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The potential of clear policy announcements to reduce the risk of stranded assets for individuals

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The potential of clear policy announcements to reduce the risk of stranded assets for individuals

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Abstract

Environmental regulation and the shift towards a low-carbon economy can generate stranded assets. In this paper I analyse whether consumers would change their behaviour facing the risk for personal assets to become stranded due to future regulation. In a choice experiment conducted in Switzerland, participants are asked to choose a vehicle from a selection of traditional vehicles (internal combustion engines, ICE), hybrid vehicles and electric vehicles. Some participants are additionally informed about future policy targets in Switzerland and related measures. I can show that participants who said that they do not consider buying an electric vehicle, but then received the additional policy information, were significantly more likely to change their opinion and choose an electric vehicle. The results suggest that some consumers change their buying decision in the light of information on a future policy. This implies first, that the bare announcement can lead to an earlier switch to more environmental-friendly products. Second, early information would most likely increase the acceptance of a policy, because individuals can eventually change plans and would not be negatively affected by the future policy.

Key words: Expectations, consumer behaviour, stranded assets, energy transition.

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1 Introduction

Mitigating global warming and achieving carbon-neutrality requires drastic changes in the economy and society. Policies directly addressing consumers are increasingly being proposed as important lever to accelerate the energy transition (e.g. Dietz et al., 2009, Steg et al., 2015). The menu of policy instruments varies from taxes to policies motivating people to change behaviour or product regulations: A large variety of policies aim to make a certain behaviour less attractive, i.e. by increasing the price of usage via taxes and levies. Also the concept of "nudging" has received more attention, where alternative (green) behaviours are made more salient for example by changing defaults, informing about peers' behaviour or norms (e.g. Costa et al., 2013). In contrast to that, usage regulations and bans of products seem to be more drastic and less popular, since they restrict the freedom of choice (Steg et al., 2015). However, they may be effective for a relatively quick market shift from dirty to clean products allowing to achieve environmental targets. A well-known example is the ban of incandescent light bulbs. Governments forced the replacement of energy-inefficient bulbs with LED bulbs by not allowing retailers to sell incandescent light bulbs starting from a record date (e.g. European Commission, 2008). People were still allowed to use them, but they would eventually be replaced with new (more efficient) ones. Although opponents hoarded old light bulbs before the policy got in place (The New York Times, 2009), the ban succeeded to extensively phase out incandescent bulbs. Similar sales regulations have been implemented with energy efficiency standards for other household appliances (European Commission, 2019).

Transportation is a major contributor to the carbon footprint of many countries (Hertwich et al., 2009), e.g. 32% for Switzerland (Swiss Federal Office of the Environment, 2018). Out of these emissions a major share is caused by individual mobility (more than 60% in Switzerland). It is thus not surprising that policies addressing consumers are being discussed or have been introduced to reduce the negative environmental impact of the transport sector. The Chinese government introduced different number plates with electric vehicle number plates being easier to get (The National, 2018). Norway exempts electric vehicle drivers from highway

tolls and allows to use bus lanes in congested cities (Phys.org, 2018) and Manchester restricted certain parking spots to electric vehicles only. Oxford decided to ban all diesel and fuel-powered vehicles in the city center in 2020 (Reuters, 2017) and London will introduce *ultra low emission zones* in April 2019 (Transport for London, 2018). Multiple countries discuss similar policies and utmost attention was received by the resolution of the German federal court stating that such ban is generally compatible with German law too (Bundesverwaltungsgericht Deutschland, 2018). Based on that decision several German cities implemented bans for diesel vehicles in certain areas.

Environmental regulation and the shift towards a low-carbon economy can generate the risk of so-called *stranded assets*, thus "assets that have suffered from unanticipated or premature write-downs, devaluations, or conversion to liabilities" (Caldecott, 2017). Long-term investments that are irreversible but have a long amortisation time are particularly vulnerable to such risks. Clear and early policy announcements could reduce the risk of stranded assets, since investments can be adjusted accordingly (e.g. Bauer et al., 2018, Bretschger et al., 2018). While literature on the effect of policy announcements on markets and investors is well established, there is surprisingly little research on the effect of policy announcements for consumers. It seems however obvious that the concept of stranded assets also fits to individual investments. This is particularly the case for policies addressing individuals. With respect to that, it is important to note the difference between the interdiction of light bulbs and the diesel ban: the first one targets retailers in restricting the assortment, the fossil-vehicle ban however addresses the use of the product. Both do not generally prohibit the usage but while the first one reduces the availability, the latter one inhibits the usage in certain areas or for specific time slots. Hence, while the consumer can use the banned product as long as it is somewhere available and (still) working in the first case, in the second case he has to accept usage restrictions. Similarly, restricted use of parking spots to electric vehicles may require more time for the search of a parking spot to non-electric vehicle drivers. Why is this important? Drews et al. (2015) summarize that public acceptance for

