University of Groningen

Beyond purchasing: Electric vehicle adoption motivation and consistent sustainable energy behaviour in The Netherlands

Peters, Annemijn Maron; van der Werff, Ellen; Steg, Linda

Published in:
Energy Research & Social Science

DOI:
10.1016/j.erss.2017.10.008

Publication date:
2018

Beyond Purchasing: Electric Vehicle Adoption Motivation and Consistent Sustainable Energy Behaviour in The Netherlands.

A.M. Peters[*], E. van der Werff & L. Steg

University of Groningen, The Netherlands

[*]Corresponding author. Department of Psychology, Faculty of Social and Behavioural Sciences, Grote Kruisstraat 2/1, 9712 TS Groningen, The Netherlands.
Tel.: +31 50 363 6452. E-mail address: a.m.peters@rug.nl

Abstract

Adoption of smart energy technologies, such as electric vehicles (EVs), can significantly reduce fossil energy use, provided that adopters of an EV also use the EV in a sustainable way. Hence, it is key to understand which factors affect the likelihood that the adoption of EVs promotes the sustainable use of EVs, and promote consistent sustainable energy behaviours. We argue that the motivation to adopt an EV plays a key role in this respect. When people adopt an EV for environmental reasons, this will signal that they are a pro-environmental person, thereby strengthening environmental self-identity and promoting consistent sustainable energy behaviours. We conducted two cross-sectional studies among EV adopters to test our reasoning. As expected, the more people adopted an EV for environmental reasons, the stronger their environmental self-identity, in turn increasing the likelihood that they engaged in other sustainable energy behaviours. In contrast, adopting an EV for financial or technological reasons was not consistently related to environmental self-identity and sustainable energy behaviours. These results suggest that the motivation for adopting an EV is crucial for the likelihood that people engage in sustainable energy behaviour consistently, which is key to realise a sustainable energy transition.

Keywords: motivation, electric vehicle, environmental self-identity, sustainable energy behaviour

Highlights

- Motivation for electric vehicle (EV) adoption affects consistent sustainable energy behaviour
- Adopting an EV for environmental reasons promotes consistent sustainable energy behaviour via environmental self-identity
- Adopting an EV for financial or technological reasons is not consistently related to environmental self-identity and sustainable energy behaviour

1. Introduction

People increasingly adopt smart energy technologies, such as photovoltaic solar panels and electric vehicles (EV), to produce, use and store energy from renewable sources (Eurostat, 2017; European Automobile Manufacturers Association, 2017). Smart energy technologies can significantly reduce fossil energy use and emissions of greenhouse gases provided that people not only accept and adopt such technologies (Steg, Perlaviciute, & Van der Werff, 2015; Noppers, Keizer, Milovanovic, & Steg, 2016), but also use them in a sustainable way (Nicolson, Huebner, Shipworth, & Elam, 2017). For example, the CO_2 emission reductions achieved by driving an EV rather than a car with an internal combustion engine will be much larger when the EV is charged with energy produced from renewable energy sources rather than by a coal-fired power plant (Bradley & Frank, 2009). Yet, people typically charge EVs in the early evening, thereby increasing peak electricity demand (Elaad, 2013). Power plants often use fossil fuels to meet such peak demand, resulting in higher CO_2 emissions (Cavoukian, Polonetsky, & Wolf, 2010; Borenstein, 2012). In addition, charging EVs at peak times can threaten grid stability and reliability (Eising, Van Onna, & Alkemade, 2014).

Hence, the adoption of smart energy technologies such as EVs is important but not sufficient to realise a sustainable energy transition; people need to use the EVs in a sustainable way and more generally, consistently engage in a wide range of sustainable energy behaviours (Steg et al., 2015). In this paper, we aim to examine which factors affect the likelihood that the adoption of EV results in sustainable use of the EV as well as engagement in a wide range of sustainable energy behaviours.

1.1. Which factors affect whether EV adoption encourages other types of sustainable energy behaviour?

Several studies have examined so-called spillover-effects, reflecting the extent to which engaging in one sustainable energy behaviour affects the likelihood of subsequent sustainable energy behaviours (Nilsson, Bergquist, & Schultz, 2017; Truelove, Carrico, Weber, Raimi & Vandenbergh, 2014, for reviews). Some studies suggest that engagement in one sustainable energy behaviour does not necessarily motivate people to engage in other types of sustainable energy behaviour as well (Steinhorst, Klöckner, & Matthies, 2015; Thomas, Poortinga, & Sautkina, 2016). In fact, performing a sustainable energy behaviour may even reduce the likelihood to act sustainably in subsequent situations (negative spillover effects; Tiefenbeck, Staake, Roth, & Sachs, 2013). It has been argued that negative spillover effects are likely when people feel licensed to act immorally (such as not engaging in sustainable energy behaviour) after engaging in behaviour that is seen as morally good (such as adopting an EV; Nilsson et al., 2017).

Yet, various studies report positive spillover effects, where engagement in initial sustainable energy behaviour increases the likelihood that people engage in other sustainable energy behaviours as well. For example, a qualitative study revealed that people who adopted an EV indicated to engage in other types of sustainable energy behaviour as well (Ryghaug & Toftaker, 2014). Notably, people are more likely to consistently engage in sustainable energy behaviour when the initial sustainable energy behaviour strengthens their environmental self-identity (Van der Werff, Steg, & Keizer, 2014a, 2014b). Environmental self-identity reflects the extent to which you see yourself as a type of person who acts environmentally-friendly (Van der Werff, Steg, & Keizer, 2013b). Environmental self-identity is likely to be strengthened when people realise they acted in a sustainable way in the past, which in turn promotes other types of sustainable energy behaviour as people are motivated to be consistent and act in line with how they see themselves (Van der Werff et al., 2014a, 2014b).

A key question is which factors affect the likelihood that the adoption of an EV strengthens one's environmental self-identity, in turn promoting the sustainable use of EVs as well as other types of sustainable energy behaviours. We propose that the motivation for EV adoption, that is, the reasons why one adopted an EV, plays a key role in this respect. More specifically, we argue that people will be more likely to use an EV in a sustainable way and to engage in other types of sustainable energy behaviour when they adopted an EV for environmental reasons, as this increases the likelihood that they perceive their choice to adopt an EV was a sustainable choice. More specifically, adopting an EV for environmental reasons will signal that one is a pro-environmental person, thereby strengthening environmental self-identity, which in turn promotes consistent sustainable energy behaviour, including using an EV in a sustainable way. Yet, when people adopt an EV for other reasons, such as financial or technological reasons, they are less likely to perceive their EV adoption as a sustainable choice. In this case, their EV adoption is less likely to signal that they are a pro-environmental person, thereby making it less likely that environmental self-identity will be strengthened and that they will engage in other types of sustainable energy behaviour as well.

Our novel reasoning has not been tested yet. Nevertheless, a few studies provide circumstantial evidence for parts of our reasoning. First, research suggests that engaging in behaviour that clearly benefits the environment strengthens one's environmental self-identity. For example, when people receive feedback showing that they acted in a sustainable way in the past, their self-concept and environmental self-identity was boosted (Taufik, Bolderdijk, & Steg, 2015; Venhoeven, Bolderdijk, & Steg, 2016). This suggests that people are more likely to perceive themselves as a pro-environmental person when they realise that their behaviour is sustainable. We argue that people are more likely to think that their behaviour is sustainable when they engaged in the behaviour for environmental reasons.

Second, research suggests that engagement in sustainable energy behaviour is particularly likely to strengthen environmental self-identity when people did not perform the behaviour because of external factors. For example, environmental self-identity is particularly strengthened when people engage in sustainable energy behaviour that is rather unique or difficult (Van der Werff et al., 2014a) and when they voluntarily engaged in the behaviour (Venhoeven et al., 2016). These findings are in line with our reasoning. When sustainable energy behaviour is unique, difficult or voluntary, it is more likely that people think they acted sustainably for environmental reasons rather than some other factor (e.g. because there was no other option, or it was the most easy or cheap option), which makes it more likely that environmental self-identity is strengthened.

Third, research suggests that emphasizing the environmental benefits of a given behaviour (such as CO_2 -emission reduction) is more likely to promote other sustainable energy behaviour compared to emphasising the financial benefits of the relevant behaviour (such as savings in Euro; Steinhorst et al., 2015; Evans et al., 2012). Similar results were found when financial costs of behaviour actually changed: a small financial charge on plastic bags motivated people to bring their own shopping bags, but it did not significantly encourage engagement in other types of sustainable energy behaviour (Thomas et al., 2016). These findings are in line with our reasoning that engagement in sustainable energy behaviour for environmental reasons promotes consistent sustainable energy behaviour.

