption? A case study on rooftop photovoltaic systems in Germany. Journal of Environmental Economics and Management, 78:38–48.

Saelen, H. and S. Kallbekken (2011). A choice experiment on fuel taxation and earmarking in Norway. Ecological Economics 70 (11):2181-2190.

Sexton, S. E. and Sexton, A. L. (2014). Conspicuous conservation: The Prius halo and willingness to pay for environmental bona fides. Journal of Environmental Economics and Management, 67(3):303–317.

Thalmann, P. (2004). The public acceptance of green taxes: 2 million voters express their opinion. Public Choice 119:179-217.