environmental policies depends on social-psychological factors and climate change perception such as political orientation and knowledge about climate change as well as the perception of the climate policy and its design and contextual factors. In particular the authors point on the perceived fairness of a policy. The ban of diesel vehicles in certain German city areas is a good example for a rather sudden policy implementation that is perceived to be unfair. The demonstrations by the "yellow vests" (*gilets jaunes*) in France, initially caused by raising fuel taxes, but also the very broad support of the French population with the protesters depicts a good example. Also, according to a representative survey in Germany the unexpected and sudden implementation of such diesel bans has evoked a lot of anger and decreased support for the policy (Welt, 2018). The information about a potential limitation in usage might have induced people to choose another (not "threatened") product (Lindenblatt et al., 2018). Instead, individuals "stranded" with their assets (the diesel vehicles), which decreases the support for the new policy.

In this paper I analyse whether consumers would react and change their behaviour facing the risk of stranded assets. To do so, I test the effect of manipulating consumer expectations about future policies on their present behaviour. I use new data from a 2018 survey on energy demand in Switzerland (SHEDS). Participants are asked about their daily commuting behaviour and the type of transport they usually select. Following that they can choose to buy a vehicle from a selection of traditional vehicles (internal combustion engines, ICE), hybrid vehicles and electric vehicles with different attributes such as size, distance, price etc. I then test the impact of two treatments on the likelihood to choose an electric vehicle compared to the control group. In the treatment groups participants are informed about various policy instruments implemented in different countries to achieve an electric vehicle share and that Switzerland aims to achieve a certain quota, too. In treatment 1 the policy instruments to achieve the quota are not yet defined while in the second treatment they are fixed and include consumer-targeting policies.

I can show that the likelihood to change opinion is significantly higher for the second treatment group: participants who said that they do not consider buying an

electric vehicle but then received the treatment were much more likely to change their opinion and choose an electric vehicle instead of a traditional ICE. My findings propose an interesting lever for policy-making. In fact, the results suggest that some consumers change their buying decision in the light of an expected limitation in future. First, this would most likely increase the acceptance of the policy, because people could prepare and adapt if necessary, so that they would not be negatively affected by the future policy. Second, the announcement might accelerate a switch to more environmental-friendly products even before the concrete policy is put in place. Consumers adjust their product choice simply because they are aware that their preferred products might be of less use in the future. Due to this incentive for an early product switch, a policy target like a quota may be approximated (at best achieved) even before any policy measure was implemented.

The paper is structured as following. In section 2 I give an overview of the current literature and discuss the gap this paper aims to address. I describe the data and method in section 3, followed by the results in section 4. I discuss the results in section 5 and section 6 concludes.

2 Theory

In the field of environmental economics the role of expectations has been widely discussed. In particular, an important strand of literature debates the effect of policy announcements on the extraction path of resources with two counteracting effects: the green paradox and the divestment effect. The first claims that resource owners change their resource extraction behaviour (to the worse) in case green policy is announced but not immediately implemented. The underlying mechanism is that resource owners anticipate increasing costs in future and fear their assets to be stranded and thus try to maximise their profit by extracting as much as possible before the policy implementation (e.g. Sinn, 2012, van der Ploeg et al., 2012, Jensen et al., 2015). This would call for a very sudden implementation of policies without any pre-announcements. In contrast to that, the divestment effect proposes that investors avoid investments that will become stranded in future. Instead they

search for alternative investments as soon as a policy is announced ("divest"), materializing in a lower extraction path (Schellnhuber et al., 2016). The final direction of the two opposing effects depends on crucial assumptions (Bauer et al., 2018). To achieve global emission reduction targets, the authors urge for reliable and clear policy announcements with short implementation lags so that the divestment effect exceeds the green paradox effect. Also with respect to a cost perception scholars increasingly point out the risk of misinformed investments, potentially causing large devaluations (Caldecott, 2017) or lock-in effects (Seto et al., 2016). Accordingly, clear policy announcements would prevent wrong expectations or ignorance about future development (Bretschger et al., 2018).

A similar reasoning is prevalent in the literature on monetary policy. Multiple authors have analysed the effect of policy announcements on asset markets (e.g. Ramiah et al., 2016). The rationale behind this is again that new information changes the expectations and risk perceptions of investors. As such, managing expectations is a popular policy instrument of central banks (e.g. King et al., 2008; Blinder et al., 2008). If a central bank or a government is credible, respective announcements are particularly useful to shape expectations. Finally, expectations are important with respect to innovation. Investment in R&D depends on expectations about future markets and revenues. Announcements about long-term policy targets allows industries to adjust accordingly (Schmidt et al., 2012).

All those research areas address expectations in the economy, but they focus on an investor's perspective. In contrast to that there is little research done with respect to individual behaviour and decision-making: whether individuals also include expectations to make decisions today and whether and how these expectations could be shaped by policy announcements. Instead the current literature focuses on policies inducing change of individual mobility behaviours or the analysis of product characteristics.