1.2. The present studies

Although the studies discussed above are in line with parts of our reasoning, they did not examine whether and why motivation to engage in one sustainable energy behaviour, such as adoption of an EV, affects the likelihood of consistent sustainable energy behaviour. More specifically, the question remains whether the motivation to adopt an EV affects the likelihood of consistent sustainable energy behaviour, including the sustainable use of an EV, because of the implications of this motivation for environmental self-identity. We conducted two cross-sectional studies among EV adopters to examine whether motivation to adopt an EV is likely to affect sustainable use of the EV as well as engagement in a wide range of sustainable energy behaviours. We expected that the more people adopted an EV for environmental reasons, the more likely the EV adoption is to signal that one is a pro-environmental person, thereby strengthening environmental self-identity and promoting consistent sustainable energy behaviour, including sustainable use of an EV (Hypothesis 1). In contrast, the more people adopt an EV for other reasons than the environment (in our studies: financial and technological), the less likely this EV adoption is to signal that one is a pro-environmental person, making it less likely that environmental self-identity will be strengthened and consistent sustainable energy behaviour will be promoted (Hypothesis 2).

2. Study 1

2.1. Method

2.1.1. Participants and procedures

Participants were recruited online via Dutch fora and Facebook pages devoted to EVs between October and December 2015. We used one inclusion criterion: people needed to possess an EV. In total, 112 people started the questionnaire, of which 74 completed the questionnaire (71 males; M_{age} = 46.01, SD_{age} = 9.91). Our sample comprised mainly men who were relatively highly educated and had a relatively high income (Table 1), which is typical of early adopters (Rogers, 2010), and particularly adopters of an EV (Plötz, Schneider, Globisch, & Dütschke, 2014).

Table 1
Socio-demographic characteristics of respondents Study 1

Highest completed level of education		**Net income of one's household per month**	
Primary school	4.1%	Less than 750€	1.4%
Pre-vocational secondary education	2.7%	Between 750€ - 1.500€	1.4%
Secondary vocational education	13.5%	Between 1.500€ - 2.250€	0%
Senior general secondary education	8.1%	Between 2.250€ - 3.000€	4.1%
Higher professional education /Pre-university education	29.7%	Between 3.000€ - 3.750€	12.2%
		Between 3.750€ - 4.500€	14.9%
University education	41.9%	More than 4.500€	52.7%
		Not willing to indicate	13.5%

2.1.2. Measures

2.1.2.1. Adoption motivation. Participants rated the importance of three types of motivation for their decision to adopt an EV: environmental, financial and technological. The items were adapted from previous research (Noppers, Keizer, Bolderdijk, & Steg, 2014; Noppers, Keizer, Bockarjova, & Steg, 2015). Respondents indicated how important environmental, financial, and technological reasons, respectively, were in their decision to adopt an EV. Table 2 provides an overview of the items included in each of the three scales, descriptive statistics and the reliability of the scales[1]. The internal consistency of the environmental motivation scale was high, while the internal consistency of the financial (ρ = .64) and technological motivation (ρ = .59) to adopt an EV scales was somewhat low[2].

Table 2
Motivation to adopt an EV scales

	M (SD)
Environmental motivation to adopt EV (Spearman-Brown coefficient ρ = .90)	**5.61 (1.42)**
1…my EV emits little CO_2	5.77 (1.41)
2…I harm the environment as little as possible when I drive a car	5.46 (1.57)
Financial motivation to adopt EV (Spearman-Brown coefficient ρ = .64)	**5.01 (1.47)**
1…I pay little or no vehicle tax for my EV	5.20 (1.73)
2…I pay as little as possible for the maintenance of my car	4.81 (1.70)
Technological motivation to adopt EV (Spearman-Brown coefficient ρ = .59)	**5.04 (1.44)**
1…I am not behind on the latest technological developments	4.49 (1.91)
2…an EV is equipped with the latest technology	5.59 (1.50)

Note. The following text preceded the items: "Please recall the moment you decided to purchase your electric vehicle and think about the considerations that were relevant to you. Please indicate to what extent the following statements were applicable to you at that moment". The items started with: "It is important to me that…"; answers were given on a 7-point scale, ranging from totally disagree (1) to totally agree (7).

[1] For the two-item scales, we used Spearman-Brown reliability coefficient, which is generally less biased than Cronbach's alpha and Pearson correlation (Eisinga, Te Grotenhuis, & Pelzer, 2013).

[2] To examine whether the lower internal consistency affects our conclusions, we also conducted our analyses including the individual items of the scales with low internal consistency (similar to the procedure followed by Poortinga, Whitmarsh, & Suffolk, 2013, and Thomas and colleagues, 2016). Generally, we found very similar results when including the individual items rather than the scales. Therefore, we report the results of the analyses including the scales. We explain in a footnote when the results of the analyses including individual items differed from the analyses including the scales. The results of the mediation analyses including individual items of both Study 1 and Study 2 can be obtained from the first author.

2.1.2.2. Environmental self-identity. We measured environmental self-identity with three items: Acting pro-environmentally is an important part of who I am; I am the type of person who acts in an environmentally-friendly way; I see myself as an environmentally friendly person (Van der Werff, Steg, & Keizer, 2013a, 2013b). The items were scored on a 7-point scale, ranging from totally disagree (1) to totally agree (7). We computed the mean score on these items (M = 4.82, SD = 1.51, Cronbach's alpha α = .96).

2.1.2.3. Sustainable energy behaviour. We measured how often participants engaged in several types of sustainable energy behaviour. We selected behavioural items based on previous research (Whitmarsh & O'Neill, 2010; Van der Werff et al., 2014a; Steg et al., 2015). To measure sustainable use of the EV, respondents were asked to indicate the extent to which they charged their EV with renewable energy sources. Besides, we included items reflecting three types of sustainable energy behaviour: direct energy saving behaviour (daily energy saving behaviour), indirect energy saving behaviour (i.e., reduction in embodied energy use, associated with the production, transportation and disposal of goods and services) and energy efficient investment behaviour (the purchase of energy efficient products). Table 3 provides an overview of the items, the descriptive statistics, and the reliability of the scales[3]. Although research has shown that different sustainable energy behaviours do not always strongly correlate (Thøgersen & Ölander, 2003; Thøgersen, 2004; Whitmarsh & O'Neill, 2010; Lanzini & Thøgersen, 2014; Steinhorst et al., 2015; Lauren, Fielding, Smith & Louis, 2016), we found that the internal consistency of the sustainable energy behaviour scales was rather high.

[3] In addition, we measured symbolic attributes of an EV (Noppers et al., 2014, 2015), financial and technological self-identity (based on Van der Werff et al., 2013a, 2013b) and interest in and intention to adopt smart energy technologies. As these are not relevant for the purpose of present study, we do not report these here.

Table 3
Sustainable energy behaviour scales

	M (SD)
Sustainable EV use	**5.32(2.17)**
1. I charge my EV with renewable energy	
Direct energy saving behaviour (Cronbach's alpha α = .79)	**4.48(1.42)**
1. I turn my laptop or computer off at night instead of leaving it on stand-by	4.38(2.39)
2. I turn the heating off one hour before I go to bed	4.50(2.2)
3. I shower less than 3 minutes	2.92(2.14)
4. I cycle short distances	3.99(2.15)
5. I only use my washing machine when it is fully loaded	5.19(1.74)
6. I turn off the lights when no one is in the room	5.88(1.43)
Indirect energy saving behaviour (Cronbach's alpha α = .73)	**4.73(1.50)**
1. I buy seasonal products	4.43(1.67)
2. I separate plastic from my regular waste	5.61(2.1)
3. I buy biodegradable cleaning products	4.14(1.79)
Energy efficient investment behaviour (Spearman-Brown coefficient ρ = .88)	**6.43(.95)**
1. My house has double-glazed windows	6.62(.92)
2. My house is insulated (for example loft, floor or wall insulation)	6.23(1.1)

Note. The following text preceded the items: "Please indicate to what extent you agree with the following statements". Answers were provided on a 7-point scale, ranging from not at all (1) to certainly yes (7).