Schuitema et al. (2010) for example analyse the acceptance of transport pricing policies and find that the acceptability is not necessarily low because car users expect negative effects on their car use, but rather because they are not be convinced

that transport pricing policies will reduce congestion and environmental problems. M.Bockarjova et al. (2014) interviewed Dutch drivers and showed that respondents were more likely to adopt electric vehicles when the negative consequences caused by conventional vehicles are perceived as more severe and when they expected electric vehicles to decrease these consequences. Barriers for electric vehicle adoption are perceived high costs of electric vehicles, and benefits associated with the use of a conventional vehicle. Noppers et al. (2014) shows that symbolic attributed may also play an important role in adopting sustainable innovation, although consumers themselves do not recognize their importance when being asked for their motives.

Research covering product choice behaviour is usually driven by interests on marketing techniques or with respect to market development. Hence, there is broad literature on attributes influencing product choices such as price, looks, usage and handling, but also habits, peers and network effects (e.g. Policy Studies Institute, 2006).

Stewart (2015) describes the interplay between markets and governments, urges for studying public policy based on marketing reasons and recognizes that consumers are not passive actors. Although, I could not find any systematic analysis on the decision-making of consumers in light of policy announcements. Coming closest to the question at hand, there are a few market analyses regarding second-hand markets. According to Bloomberg (2017) the demand for diesel vehicles decreased massively on second-hand platforms in Germany caused by the discussions about the diesel bans. However, whether consumers stopped buying these vehicles precisely due to an expected policy or any other factor is not clear.

With this paper, I aim to address this gap and experimentally test the impact of policy announcements on consumer buying decisions between conventional and more environmental-friendly alternatives in transportation. In particular, I test whether consumers make a different buying decision depending on policy measures that will (potentially) be implemented in the future. I have the following hypotheses:

Hypothesis H_1: People adjust their buying behaviour if they expect a policy in

the future that potentially decreases the value of their (personal) assets.

Certainly the effect becomes stronger if people expect that they will be directly affected by the policy. Thus:

Hypothesis H_2: People adjust their buying behaviour even more if the policy instruments are known.

The first hypothesis is linked to a situation where the policy framework is still quite vague. People know about a political target to be achieved but not what measures will be taken. In the second hypothesis they are aware about the measures and can weigh the (perceived) benefits of a certain product against expected devaluation.

3 Data and method

The Swiss Household Energy Demand Survey (SHEDS) is a questionnaire developed by the Swiss Competence Centre for Research in Energy, Society and Transition (SCCER CREST). Its aim is to study energy-related behaviour of households, as well as socio-economic and attitudinal attributes linked to this behaviour. The core questionnaire is designed in a longitudinal format which allows to detect long-term changes in energy consumption. Participants of the preceding years are invited to participate again in order to create a panel dataset. To still guarantee a representative sample, additional participants are selected randomly from representative subgroups. Every survey contains a limited number of choice experiments complementing the core questions. The first wave of SHEDS was conducted in 2016 with a focus on electricity consumption in the choice experiments. The consecutive survey in 2017 focused on heating, the survey of 2018 on mobility.

3.1 The SEQ choice experiment in SHEDS 2018

Overall, 5514 individuals participated in SHEDS2018. The sample was split between 5 different experiments. 995 participants were randomly assigned to the SEQ choice experiment, which is of interest for this paper. The primary aim of the choice experiment was to find out what kind of mobility patterns people have for different situations/trips and how that affects the choice of a specific vehicle type.

In the introductory questions, participants had to provide information about their current mobility patterns with respect to their daily commuting behaviour, week-day leisure and weekend leisure trips. They indicate the travelled distances and the (average) time to reach the destination, the distance from home to public transportation stops, whether they had any public transport pass and the number of people that would normally travel with them. Also participants had to say whether they would consider buying an electric vehicle.

The following core exercise was to choose zero, one or two vehicles from a list. After indicating the desired size of the vehicle (micro, small, small-medium, medium-large, large, SUV) the participants could choose from a list of 6 different vehicles. The list contained one vehicle with an internal combustion engine ('traditional vehicle"), two with hybrid engines and two with electric engines. Hybrids and electric vehicles had two options with respect to battery power and price. For all vehicles in the list, participants were shown 4 to 5 attributes, namely price, driving costs, max speed, range of battery (if applicable) and CO_2 emissions. Those attributes were defined by the group of researchers from the university of Neuchâtel who had the lead in the experiment. Based on their research, they chose values reflecting average numbers for these vehicle types (see figure 3 in appendix 7.1).

Finally, in the follow-up questions participants could explain why they chose an electric vehicle or not. Participants could choose up to 3 reasons out of 8 options: comfort, noise, charging/fuelling infrastructure, battery/fuel range, purchase price, driving cost, CO_2 emissions and any other reason with a free text box.

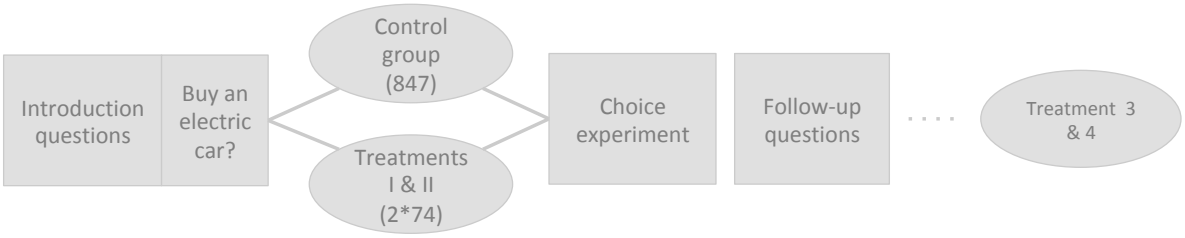

Figure 1: Experimental Design

3.2 The treatments

Out of the 995, 2 groups of 74 participants were randomly selected for two policy treatments. Treatment 1 (T1) and treatment 2 (T2) were constructed in a similar manner. After the introductory questions, participants in T1 and T2 received additional information about the Swiss climate targets in light of the Paris climate agreement and the share of total Swiss emissions caused by mobility. Then participants were informed about the measures other countries implemented in order to reduce pollution from mobility, e.g. quotas, bans, subsidies etc. Finally, participants were informed that the Swiss government planned to achieve an electric vehicle quota in 2023. In T1, the policy instruments to get there were not defined yet. In T2, participants were informed that the parliament has defined multiple instruments that will be introduced stepwise from 2020 onwards to achieve the quota (see appendix 7.2 for the exact treatment texts). After having read this information, the participants proceeded to the same questions as the control group.

Following the experiment, participants from T1 and T2 had to answer two additional follow-up questions. They were first asked how important the policy information was. Second, they were asked how likely they see the introduction of a ban on non-electric vehicles in Switzerland. Both questions were designed with a 5-point Likert answer scale from "Very important" to "Not important at all" in question 1 and "Very likely" to "Not likely at all" in question 2.

Another 140 participants were assigned to other treatments (T3 and T4) regarding shared mobility services. T3 and T4 added some information for the treated participants in the very end of the survey (after the core choice experiment and

the follow-up questions). Since T3 and T4 could not have influenced the choice behaviour, all 847 participants not treated in T1 and T2 could be assigned to the control group.

3.3 Method

The data was analysed with multinomial logit models. Note that it is a one-choice situation, thus participants were asked only once to choose a vehicle and all of them received the same choice setting. It is thus not possible nor necessary to control for preference heterogeneity of individuals. A mixed logit model would thus not reveal any further insights (Train, 2009).

Thanks to the additional questions in the core survey, I can control for multiple socio-economic and person-specific variables (see table 1).

Control Variables		
Socioeconomic		
	gender	m/f
	age group	3 groups, "18-34", "35-54", "55+"
	education	9 groups from compulsory school to university degree
	income	5 groups from <3'000 CHF to >12'000 CHF
Living situation		
	region	4 regions
	living area	urban/rural
	house with solar panels (photovoltaics)	yes/no
	renewable electricity package	yes/no
Mobility		
	desired size of vehicle	6 groups from micro to SUV
	already e-vehicle	yes/no
	already e-bike	yes/no
Political opinion		
	preference for political party	

Table 1: Control variables.

First I tested the log likelihood to choose an electric vehicle when participants received one of the treatments. Second, I tested whether people who said that they would not buy an electric vehicle at first, changed opinion and chose an electric vehicle following one of the treatments. Third, I also analysed the reasons for

choosing/not choosing an electric vehicle from the follow-up questions. Finally I analysed whether treated participants considered the policy information important for their choice.

The different wording between the two treatments allows me to test the two hypotheses. I expect a stronger effect for participants under assumption 2 since they receive much more specific information about the future policy measures they have to expect.

4 Results

Table 2 gives some descriptive insights on the dataset. One can see that men generally expressed a slightly higher interest for electric vehicles than women. The number of internal combustion, hybrid and electric vehicles chosen is similar on average.

Participants		Male	Female
Interest in electric vehicle			
	Yes	278	235
	No	236	246
Vehicle choice			
	ICE	154	143
	Hybrid	147	135
	Electric	160	143
	None	53	60
Treatment			
	Treatment 1	42	32
	Treatment 2	41	32
	Control Group	431	416
Total		514	481

Table 2: Descriptive statistics.

In table 3 one can see the log odds for the choice of engine type including the whole dataset. Clearly, the decisive variable is whether participants indicated beforehand that they envision to buy an electric vehicle. Also vehicle size and education levels determine the choice.[1] The treatments do however not show any significant effect.

[1]For legibility only the important coefficients are shown in the tables.