2.1.3. Analyses

We first reported correlations between the three types of motivation to adopt an EV, environmental self-identity and the four types of sustainable energy behaviour. Next, we reported the results of mediation analyses to test whether environmental self-identity mediated the relationship between the different types of adoption motivation on the one hand, and on the other hand sustainable use of the EV and other types of sustainable energy behaviour. We used the PROCESS macro for SPSS with a 95% bias-corrected bootstrap confidence interval with 10.000 bootstrap samples to estimate the indirect effects of the different types of EV adoption motivation on different types of sustainable energy behaviours via environmental self-identity (Hayes, 2013, 2016)[4]. We conducted the mediation analyses for each type of sustainable energy behaviour separately. In each mediation analysis, we included one adoption motivation as independent variable while we controlled for the other types of adoption motivation. This method enabled us to test the extent to which each type of adoption motivation affects sustainable use of the EV and other types of sustainable energy behaviour via environmental self-identity.

2.2. Results

Table 4 shows that the three types of EV adoption motivation were not significantly correlated. The more people adopted an EV for environmental reasons, the stronger their environmental self-identity and the more they engaged in other types of sustainable energy behaviour, except for energy efficient investment behaviour. In addition, the more people adopted an EV for technological reasons, the stronger their environmental self-identity, although this relationship was much weaker. The financial motivation to adopt an EV was not related to environmental self-identity. Both financial and technological motivation to adopt an EV were not significantly related to any of the sustainable energy behaviours. Table 4 further shows that the stronger environmental self-identity, the more likely it is that people engaged in different types of sustainable energy behaviour, except energy efficient investment behaviour. Besides, the more people engaged in one type of sustainable energy behaviour, the higher the likelihood that they engaged in other types of sustainable energy behaviour as well, except for energy efficient investment behaviour.

[4] The OLS regression procedure in PROCESS is the preferred option as we test a relatively simple theoretical model, and because the sample is relatively small (Preacher & Hayes, 2008; Hayes, 2013).

Table 4
Correlations between EV adoption motivations, environmental self-identity, and types of sustainable energy behaviour

	2	3	4	5	6	7	8
1. Environmental motivation	-.15	.01	.65**	.55**	.42**	.57**	.01
2. Financial motivation		.04	-.06	-.16	-.17	-.09	.02
3. Technological motivation			.24*	-.07	.05	.20	.03
4. Environmental self-identity				.43**	.48**	.61**	.07
5. Sustainable EV use					.32**	.48**	-.07
6. Direct energy saving behaviour						.48**	.23
7. Indirect energy saving behaviour							.20
8. Energy efficient investment behaviour							

Note. ***p* < .01; **p* < .05

Next, we tested whether environmental self-identity mediated the relationship between the different types of EV adoption motivation and sustainable use of the EV and other types of sustainable energy behaviour[5]. We only reported the results of the significant mediation analyses. All direct effects and non-significant indirect effects are presented in Table A1-A5, appendix A[6].

We found that the mean indirect effects of environmental motivation to adopt an EV on direct energy saving behaviour ($a_i\, b_i$ = .25, 95% bias-corrected bootstrap CI [.08 to .50]) and indirect energy saving behaviour ($a_i\, b_i$ = .26, 95% bias-corrected bootstrap CI [.09 to .54]) via environmental self-identity were positive and significant. Yet, the mediation model was not statistically significant when we included sustainable EV use and energy efficient investment behaviour as dependent variables. This implies that Hypothesis 1 is partly supported: the more people adopted an EV for environmental reasons, the stronger their environmental self-identity, which in turn was positively related to direct and indirect energy saving behaviour, but not to sustainable EV use and energy efficient investment behaviour.

[5] We tested for mediation effect only for the types of sustainable energy behaviour that were significant related to environmental self-identity (i.e., as reflected in significant correlations, see table 4; Shrout & Bolger 2002).
[6] An effect is non-significant when the confidence interval includes 0.

In addition, the mean indirect effects of technological motivation to adopt an EV on direct energy saving behaviour ($a_i\, b_i$ = .09, 95% bias-corrected bootstrap CI [.01 to .25]) and indirect energy saving behaviour ($a_i\, b_i$ = .09, 95% bias-corrected bootstrap CI [.02 to .20]) via environmental self-identity were positive and significant. Yet, these relationships were much weaker than the indirect effects of environmental motivation to adopt an EV on direct and indirect energy saving behaviour[7]. The indirect effects of technological motivation to adopt an EV on sustainable EV use and energy efficient investment behaviour via environmental self-identity were not statistically significant. Furthermore, the mean indirect effects of financial motivation to adopt an EV on the four types of sustainable energy behaviour via environmental self-identity were not statistically significant. This means that Hypothesis 2 is partly supported: non-environmental motivations to adopt an EV are less likely to strengthen environmental self-identity and to encourage consistent sustainable energy behaviours.

2.3. Discussion

The results show that environmental self-identity mediated the relationship between adopting an EV for environmental reasons and both direct and indirect energy saving behaviour, providing partial support for Hypothesis 1. Although people were more likely to charge their EV in a sustainable way when they adopted an EV for environmental reasons, environmental self-identity did not mediate this relationship. Environmental adoption motivation and environmental self-identity were not significantly related to energy efficient investment behaviour. In addition, our results partially support Hypothesis 2: environmental self-identity mediated the relationship between technological motivation to adopt an EV and direct and indirect energy saving behaviour, but these relationships were much weaker than the indirect effects of environmental motivation to adopt an EV on direct and indirect energy

[7] The effects of single technological EV adoption motivation items on direct and indirect energy saving behaviour via environmental self-identity were not statistically significant, suggesting that the effects were weaker when individual items rather than the scale were included in the analyses.

saving behaviour via environmental self-identity. In addition, as expected, financial motivation to adopt an EV did not promote sustainable energy behaviour via environmental self-identity.

3. Study 2

Study 2 aimed to replicate the findings of Study 1. This time, we approached a larger sample. Additionally, we aimed to increase the internal consistency of the financial and technological EV adoption motivation scales by adapting the items reflecting adoption motivations. Besides, to test the robustness of our findings we also included different items reflecting sustainable energy behaviour.

3.1. Method

3.1.1. Participants and procedures

Members of a Dutch organization which connects the public charging stations for EVs to the Dutch electricity grid received an email with a request to complete the questionnaire between April and May 2015. Again, only people possessing an EV were invited to participate in the study. In total 251 people participated in the study (231 males; M_{age} = 50.14, SD_{age} = 8.36). Again, our sample comprised mainly males, who were relatively highly educated and had a relatively high income (Table 5).

Table 5
Socio-demographic characteristics of respondents Study 2

Highest completed level of education		**Gross individual income per month**	
Primary school	.8%	Less than 750€	0%
Pre-vocational secondary education	1.2%	Between 750€ - 1.500€	.8%
Secondary vocational education	16.3%	Between 1.500€ - 2.250€	2%
Senior general secondary education	7.6%	Between 2.250€ - 3.000€	5.6%
Higher professional education /Pre-university education	40.6%	Between 3.000€ - 3.750€	6%
		Between 3.750€ - 4.500€	10.4%
University education	33.5%	More than 4.500€	57%
		Not willing to indicate	13.1%
		Missing	5.2%

3.1.2. Measures

3.1.2.1. Adoption motivation. As in Study 1, participants were asked to rate the importance of three types of motivation in their decision to adopt an EV: environmental, financial and technological motivation. The items were measured on a 7-point scale, ranging from very unimportant (1) to very important (7). Table 6 provides an overview of the items, descriptive statistics and the reliability of the scales. The internal consistency of the environmental and technological motivation scale was high, but somewhat low for the financial (ρ = .64) EV adoption motivation scale[2].

Table 6
Motivation to adopt an EV scales

	M(SD)
Environmental motivation to adopt EV (Spearman-Brown coefficient ρ =.80)	**5.28(1.40)**
1. Low emission of greenhouse gases (CO_2)	5.23(1.62)
2. Harming the environment as little as possible by driving a car	5.33(1.45)
Financial motivation to adopt EV (Spearman-Brown coefficient ρ =.64)	**5.47(1.33)**
1. Low fixed car costs (for example taxes)	5.69(1.60)
2. Low car costs for driving and maintenance	5.25(1.50)
Technological motivation to adopt EV (Spearman-Brown coefficient ρ =.85)	**5.43(1.46)**
1. Being technologically innovative	5.43(1.55)
2. Driving a technologically innovative car	5.43(1.58)

Note. The following text preceded the items: “Please indicate how important the following considerations were in your decision to purchase your electric vehicle”. The items were measured on a 7-point scale, ranging very unimportant (1) to very important (7).