	Dependent variable: Choice of vehicle (engine type)	
	Hybrid vehicle	Electric vehicle
Considers buying an electric vehicle	1.997***	3.632***
	(0.227)	(0.269)
vehicle size micro	1.977*	2.976***
	(1.050)	(1.077)
vehicle size small	0.861	1.302**
	(0.529)	(0.557)
vehicle size mid-size	0.981*	0.553
	(0.519)	(0.560)
vehicle size SUV	0.948*	0.525
	(0.522)	(0.565)
Basic vocational school	−15.298***	2.597*
	(0.00000)	(1.570)
Domestic school	−0.454	−35.728***
	(1.145)	(0.000)
Treatment 1	0.214	0.245
	(0.375)	(0.430)
Treatment 2	0.240	0.200
	(0.361)	(0.421)
Control variables	✓	✓
Constant	−1.954**	−3.995***
	(0.870)	(1.063)
N = 995		
Note:		*p<0.1; **p<0.05; ***p<0.01

Table 3: Regression including all participants. Coefficients indicate the log odds to choose a hybrid (1) or electric (2) vehicle compared to the baseline (ICE vehicle). Standard deviations are given in brackets.

4.1 Opinion Changers

I then subset the data to participants who choose to buy a vehicle. The dataset is reduced to 882 participants. Following the introductory part, participants can be split in two groups, those who can envision to buy an electric vehicle and those who can't. In figure 2 one can see that several participants changed their opinion between the introductory question and the actual choice. In particular more than 10% of participants who received the treatment 2 changed their opinion in favour of an electric vehicle.

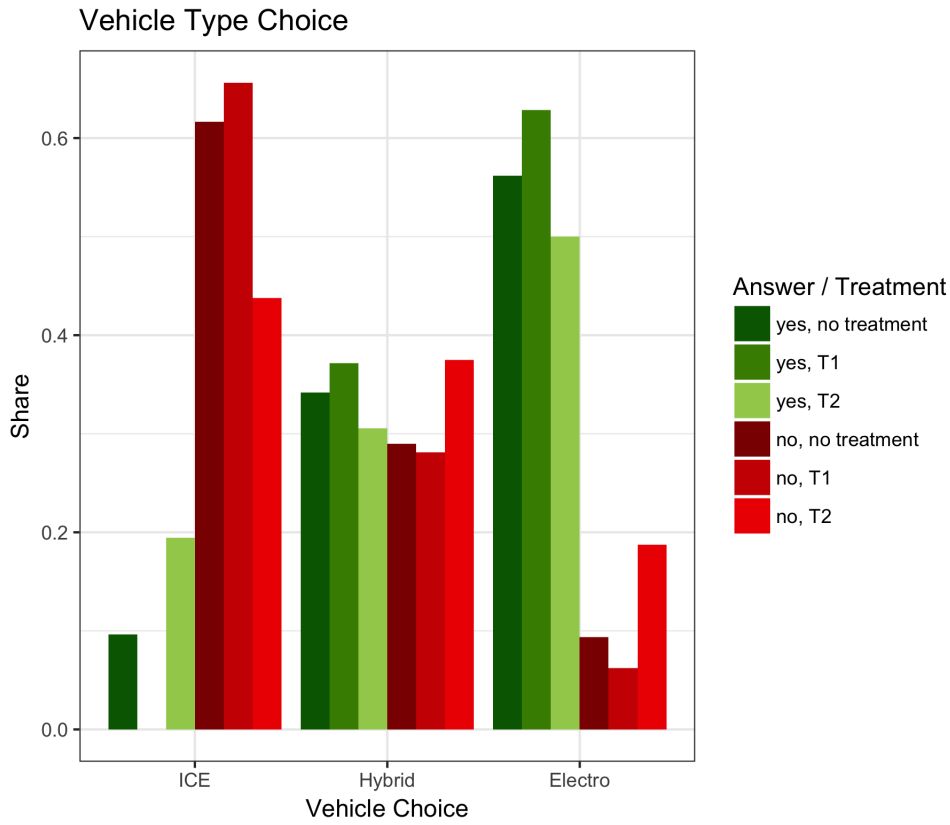

Figure 2: Choice of vehicle type for both treatment groups and the control group (in percentage). Bars in red colours show participants who said that they can not envision to buy an electric vehicle, bars in green show participants who say they can.

In table 4 one can see the regression results if we subset the data to those participants who want to buy a vehicle, but can not envision to buy an electric vehicle (416 participants). For participants who said that they do not consider buying an electric vehicle, the log likelihood to choose an electric vehicle compared to a ICE (baseline) is nevertheless significantly higher after receiving the treatment 2 (p-Value $< 5\%$).