3.1.2.2. Environmental self-identity. We measured environmental self-identity with the same items as in Study 1 (*M* = 5.18, *SD* = 1.28, α = .91).

3.1.2.3. Sustainable energy behaviour. Similar to Study 1, we measured how often participants engaged in different types of sustainable energy behaviour. Answers were given on a 7-point scale ranging from (almost) never (1) to (almost) always (7). Again, we measured sustainable use of an EV, direct energy saving behaviour, indirect energy saving behaviour, and energy efficient investment behaviour. Table 7 provides an overview of the items, the descriptive statistics, and the reliability of the scales[8]. The internal consistency for scales measuring sustainable EV use (Spearman-Brown coefficient ρ = .49), direct energy saving behaviour (Cronbach's alpha α = .58), indirect energy saving behaviour (Cronbach's alpha α = .66) and energy efficient investment behaviour (Spearman-Brown coefficient ρ = .16) was lower than in Study 1[2]. Yet, we decided to include the single items reflecting energy efficient investment behaviour in all analyses, as both items were hardly correlated.

Table 7
Sustainable energy behaviour scales

	M (SD)
Sustainable EV use (Spearman-Brown coefficient ρ =.49)	**4.09(1.72)**
1.I charge my EV with renewable energy	4.85(2.08)
2. I charge my car in a smart way*	3.33(2.14)
Direct energy saving behaviour (Cronbach's alpha α = .58)	**4.76(1.24)**
1. I turn my laptop or computer off at night instead of leaving it stand-by	4.93(2.44)
2. I turn the heating off one hour before I go to bed	5.22(1.93)
3. I shower less than 3 minutes	3.63(2.02)
4. I cycle short distances	4.42(2.16)
5. I only use my washing machine when it is full	5.61(1.50)
Indirect energy saving behaviour (Cronbach's alpha α = .66)	**4.4(1.29)**
1. I buy seasonal products	4.88(1.51)
2. I buy biodegradable cleaning products	4.11(1.77)
3. I avoid products with unnecessary packaging	4.22(1.72)
Energy efficient investment behaviour (Spearman-Brown coefficient ρ =.16)	**5.83(1.08)**
1. I insulated my house (for example floor or wall insulation)	5.89 (1.49)
2. When I buy a new household appliance, I buy the energy efficient option	5.77 (1.44)

*Description: charging an EV as much as possible at moments of energy surplus to promote the efficient use of renewable energy.
Note. The following text preceded the items: "Please indicate how often you perform the following behaviours". Answers were given on a 7-point scale, ranging from (almost) never (1) to (almost) always (7).

3.2. Results

Table 8 shows that environmental EV adoption motivation and technological EV adoption motivation were significantly correlated. Besides, the stronger the environmental

[8]The study was part of a larger study from an interdisciplinary research team, comprising questions regarding EV characteristics (e.g. car type, battery range), EV use (e.g. number of trips per week, driving experience), charging (e.g. facilities, fast and smart charging) and other behaviours (e.g. possession of motorized vehicles, activities to promote EV). As these variables are not relevant for the purpose of present study, we do not report these here.

motivation to adopt an EV, the stronger environmental self-identity, and the more likely people were to engage in all types of sustainable energy behaviour except for insulation of one's house. Technological motivation to adopt an EV was also positively related to environmental self-identity and to all sustainable energy behaviours, but these relationships were much weaker than for the environmental motivation to adopt an EV. The more people adopted an EV for financial reasons, the more likely they were to have insulated their house. Table 8 further shows that the stronger environmental self-identity, the more people engaged in all types of sustainable energy behaviour. Furthermore, most sustainable energy behaviours were positively related, indicating that the more people engaged in one sustainable energy behaviour, the more likely they were to engage in other sustainable energy behaviours as well.

Table 8
Correlations between EV adoption motivations, environmental self-identity, and types of sustainable energy behaviour

	2	3	4	5	6	7	8	9
1. Environmental motivation	.07	.37**	.71**	.33**	.40**	.57**	.08	.42**
2. Financial motivation		.12	.01	-.06	.12	-.01	.14*	.10
3. Technological motivation			.33**	.16*	.14*	.17**	.19**	.16*
4. Environmental self-identity				.37**	.45**	.55**	.18**	.38**
5. Sustainable EV use					.27**	.33**	.18**	.34**
6. Direct energy saving behaviour						.55**	-.01	.40**
7. Indirect energy saving behaviour							.07	.49**
8. Insulating one's house								.09
9. Buying energy efficient appliances								

Note. $^{**}p < .01$; $^{*}p < .05$

Next, we tested whether environmental self-identity mediated the relationship between the different types of EV adoption motivation and sustainable use of the EV and other types of sustainable energy behaviour[9]. We only report the results of the significant mediation analyses. All direct effects and non-significant indirect effects are presented in Table B1-B5 in appendix B.

We found that the mean indirect effects of environmental motivation to adopt an EV on sustainable use of the EV ($a_i\, b_i$ = .22, 95% bias-corrected bootstrap CI [.08 to .38]), direct energy saving behaviour ($a_i\, b_i$ = .21, 95% bias-corrected bootstrap CI [.11 to .33]), indirect energy saving behaviour ($a_i\, b_i$ = .19, 95% bias-corrected bootstrap CI [.10 to .31]) and insulating one's house ($a_i\, b_i$ = .18, 95% bias-corrected bootstrap CI [.05 to .33]) via environmental self-identity were positive and significant[10]. Yet, the mediation model was not statistically significant when we included buying energy efficient appliances ($a_i\, b_i$ = .11, 95% bias-corrected bootstrap CI [-.01 to .25]) as dependent variable. Hence, Hypothesis 1 is partly supported: the more people adopted an EV for environmental reasons, the stronger their environmental self-identity, which in turn increased the likelihood they used the EV in a sustainable way, engaged in direct and indirect energy saving behaviour, and insulated their house, but not buying energy efficient appliances.

In addition, the mean indirect effects of financial and technological motivations to adopt an EV on the different types of sustainable energy behaviour were not statistically significant[11]. This means that Hypothesis 2 is supported: non-environmental motivations to adopt an EV are less likely to strengthen environmental self-identity and to promote sustainable energy behaviours.

---

[9] The PROCESS Macro (Hayes, 2013, 2016) includes only complete cases to test for mediation. As five participants answers did not complete all items, the mediation analyses included 246 participants.

[10] The effects of environmental EV adoption motivation on the individual sustainable energy behaviours 'smart charging', 'buying energy efficient appliances', 'taking short showers' and 'purchasing seasonal products' via environmental self-identity were not statistically significant, suggesting that the effects were weaker when individual items rather than the scale were included in the analyses.

[11] When conducting mediation analyses with single items of financial EV adoption motivation, we found significant indirect effects for the items: 'turning off the heating one hour before one goes to bed', 'cycling short distances' and 'avoiding products with unnecessary packaging' via environmental self-identity, with intervals just excluding 0. Therefore, we do not discuss these further. Detailed results can be obtained from first author.

3.3. Discussion

Importantly, in line with Hypothesis 1, environmental self-identity mediated the relationships between adopting an EV for environmental reasons on the one hand, and sustainable EV use as well as the different types of sustainable energy behaviour on the other hand. Although people were more likely to purchase energy efficient appliances when they adopted an EV for environmental reasons, environmental self-identity did not mediate this relationship. Our results are in line with Hypothesis 2: when people adopt an EV for non-environmental reasons, this was not consistently related to environmental self-identity and sustainable energy behaviours.