	Dependent variable: Choice of vehicle (engine type)	
	Hybrid vehicle	Electric vehicle
Treatment 1	−0.157	−0.190
	(0.487)	(1.146)
Treatment 2	0.619	1.660**
	(0.469)	(0.713)
Income less than 3,000	−2.393**	1.347
	(1.184)	(1.213)
Income more than 12,000	−0.363	−2.290**
	(0.496)	(1.066)
Basic vocational school	−17.934***	2.966
	(0.000)	(2.472)
Compulsory school	−25.173***	2.143
	(0.000)	(1.790)
Domestic school	−26.998***	−23.368***
	(0.000)	(0.000)
Vocational/general school	−0.056	−40.242***
	(0.553)	(0.000)
University, ETH, university of applied sciences	0.843***	−0.885
	(0.312)	(0.563)
Control variables	✓	✓
Constant	−32.510***	−45.300***
	(0.767)	(0.461)
N = 416		
Note:		*p<0.1; **p<0.05; ***p<0.01

Table 4: Regression with people who said that they do not envision to buy an electric vehicle. Coefficients indicate the log odds to choose a hybrid (1) or electric (2) vehicle compared to the baseline (ICE vehicle). Standard deviations are given in brackets.

4.2 Follow-up questions

The analysis of the follow-up questions yields a slightly puzzling result. The reasons for choosing an electric vehicle did not significantly differ between participants who received the treatment and those who didn't. As it can be seen in table 5 81% of the non-treated participants said that CO_2 emissions or the environment/pollution was an important reason to choose an electric vehicle, compared to 84% for both treated groups. In contrast, those participants that did not choose an electric vehicle the indicated reasons somehow differ. In particular, those participants that have received

the treatment 2 substantially more often pointed out that electric vehicles are not environmental-friendly neither (i.e. CO_2 emissions and energy use of the production process and the electricity for use) compared to the control group.

Group	1: Electric Vehicle		2: Importance of policy information		
	Yes	No	Important	Not important	Neutral
Control Group	81% (225)	10% (59)			
Treatment Group 1	84% (21)	6% (3)	24% (18)	36% (27)	39% (29)
Treatment Group 2	84% (21)	22% (7)	19% (14)	51% (38)	30% (22)
N	337	711	32	65	51

Table 5: Analysis of follow-up questions. 1: Participants indicating the environment and/or CO_2 emissions for choosing / not choosing an electric vehicle. 2: Importance of information about policy (for treated participants only).

Looking at the treated participants only, one can analyse how important they considered the additional information they received (column 2 in table 5. Interestingly and despite the above described significant effect, most of the participants answered that the information was not important to them. 65 of the 148 participants responded that it was somewhat or completely unimportant for them, 51 did not agree nor disagree and only 32 said that the information was somehow or completely important.

5 Discussion

The first regression shows that people who envision buying an electric vehicle are more likely to do so than people who do not. However, in order to accelerate the energy transition, people that are not intrinsically interested in electric vehicles have to be addressed. The second regression including "no-sayers" only is of much more interest. The results suggest that if individuals receive information about future policies, they are more likely to change decision, because they expect measures directly affecting themselves. This happened even though most of the treated participants said that the information was not important for them.

According to my analysis, only the second treatment had a significant effect. I would thus not reject my first hypothesis but only in combination with the second

one. My results indicate that people take into account future policies if they also expect to be personally affected by them. This calls for clear and early communication about policy targets and measures also for individuals as consumers.

Although this has not been experimentally tested, the implication may be twofold: first, if people are aware of future policy changes and adapt their choice beforehand they are more likely to support or at least accept the policy once it is implemented. This is the case because they are not going to be negatively affected by the policy. Ziegler, 2019 and Shwom et al., 2010 show that people's support of policies depends on perceived fairness and personal concern. If people had time to adapt to new policies they can include future costs or restrictions in today's decision-making, which is most likely going to increase the perceived fairness. Second, the announcements of policy targets and respective measures may profit from some kind of self-fulfilling phenomena. In 1991 Krugman described the so-called self-fulfilling prophecy (Krugman, 1991), known in psychological research since longer as the "Thomas theorem". An intuitive example is an investor who expects an asset value to increase and thus buys the asset. If all investors think the same and invest similarly, the value of the asset will indeed increase. For example (Bretschger et al., 2017) and (Schaefer et al., 2018) show that positive expectations can positively influence the growth path of an economy and induce an earlier switch to a green economy. In light of the experiment at hand, I propose that a similar process could work with policy-making: If individuals believe that policy measures will be implemented to achieve a policy target, they will potentially already adapt to conform with the policy target (i.e. by buying an alternative product). By doing so, the quota may be approached (or even achieved) without any actual policy measurement already implemented.

Note that there are several limitations to the analysis: first, the sample size is very small. Furthermore the data is collected with a survey. Hence, I can neither control nor test whether people would actually buy a vehicle and/or change opinions. Certainly, it is also possible that another variable such as perceived peer pressure or change of norms (also) determines the behaviour. Another limitation is that I

can not control for existing expectations of the participants. Some of them may had previous knowledge about policies. However, the random assignments to the treatments and the fact that no participant mentioned future policies in the follow-up question reduces this concern. Finally, my test focused on a vey specific good where substitution among engine types is relatively easy. For the moment I can not say whether such policy announcements would have a similar effect with respect to other investments, e.g. housing. This calls for further research and experimental testing.