4. General discussion

Adoption of smart energy technologies, such as EVs, is important to achieve a sustainable energy transition. Yet, sustainable energy technologies will not achieve their true potential if adopters do not use them in a sustainable way. Although many studies examined which factors influence the adoption sustainable energy technologies including alternative fuel vehicles (see Wolske & Stern, in press, for a review), little is known about whether and why adoption of such technologies affects the sustainable use of these technologies, and sustainable energy behaviour in general. We proposed and tested a novel reasoning, and argued that the motivation to adopt an EV affects the likelihood of other sustainable energy behaviours, including sustainable use of the EV, because of the implications of this motivation for environmental self-identity. More specifically, we argued that people are more likely to use their EV in a sustainable way and engage in other types of sustainable energy behaviour when they adopted an EV for environmental reasons, as this increases the likelihood that they perceive their choice to adopt an EV as a sustainable choice. More specifically, adopting an EV for environmental reasons is likely to signal that one is a pro-environmental person, thereby strengthening environmental self-identity and promoting consistent sustainable energy behaviour. In contrast, when people adopt an EV for other reasons, such as financial or technological reasons, this behaviour is less likely to signal that one is a pro-environmental person, in which case environmental self-identity will not be strengthened, making consistent sustainable energy behaviour less likely. We conducted two cross-sectional questionnaire studies among individuals who actually had adopted an EV rather than focussing on behaviours induced in a lab setting, thereby increasing the external validity of our studies.

As expected, generally, our studies showed that environmental motivation to adopt an EV increased the likelihood that people engaged in other sustainable energy behaviours including the sustainable use of the EV as well. Moreover, as expected, environmental self-identity mediated the relationship between environmental motivation to adopt an EV on the one hand, and sustainable EV use and other types of sustainable energy behaviour on the other hand (supporting Hypothesis 1). More specifically, the mediation analyses show that the more people adopted an EV for environmental reasons, the stronger their environmental self-identity, which in turn was positively related to sustainable use of the EV (Study 2, but not in Study 1), direct energy saving behaviours (Study 1 and 2), indirect energy saving behaviours (Study 1 and 2) and insulating one's house (Study 2). Although adopting an EV for environmental reasons was directly related to using the EV in a sustainable way (Study 1) and purchasing energy efficient appliances (Study 2), environmental self-identity did not mediate these relationships.

Our studies are first to show that motivation to engage in a sustainable energy behaviour (i.e. EV adoption) affects environmental self-identity and engagement in other types of sustainable energy behaviour. Notably, research has shown that environmental self-identity is strengthened by sustainable behaviour in the past (Van der Werff, Steg, & Keizer, 2014a, 2014b). We extend this research by showing that sustainable behaviour in the past particularly strengthens environmental self-identity and promotes consistent sustainable energy behaviour when people engaged in the initial sustainable behaviour for environmental reasons.

Future research could examine under which conditions environmental motivations are particularly likely to encourage consistent engagement in sustainable energy behaviour by strengthening environmental self-identity. It could be that our reasoning particularly holds when people do not face significant barriers to engage in the behaviour. Notably, when people are not able to engage in the behaviour (e.g. because the behaviour is too costly or not under individual's control), motivational factors and environmental self-identity are likely to be less influential in their choices (Guagnano, Stern, & Dietz, 1995; Steg & Vlek, 2009). In addition, people need to have sufficient knowledge of the environmental impact of their behaviour in order to know how to act in line with their environmental self-identity (Steg et al., 2015).

As expected, in both studies environmental self-identity did not mediate the relationship between financial motivation to adopt an EV and the different types of sustainable energy behaviour (partially supporting Hypothesis 2). Yet, in Study 1, environmental self-identity mediated the relationship between technological motivation to adopt an EV and two types of sustainable energy behaviours: direct and indirect energy saving behaviour. However, these relationships were much weaker than the effect of environmental motivation to adopt an EV on direct and indirect energy saving behaviour via environmental self-identity, and we did not replicate this finding in Study 2. Future research could test the conditions under which non-environmental motivations, in particular adopting and EV for technological reasons, may strengthen environmental self-identity and thereby promote consistent sustainable energy behaviour. Overall, these results support our reasoning that non-environmental motivations to adopt an EV are less likely to strengthen environmental self-identity and to encourage consistent sustainable energy behaviours.

Our results have important implications for theory on positive spillover effects, that is, whether and why engagement in on sustainable energy behaviour is likely to encourage a wide range of sustainable energy behaviours. The processes underlying and the conditions under which engagement in one sustainable energy behaviour can encourage engagement in other sustainable energy behaviours have hardly been studied yet. Our study is the first to show that the motivation for engagement in the initial sustainable energy behaviour can play a key role in promoting positive spillover effects. More specifically, our findings suggest that positive spillover effects are more likely when people engage in a particular sustainable energy behaviour for environmental reasons, as this is more likely to strengthen their environmental self-identity and people are motivated to act in line with their identity in subsequent situations. When people engage in sustainable energy behaviour for other reasons than the environment, environmental self-identity is less likely to be strengthened, making it less likely that people consistently engage in sustainable energy behaviours.

Future research could aim to replicate our findings by studying adoption of other smart energy technologies, such as solar panels, and more generally whether engagement in other types of sustainable energy behaviour (including curtailment behaviour) for environmental reasons would encourage engagement in other sustainable energy behaviours in a similar way. In doing so, studies could also examine whether similar results are found for behaviours that are adopted by representative groups of the population. Our sample mainly comprised male respondents with a relatively high income and education level, which is typical for adopters of electric vehicles (Plötz et al., 2014), and early adopters in general (Rogers, 2010). By studying whether motivation to engage in different types of sustainable energy behaviour can promote positive spillover effects, it is possible to include more representative population samples. In addition, future studies could include measures of actual behaviour rather than self-reported behaviour, for example by observing or tracking behaviour via technology (e.g. apps or smart meter data).

We followed a cross sectional design measuring all variables at one single point in time, therefore one should be careful with drawing causal conclusions. For example, it could be argued that people with a strong environmental self-identity are more likely to adopt an EV for environmental reasons and to engage in other types of sustainable energy behaviour. Yet, results of a few experimental studies are in line with our theoretical reasoning, providing circumstantial support for the causal chain proposed in our model. Notably, studies have shown that environmental self-identity can be strengthened by sustainable behaviour in the past (Van der Werff et al., 2014a, 2014b). More specifically, environmental self-identity is likely to be strengthened when people realise their behaviour is sustainable (Taufik et al., 2015; Venhoeven et al., 2016) and when they attribute engagement in this sustainable behaviour to themselves rather than to external factors (Van der Werff et al., 2014a; Venhoeven et al., 2016). These results are in line with our reasoning that when people engaged in an initial action (i.e., adoption of an EV) for environmental reasons, this will strengthen environmental self-identity, which in turn motivates them to act in line with this identity over and again.

In addition, it is more likely that environmental self-identity is affected by rather than a predictor of the motivation to adopt an EV for environmental reasons because we conceptualized motivation in our studies at a behaviour specific level, that is, the motivation to adopt an EV. According to the compatibility principle, variables predict behaviour best when they are measured at the same level of specifity (Ajzen & Fishbein, 1970). Hence, it is not likely that motivation to adopt an EV (behaviour specific) predicts a wide range of sustainable energy behaviours, In contrast, environmental self-identity is a general antecedent of sustainable energy behaviour, and indeed, studies have shown that environmental self-identity predicts a wide range of sustainable energy behaviours (Van der Werff et al., 2013a, 2013b, 2014a, 2014b; Van der Werff & Steg, 2016). Yet, given the correlational design of our study, we cannot draw firm conclusions on causality. To test the causal relationships between the motivation to adopt an EV, or more generally the motivation for engagement in initial sustainable energy behaviours, environmental self-identity and other sustainable energy behaviours further, future research could manipulate different types of motivation and examine whether this indeed affects environmental self-identity as well as subsequent sustainable energy behaviours. Alternatively, longitudinal studies could measure environmental self-identity and sustainable energy behaviours both pre- and post-engagement in initial sustainable energy behaviour (such as EV adoption), and measure motivation before actual engagement in the behaviour.

The internal consistency of some of our scales was somewhat low, which may have affected our results. More specifically, in Study 1, the reliability of the financial and technological EV adoption motivation scales was up for improvement. We adapted these scales in Study 2, resulting in an improved reliability coefficient for the technological motivation to adopt an EV scale, while the reliability of the financial motivation remained somewhat low. Furthermore, in Study 2, the reliability of the scales measuring sustainable EV use, energy efficient investment behaviour, direct and indirect energy saving behaviour were lower than in Study 1. Yet, it seems that the lower reliability of the scales did not affect our conclusions in important ways. First, in both studies, mediation analyses including the individual items of the scales that showed lower internal consistency revealed very similar results to the analyses including the scales. Second, the results of Study 2 were very similar to the results of Study 1, despite the differences in reliability of the scales used in both studies (i.e., results were very similar irrespective of the fact that the internal consistency of the scales was much higher in one of the studies than in the other). Yet, future research could aim at developing more reliable scales, particularly to measure financial motivation.