6 Conclusions

The risk of having stranded assets linked to environmental policy is not only relevant for markets and investors but also for individuals. This paper proposes that consumers integrate expectations about future policies with respect to investments in personal goods. With a small choice experiment in a Swiss energy demand survey, I show that for participants that were informed about future policies directly affecting them, the log likelihood is higher to change opinion: participants who did not envision to buy an electric vehicle were more likely to still choose one after the informative treatment. My findings suggest that policy announcements are important also for individuals. If people can plan ahead, the risk of investments becoming stranded decreases. This could not only decrease costs but most likely increase support and acceptance of policies.

References

Bauer, N., C. McGlade, J. Hilaire, and P. Ekins. 2018. "Divestment prevails over the green paradox when anticipating strong future policies." *Nature Climate Change* 8:130–134.

Blinder, A. S., M. Erhmann, M. Fratzscher, J. De Haan, and D.-J. Jansen. 2008. "Central Bank Communication and Monetary Policy: A Survey of Theory and Evidence." *CEPS Working Paper No. 161.*

Bloomberg. 2017. "Germany's 'Diesel Fear' Leaves 5 Billion Dollar in Used Cars Gathering Dust." https://www.bloomberg.com/news/articles/2017-08-24/germany-s-diesel-fear-sees-5-billion-in-used-cars-gather-dust.

Bretschger, L., and A. Schaefer. 2017. "Dirty history versus clean expectations: Can energy policies provide momentum for growth?" *Environmental Economics and Policy Studies* 99:170–190.

Bretschger, L., and S. Soretz. 2018. "Stranded Assets: How Policy Uncertainty Affects Capital, Growth, and the Environment." *CER-ETH – Center of Economic Research at ETH Zurich Working Paper,* nos. 18/288.

Bundesverwaltungsgericht Deutschland. 2018. "Luftreinhalteplaene Duesseldorf und Stuttgart: Diesel-Verkehrsverbote ausnahmsweise möglich." https://www.bverwg.de/pm/2018/9.

Caldecott, B. 2017. "Introduction to special issue: stranded assets and the environment." *Journal of Sustainable Finance & Investment* 7:1–13.

Costa, D. L., and M. E. Kahn. 2013. "Energy conservation "nudges" and environmentalist ideology: evidence from a randomized residential electricity field experiment." *Journal of the European Economic Association* 11 (3): 680–702.

Dietz, T., G. T. Gardner, J. Gilligan, P. C. Stern, and M. P. Vandenbergh. 2009. "Household actions can provide a behavioral wedge to rapidly reduce US carbon emissions." *Proceedings of the National Academy of Sciences of the United States of America.*

Drews, S., and J. C. van den Bergh. 2015. "What explains public support for climate policies? A review of empirical and experimental studies." *Climate Policy.*

European Commission. 2008. "Member States approve the phasing-out of incandescent bulbs by 2012." *IP/08/1909.*

———. 2019. "Energy Efficiency." https://ec.europa.eu/energy/en/topics/energy-efficiency.

Hertwich, E. G., and G. P. Peters. 2009. "Carbon Footprint of Nations: A Global, Trade-Linked Analysis." *Environment Science & Technology.*

Jensen, S., K. Mohlin, K. Pittel, and T. Sterner. 2015. "An introduction to the green paradox: the unintended consequences of climate policies." *Review of Environmental Economic Policy* 9:246–265.

King, R. G., Y. K. Lu, and E. S. Pastén. 2008. "Managing Expectations." *Journal of Money, Credit and Banking.*

Krugman, P. 1991. "History versus expectations." *Quarterly Journal of Economics,* no. 106: 651–667.

Lindenblatt, R., I. Malcher, and D. Wolf. 2018. *Ein Witz.*

M.Bockarjova and L.Steg. 2014. "Can Protection Motivation Theory predict pro-environmental behavior? Explaining the adoption of electric vehicles in the Netherlands." *Global Environmental Change* 28:276–288.

Noppers, E. H., K. Keizer, J. W. Bolderdijk, and L. Steg. 2014. "The adoption of sustainable innovations: Driven by symbolic and environmental motives." *Global Environmental Change.*

Phys.org. 2018. "Norway sees boom in electric cars, fueled by the government." `https://phys.org/news/2018-12-norway-boom-electric-cars-fueled.html`.

Policy Studies Institute. 2006. "Designing policy to influence consumers: Consumer behaviour relating to the purchasing of environmentally preferable goods."

Ramiah, V., T. Morris, I. Moosa, M. Gangemi, and L. Puican. 2016. "The effects of announcement of green policies on equity portfolios: Evidence from the United Kingdom." *Managerial Auditing Journal* 31 (2): 138–155. doi:`10.1108/MAJ-08-2014-1065`. eprint: `https://doi.org/10.1108/MAJ-08-2014-1065`. `https://doi.org/10.1108/MAJ-08-2014-1065`.

Reuters. 2017. "Oxford to become first UK city to ban petrol and diesel cars from centre." `https://af.reuters.com/article/energyOilNews/idAFL8N1MN2LK`.

Schaefer, A., and A. Stuenzi. 2018. "The relevance of green preferences on the impact of history versus expectations." *ETH Economic Working Paper Series.*

Schellnhuber, H. J., S. Rahmstorf, and R. Winkelmann. 2016. "Why the right climate target was agreed in Paris." *Nature Climate Change* 6:649–653.

Schmidt, T. S., M. Schneider, K. S. Rogge, M. J. Schuetz, and V. H. Hoffmann. 2012. "The effects of climate policy on the rate and direction of innovation: A survey of the EU ETS and the electricity sector." *Environmental Innovation and Societal Transitions* 2:23–48.

Schuitema, G., L. Steg, and J. Rothengatter. 2010. "The acceptability, personal outcome expectations, and expected effects of transport pricing policies." *Journal of Environmental Psychology.*

Seto, K. C., S. J. Davis, R. B. Mitchell, E. C. Stokes, G. Unruh, and D. Uerge-Vorsatz. 2016. "Carbon Lock-In: Types, Causes, and Policy Implications." *Annual Reviews:* 425–452.

Shwom, R., D. Bidwell, A. Dan, and T. Dietz. 2010. "Understanding U.S. public support for domestic climate change policies." *Global Environmental Change* 90:343–358.

Sinn, H.-W. 2012. *The Green Paradox, a supply-side approach to global warming.* MIT Press, Cambridge, MA.

Steg, L., G. Perlaviciute, and E. van der Werff. 2015. "Understanding the human dimensions of a sustainable energy transition." *Frontiers in Psychology* 6 (805).

Stewart, D. W. 2015. "Why Marketers Should Study Public Policy." *Journal of Public Policy & Marketing* 34:1–3.

Swiss Federal Office of the Environment. 2018. "Climate: In brief." `https://www.bafu.admin.ch/bafu/en/home/topics/climate/in-brief.html`.

The National. 2018. "Six Chinese cities where an electric car makes more sense than petrol." `https://www.thenational.ae/business/technology/six-chinese-cities-where-an-electric-car-makes-more-sense-than-petrol-1.734709`.

The New York Times. 2009. "Europe's Ban on Old-Style Bulbs Begins." `https://www.nytimes.com/2009/09/01/business/energy-environment/01iht-bulb.html?_r=1`.

Train, K. E. 2009. *Discrete Choice Methods with Simulation.* Cambridge University Press.

Transport for London. 2018. "Ultra Low Emission Zone." https://tfl.gov.uk/modes/driving/ultra-low-emission-zone.

van der Ploeg, F., and C. Withagen. 2012. "Is there really a green paradox?" *Journal of Environmental Economics and Management* 64:342–363.

Welt. 2018. "Die Bundesregierung ist schuld an den Fahrverboten." https://www.welt.de/wirtschaft/article176835105/Dieselfahrverbote-In-Hamburg-sind-die-ersten-Strassen-seit-heute-gesperrt.html.

Ziegler, A. 2019. "The Relevance of Attitudinal Factors for the Acceptance of Energy Policy Measures: A Micro-econometric Analysis." *Ecological Economics* 157:129–140.

7 Appendix

7.1 Car variables

	1 Electric	2 Electric	3 Plug-in hybrid	4 Plug-in hybrid	5 Hybrid	6 ICE
Price (CHF)	21,000	31,000	24,000	32,000	20,000	13,000
Driving cost (CHF/100km)	2.30	2.00	3.20	4.00	5.00	6.20
Range of battery (km)	90	160	40	45	-	-
Max speed (km/h)	130	140	150	180	160	160
CO_2 emissions (g/km)	0	0	18	25	65	95

Figure 3: Attributes given for all vehicle types in the choice setting.

7.2 Treatment text

With the Paris Climate Agreement the international community of states aims to keep global warming below 2 degrees. Following that, the Swiss government has defined a target to reduce national emissions by 50% compared to 1990 levels. Since the transportation sector is responsible for a large share of total CO2 emissions in Switzerland, one central climate policy pillar addresses mobility and transportation. Across the world one can observe similar efforts. The Chinese Government aims to achieve a quota of at least 8 percent of electric vehicles by 2019, rising up to 20% in 2025. To fulfil this target, they introduced a fixed sales quota for vehicle suppliers, but also implemented various policies directly addressing consumers, such as the introduction of different number plates (with restricted quantities for non-electric vehicles). Other countries abolished highway fees for electric vehicles (Norway) or increased fuel levies (France). Oxford decided to ban all diesel and fuel-powered vehicles in the city center from 2020 onwards and similar policies are discussed in several German cities.

Assume now, that the Swiss government has announced, that it wants to achieve a new sales quota of 20% of electric vehicles by 2023.

Addition for treatment 1:

The policy to achieve this target has not been defined yet and is matter of discussion in the parliament.

Addition for treatment 2:

From 2020 onwards several measures will be implemented step-wise, such as increasing fuel levies, vehicle import restrictions and a ban of non-electric vehicles in the city center.