Our results show that environmental motivation to adopt an EV is a key factor promoting consistent sustainable energy behaviour. Future research could study whether it is possible to encourage people to engage in a wide range of sustainable energy behaviours, even if they adopted their EV merely for other reasons than the environment. For example, research could investigate whether providing feedback emphasising the environmental rather than financial benefits of a particular behaviour may make people focus on environmental reasons to engage in the relevant actions, thereby strengthening environmental self-identity and promoting other sustainable energy behaviours.

Our results have important practical implications. Policy makers could emphasise environmental rather than financial or technological reasons for the adoption of an EV, as people seem more likely to use their EV in a way that is aligned with energy system reliability and sustainability and to consistently engage in other types of sustainable energy behaviour when people adopted an EV for environmental reasons.

5. Conclusion

To realise a sustainable energy transition, it is important to understand which factors affect the likelihood that the adoption of an EV results in sustainable use of EV as well as engagement in a wide range of sustainable energy behaviours. Our research suggests that the motivation to adopt an EV plays a crucial role in this respect. Adopting EV for environmental reasons is likely to signal that one is a pro-environmental person, thereby strengthening environmental self-identity and promoting a wide range of sustainable energy behaviour, including the sustainable use of the EV. Yet, when people adopt an EV for other reasons than the environment, EV adoption is less likely to signal that one is a pro-environmental person, thereby making it less likely that environmental self-identity will be strengthened and that people consistently engage in sustainable energy behaviour.

Acknowledgements

The studies have been conducted within the project "Realizing the smart grid: aligning consumer behaviour with technological opportunities (SMARTER, grant number: 408-13-009)". The project is part of the research program "Uncertainty Reduction in Smart Energy Systems" (URSES), funded by NWO and Shell. There are no known conflicts of interest associated with this publication and there has been no financial support for this work that could have influenced its outcome.

We want to thank Jikke Jelles, Ive de Jong, Bahar Özen and Tom Downer (University of Groningen, The Netherlands) for their help in the data collection for Study 1.

We want to thank Auke Hoekstra (Eindhoven University of Technology & ElaadNL, The Netherlands) for collaborating in data collection for Study 2.

We want to thank Tom van Onna (Alliander, The Netherlands), Arjen Jongepier (Enduris, The Netherlands), Arnoud Rijneveld (Stedin, The Netherlands) and John Hodemaekers (Stedin, The Netherlands) for their feedback on the design of the studies.

References

Ajzen, I., & Fishbein, M. (1970). The prediction of behavior from attitudinal and normative variables. *Journal of Experimental Social Psychology,* 6(4), 466-487. doi: 10.1016 /0022-1031(70)90057-0.

Borenstein, S. (2012). The private and public economics of renewable electricity generation. *The Journal of Economic Perspectives*, *26*(1), 67-92. doi: 10.1257 /jep.26.1.67.

Bradley, T. H., & Frank, A. A. (2009). Design, demonstrations and sustainability impact assessments for plug-in hybrid electric vehicles. *Renewable and Sustainable Energy Reviews*, *13*(1), 115-128. doi: 10.1016/j.rser.2007.05.003.

Cavoukian, A., Polonetsky, J., & Wolf, C. (2010). Smartprivacy for the smart grid: embedding privacy into the design of electricity conservation. *Identity in the Information Society*, *3*(2), 275-294. doi:10.1007/s12394-010-0046-y.

Eising, J.W, van Onna, T, Alkemade, F. (2014). Towards smart grids: identifying the risks that arise from the integration of energy and transport supply chains. *Applied Energy, 123*, 448–55. doi:10.1016/j.apenergy.2013.12.017.

Eisinga, R., Te Grotenhuis, M., Pelzer, B. (2013). The reliability of a two-item scale: Pearson, Cronbach or Spearman-Brown? *International Journal of Public Health*, *58*(4), 637–642. doi: 10.1007/s00038-012-0416-3.

Elaad (2013, May 16). Opladen elektrische autos zorgt voor piekbelastingen. Retrieved from https://www.elaad.nl/nieuws/opladen-elektrische-autos-zorgt-voor-piekbelastingen-2/

European Automobile Manufacturers Association. (2017, February 2). *Alternative fuel vehicle registrations.* Retrieved from http://www.acea.be/press- releases/article /alternative-fuel-vehicle-registrations-37.6-in-first-quarter-of-2017.

Eurostat. (2017). Primary production of renewable energy by type. Retrieved from http://ec.europa.eu/eurostat/web/products-datasets/-/ten00081.

Evans, L., Maio, G. R., Corner, A., Hodgetts, C.J., Ahmed, S., & Hahn, U. (2012). Self-interest and pro-environmental behaviour. *Nature Climate Change*, *3*, 122-125. doi: 10.1038/NCLIMATE1662.

Guagnano, G. A., Stern, P. C., & Dietz, T. (1995). Influences on attitude-behavior relationships a natural experiment with curbside recycling. *Environment and behavior*, *27*(5), 699-718. doi:10.1177/0013916595275005.

Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York: The Guilford Press.

Hayes, A.F. (2016). PROCESS (Version 2.16) [add-on for SPSS and SAS]. Available from http://processmacro.org/

Lanzini, P., & Thøgersen, J. (2014). Behavioural spillover in the environmental domain: An intervention study. *Journal of Environmental Psychology*, *40*, 381- 390. doi: 10.1016 / j.jenvp.2014.09.006.

Lauren, N., Fielding, K.S., Smith, L. & Louis, W.R. (2016). You did, so you can and you will: self-efficacy as a mediator of spillover from easy to more difficult pro-environmental behaviour. *Journal of Environmental Psychology*, *48*, 191-199. doi: 10.1016/j.jenvp.2016.10.004.

Nicolson, M., Huebner, G. M., Shipworth, D., & Elam, S. (2017). Tailored emails prompt electric vehicle owners to engage with tariff switching information. *Nature Energy*, *2*. doi: 10.1038/nenergy.2017.73.

Nilsson, A., Bergquist, M., & Schultz, W. P. (2017). Spillover effects in environmental behaviors, across time and context: a review and research agenda. *Environmental Education Research*, *23*(4), 573-589. doi: 10.1080/13504622.2016.1250148.

Noppers, E. H., Keizer, K., Bockarjova, M., & Steg, L. (2015). The adoption of sustainable innovations: The role of instrumental, environmental, and symbolic attributes for earlier and later adopters. *Journal of Environmental Psychology*, *44*, 74-84. doi: 10.1016/j.jenvp.2015.09.002.

Noppers, E. H., Keizer, K., Bolderdijk, J. W., & Steg, L. (2014). The adoption of sustainable innovations: Driven by symbolic and environmental motives. *Global Environmental Change*, *25*, 52-62. doi: 10.1016/j.gloenvcha.2014.01.012.

Noppers, E. H., Keizer, K., Milovanovic, M., & Steg, L. (2016). The importance of instrumental, symbolic, and environmental attributes for the adoption of smart energy systems. *Energy Policy*, *98*, 12-18.doi: 10.1016/j.enpol.2016.08.007.

Plötz, P., Schneider, U., Globisch, J., & Dütschke, E. (2014). Who will buy electric vehicles? Identifying early adopters in Germany. *Transportation Research Part A: Policy and Practice*, *67*, 96-109. doi: 10.1016/j.tra.2014.06.006.

Poortinga, W., Whitmarsh, L., Suffolk, C. (2013). The introduction of a single-use carrier bag charge in Wales: attitude change and behavioural spillover effects. *Journal of Environmental Psychology*, *36*, 240 - 247. doi: 10.1016/j.jenvp.2013.09.001.

Preacher, K. J., & Hayes, A. F. (2008). Assessing mediation in communication research. *The Sage sourcebook of advanced data analysis methods for communication research*, 13-54.

Rogers, E. M. (2010). Diffusion of Innovations (5th ed.). New York: Simon and Schuster.

Ryghaug, M., & Toftaker, M. (2014). A transformative practice? Meaning, competence, and material aspects of driving electric cars in Norway. *Nature and Culture*, *9*(2), 146-163. doi: 10.3167/nc.2014.090203.

Shrout, P. E., & Bolger, N. (2002). Mediation in experimental and nonexperimental studies: New procedures and recommendations. *Psychological methods*, *7*(4), 422-445. doi: 10.1037//1082-989X.7.4.422.

Steg, L., Perlaviciute, G., & van der Werff, E. (2015). Understanding the human dimensions of a sustainable energy transition. *Frontiers in psychology*, *6*, 805. doi: 10.3389/fpsyg .2015.00805.

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, *29*(3), 309-317. doi: 10.1016/j.jenvp.2008.10.004.

Steinhorst, J., Klöckner, C. A., & Matthies, E. (2015). Saving electricity–For the money or the environment? Risks of limiting pro-environmental spillover when using monetary framing. *Journal of Environmental Psychology*, *43*, 125-135. doi: 10.1016/j.jenvp .2015.05.012.

Taufik, D., Bolderdijk, J.W. & Steg, L. (2015). Acting green elicits a literal warm glow. *Nature Climate Change, 5,* 37 – 40. doi: 10.1038/nclimate2449.

Tiefenbeck, V., Staake, T., Roth, K., & Sachs, O. (2013). For better or for worse? Empirical evidence of moral licensing in a behavioural energy conservation campaign. *Energy Policy, 57,* 160 – 171. doi: 10.1016/j.enpol.2013.01.021.

Thøgersen, J. (2004). A cognitive dissonance interpretation of consistencies and inconsistencies in environmentally responsible behaviour. *Journal of Environmental Psychology, 24*, 93 – 103. doi: 10.1016/S0272-4944(03)00039-2.

Thøgersen, J. & Ölander, F. (2003). Spillover of environment-friendly consumer behaviour. *Journal of Environmental Psychology, 23*, 225-236. doi: 10.1016/S0272-4944 (03)00018-5.

Thomas, G. O., Poortinga, W., & Sautkina, E. (2016). The Welsh Single-Use Carrier Bag Charge and behavioural spillover. *Journal of Environmental Psychology, 47*, 126-135. doi: 10.1016/j.jenvp.2016.05.008.

Truelove, H.B., Carrico, A.R., Weber, E.U., Raimi, K.T., & Vandenbergh, M.P. (2014).

Positive and negative spillover of pro-environmental behaviour: An integrative review and theoretical framework. *Global Environmental Change,* 29, 127-138. doi: 10.1016/j.gloenvcha.2014.09.004.

Van der Werff, E., & Steg, L. (2016). The psychology of participation and interest in smart energy systems: Comparing the value-belief-norm theory and the value-identity-personal norm model. *Energy Research & Social Science, 22*, 107-114. doi: 10.1016/j.erss.2016.08.022.

Van der Werff, E., Steg, L., & Keizer, K. (2013a). It is a moral issue: The relationship between environmental self-identity, obligation-based intrinsic motivation and pro-environmental behaviour. *Global Environmental Change, 23*(5), 1258-1265. doi: 10.1016/j. gloenvcha.2013.07.018.

Van der Werff, E., Steg, L. & Keizer, K. (2013b). The value of environmental self-identity: The relationship between biospheric values, environmental self-identity and pro-environmental preferences, intentions and behaviour. *Journal of Environmental Psychology, 34*, 55-63. doi: 10.1016/j.jenvp.2012.12.006.

Van der Werff, E. Steg, L., & Keizer, K. (2014a). Follow the signal: when past pro-environmental actions signal who you are. *Journal of Environmental Psychology, 40,* 273-282. doi: 10.1016/j.jenvp.2014.07.004.

Van der Werff, E., Steg, L., & Keizer, K. (2014b). I am what I am by looking past the present: The influence of biospheric values and past behaviour on environmental self-identity. *Environment and Behavior, 46*(5), 626-657. doi: 10.1177/0013916512475209.

Venhoeven, L.A., Bolderdijk, J.W., & Steg, L. (2016). Why acting environmentally-friendly feels good: exploring the role of self-image. *Frontiers in Environmental Psychology, 7,* 1846. doi: 10.3389/fpsyg.2016.01846.

Whitmarsh, L., & O'Neill, S. (2010). Green identity, green living? The role of pro-environmental self-identity in determining consistency across diverse pro-environmental behaviours. *Journal of Environmental Psychology*, *30*(3), 305-314. doi: 10.1016/j.jenvp.2010.01.003.

Wolske, K.S. & Stern, P.C. (in press). Contributions of psychology to limiting climate change: Opportunities through consumer behavior. In S. Clayton & C. Manning (Eds.), *Psychology and Climate Change*. Elsevier.

Appendix A

Table A1

General Model Path Estimates Study 1

Model Path Estimates	Coefficient	SE	LL 95% CI	UL 95% CI
$X_1 \rightarrow M$	.69	.09	.51	.88
$X_2 \rightarrow M$	.03	.09	-.15	.21
$X_3 \rightarrow M$	.24	.09	.06	.42

Note. X_1 = environmental motivation to adopt EV, X_2 = financial motivation to adopt EV, X_3 = technological motivation to adopt EV, M = environmental self-identity.

Table A2

Direct effects of X on sustainable charging behaviour Study 1

Model Path Estimates	Coefficient	SE	LL 95% CI	UL 95% CI
$X_1 \rightarrow Y$	.66	.20	.25	1.07
$X_2 \rightarrow Y$	-.13	.15	-.42	.17
$X_3 \rightarrow Y$	-.17	.16	-.48	.14
$M \rightarrow Y$	.24	.20	-.15	.63

Note. X_1 = environmental motivation to adopt EV, X_2 = financial motivation to adopt EV, X_3 = technological motivation to adopt EV, M = environmental self-identity, Y = sustainable charging behaviour.

Total effects of X on sustainable charging behaviour Study 1

Total effect	Coefficient	SE	LL 95% CI	UL 95% CI
X_1 on Y	.83	.15	.52	1.13
X_2 on Y	-.12	.15	-.42	.17
X_3 on Y	-.12	.15	-.41	.18

Indirect effects of X on sustainable charging behaviour Study 1

Indirect effect	Effect	Boot SE	LL 95% CI	UL 95% CI
$X_1 \rightarrow M \rightarrow Y$	.17	.18	-.07	.65
$X_2 \rightarrow M \rightarrow Y$	.01	.04	-.04	.11
$X_3 \rightarrow M \rightarrow Y$	.06	.06	-.02	.23

Table A3

Direct effects of X on direct energy saving behaviour Study 1

Model Path Estimates	Coefficient	SE	LL 95% CI	UL 95% CI
$X_1 \rightarrow Y$	.15	.14	-.13	.43
$X_2 \rightarrow Y$	-.12	.10	-.32	.08
$X_3 \rightarrow Y$	-.04	.11	-.25	.17
$M \rightarrow Y$	.36	.13	.10	.63

Note. X_1 = environmental motivation to adopt EV, X_2 = financial motivation to adopt EV, X_3 = technological motivation to adopt EV, M = environmental self-identity, Y = direct energy saving behaviour.

Total effects of X on direct energy saving behaviour Study 1

Total effect	Effect	SE	LL 95% CI	UL 95% CI
X_1 on Y	.40	.11	.19	.62
X_2 on Y	-.11	.11	-.32	.10
X_3 on Y	.05	.11	-.17	.26

Indirect effects of X on direct energy saving behaviour Study 1

Indirect effect	Effect	Boot SE	LL 95% CI	UL 95% CI
$X_1 \rightarrow M \rightarrow Y$	.25	.10	.08	.50
$X_2 \rightarrow M \rightarrow Y$	.01	.04	-.04	.13
$X_3 \rightarrow M \rightarrow Y$	.09	.06	.01	.25

Table A4

Direct effects of X on indirect energy saving behaviour Study 1

Model Path Estimates	Coefficient	SE	LL 95% CI	UL 95% CI
$X_1 \rightarrow Y$	.33	.13	.07	.59
$X_2 \rightarrow Y$	-.02	.09	-.21	.16
$X_3 \rightarrow Y$	.12	.10	-.08	.31
$M \rightarrow Y$	.38	.12	.13	.63

Note. X_1 = environmental motivation to adopt EV, X_2 = financial motivation to adopt EV, X_3 = technological motivation to adopt EV, M = environmental self-identity, Y = indirect energy saving behaviour.

Total effects of X on indirect energy saving behaviour Study 1

Total effect	Coefficient	SE	LL 95% CI	UL 95% CI
X_1 on Y	.60	.10	.39	.80
X_2 on Y	-.01	.10	-.21	.18
X_3 on Y	.21	.10	.01	.41

Indirect effects of X on indirect energy saving behaviour Study 1

Indirect effect	Effect	Boot SE	LL 95% CI	UL 95% CI
$X_1 \rightarrow M \rightarrow Y$	.26	.11	.09	.54
$X_2 \rightarrow M \rightarrow Y$	.01	.04	-.05	.10
$X_3 \rightarrow M \rightarrow Y$	.09	.05	.02	.20

Table A5

Direct effects of X on energy efficient investment behaviour Study 1

Model Path Estimates	Coefficient	SE	LL 95% CI	UL 95% CI
$X_1 \rightarrow Y$	-.04	.11	-.26	.18
$X_2 \rightarrow Y$	.01	.08	-.15	.17
$X_3 \rightarrow Y$	.00	.08	-.16	.17
$M \rightarrow Y$	.07	.10	-.14	.28

Note. X_1 = environmental motivation to adopt EV, X_2 = financial motivation to adopt EV, X_3 = technological motivation to adopt EV, M = environmental self-identity, Y = indirect energy saving behaviour.

Total effects of X on energy efficient investment behaviour Study 1

Total effect	Coefficient	SE	LL 95% CI	UL 95% CI
X_1 on Y	.01	.08	-.15	.17
X_2 on Y	.01	.08	-.14	.17
X_3 on Y	.02	.08	-.14	.18

Indirect effects of X on energy efficient investment behaviour Study 1

Indirect effect	Effect	Boot SE	LL 95% CI	UL 95% CI
$X_1 \rightarrow M \rightarrow Y$	.05	.06	-.05	.19
$X_2 \rightarrow M \rightarrow Y$	.00	.01	-.01	.03
$X_3 \rightarrow M \rightarrow Y$	.02	.02	-.01	.08

Appendix B

Table B1
General Model Path Estimates Study 2

Model Path Estimates	Coefficient	SE	LL 95% CI	UL 95% CI
$X_1 \rightarrow M$	.62	.04	.53	.71
$X_2 \rightarrow M$	-.05	.04	-.13	.04
$X_3 \rightarrow M$	.08	.04	.00	.16

Note. X_1 = environmental motivation to adopt EV, X_2 = financial motivation to adopt EV, X_3 = technological motivation to adopt EV, M = environmental self-identity

Table B2
Direct effects of X on sustainable EV use Study 2

Model Path Estimates	Coefficient	SE	LL 95% CI	UL 95% CI
$X_1 \rightarrow Y$	.16	.11	-.05	.37
$X_2 \rightarrow Y$	-.08	.08	-.24	.07
$X_3 \rightarrow Y$	.04	.08	-.11	.19
$M \rightarrow Y$	.35	.11	.13	.58

Note. X_1 = environmental motivation to adopt EV, X_2 = financial motivation to adopt EV, X_3 = technological motivation to adopt EV, M = environmental self-identity, Y = sustainable EV use.

Total effects of X on sustainable EV use Study 2

Total effect	Coefficient	SE	LL 95% CI	UL 95% CI
X_1 on Y	.38	.08	.22	.54
X_2 on Y	-.10	.08	-.26	.05
X_3 on Y	.07	.08	-.09	.22

Indirect effects of X on sustainable EV use Study 2

Indirect effect	Effect	Boot SE	LL 95% CI	UL 95% CI
$X_1 \rightarrow M \rightarrow Y$	.22	.07	.08	.38
$X_2 \rightarrow M \rightarrow Y$	-.02	.02	-.06	.01
$X_3 \rightarrow M \rightarrow Y$	.03	.02	.00	.09

Table B3

Direct effects of X on direct energy saving behaviour Study 2

Model Path Estimates	Coefficient	SE	LL 95% CI	UL 95% CI
$X_1 \rightarrow Y$	.13	.07	-.01	.28
$X_2 \rightarrow Y$	.10	.05	.00	.21
$X_3 \rightarrow Y$	-.04	.05	-.14	.06
$M \rightarrow Y$	.34	.08	.19	.50

Note. X_1 = environmental motivation to adopt EV, X_2 = financial motivation to adopt EV, X_3 = technological motivation to adopt EV, M = environmental self-identity, Y = direct energy saving behaviour.

Total effects of X on direct energy saving behaviour Study 2

Total effect	Coefficient	SE	LL 95% CI	UL 95% CI
X_1 on Y	.35	.06	.24	.46
X_2 on Y	.09	.05	-.02	.19
X_3 on Y	-.01	.05	-.12	.09

Indirect effects of X on direct energy saving behaviour Study 2

Indirect effect	Effect	Boot SE	LL 95% CI	UL 95% CI
$X_1 \rightarrow M \rightarrow Y$	.21	.06	.11	.33
$X_2 \rightarrow M \rightarrow Y$	-.02	.02	-.06	.01
$X_3 \rightarrow M \rightarrow Y$	.03	.02	-.01	.07

Table B4

Direct effects of X on indirect energy saving behaviour Study 2

Model Path Estimates	Coefficient	SE	LL 95% CI	UL 95% CI
$X_1 \rightarrow Y$	.35	.07	.22	.48
$X_2 \rightarrow Y$	-.04	.05	-.14	.06
$X_3 \rightarrow Y$	-.06	.05	-.16	.04
$M \rightarrow Y$	.31	.07	.17	.46

Note. X_1 = environmental motivation to adopt EV, X_2 = financial motivation to adopt EV, X_3 = technological motivation to adopt EV, M = environmental self-identity, Y = indirect energy saving behaviour

Total effects of X on indirect energy saving behaviour Study 2

Total effect	Coefficient	SE	LL 95% CI	UL 95% CI
X_1 on Y	.54	.05	.44	.65
X_2 on Y	-.05	.05	-.15	.05
X_3 on Y	-.03	.05	-.14	.07

Indirect effects of X on indirect energy saving behaviour Study 2

Indirect effect	Effect	Boot SE	LL 95% CI	UL 95% CI
$X_1 \rightarrow M \rightarrow Y$	.19	.05	.10	.31
$X_2 \rightarrow M \rightarrow Y$	-.02	.02	-.05	.01
$X_3 \rightarrow M \rightarrow Y$	.03	.02	.00	.07

Table B5

Direct effects of X on insulating one's house Study 2

Model Path Estimates	Coefficient	SE	LL 95% CI	UL 95% CI
$X_1 \rightarrow Y$	-.16	.09	-.35	.02
$X_2 \rightarrow Y$	.15	.07	.01	.29
$X_3 \rightarrow Y$	.15	.07	.01	.28
$M \rightarrow Y$	.29	.10	.09	.49

Note. X_1 = environmental motivation to adopt EV, X_2 = financial motivation to adopt EV, X_3 = technological motivation to adopt EV, M = environmental self-identity, Y = insulating one's house

Total effects of X on insulating one's house Study 2

Total effect	Coefficient	SE	LL 95% CI	UL 95% CI
X_1 on Y	.02	.07	-.13	.16
X_2 on Y	.14	.07	.00	.27
X_3 on Y	.17	.07	.04	.31

Indirect effects of X on insulating one's house Study 2

Indirect effect	Effect	Boot SE	LL 95% CI	UL 95% CI
X_1 → M → Y	.18	.07	.05	.33
X_2 → M → Y	-.01	.02	-.06	.01
X_3 → M → Y	.02	.02	.00	.08

Table B6

Direct effects of X on buying energy efficient appliances Study 2

Model Path Estimates	Coefficient	SE	LL 95% CI	UL 95% CI
X_1 → Y	.31	.09	.14	.48
X_2 → Y	.09	.06	-.04	.21
X_3 → Y	-.02	.06	-.14	.11
M → Y	.18	.09	.00	.36

Note. X_1 = environmental motivation to adopt EV, X_2 = financial motivation to adopt EV, X_3 = technological motivation to adopt EV, M = environmental self-identity, Y = buying energy efficient appliances

Total effects of X on buying energy efficient appliances Study 2

Total effect	Coefficient	SE	LL 95% CI	UL 95% CI
X_1 on Y	.42	.06	.29	.55
X_2 on Y	.08	.06	-.05	.20
X_3 on Y	.00	.06	-.12	.12

Indirect effects of X on buying energy efficient appliances Study 2

Indirect effect	Effect	Boot SE	LL 95% CI	UL 95% CI
X_1 → M → Y	.11	.07	-.01	.25
X_2 → M → Y	-.01	.01	-.04	.01
X_3 → M → Y	.01	.01	.00	.05