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17 Understanding Residential Sustainable Energy Behaviour and Policy Preferences

Goda Perlaviciute, Linda Steg and Ellen van der Werff

17.1 Introduction

Energy production and use account for two-thirds of the world's greenhouse gas emissions (IEA, 2015), thereby contributing to global climate change (IPCC, 2014). Besides environmental problems, energy production and use pose societal challenges, including energy poverty and geopolitics of energy that threaten global security and prosperity. The Paris Agreement marks a historic event when countries worldwide committed to combat climate change. To achieve these ambitious targets, countries will have to shift towards more sustainable ways of producing and using energy (EC, 2016a).

The residential sector accounts for about 20 to 25 per cent of the total energy consumption in European Union (EU) countries (Eurostat, 2014a) and Organisation for Economic Cooperation and Development (OECD) countries (IEA, 2015). If households used cleaner energy and engaged in more sustainable energy behaviours, this could significantly contribute to combating climate change (Nature Energy, 2016; Stern et al., 2016a). But which factors influence whether individuals and households act sustainably and whether they accept sustainable solutions, such as renewable energy projects? Social sciences have an important role to play in answering these questions (Clayton et al., 2015; Hackmann, Moser and Clair, 2014; Sovacool, 2014; Stern, Sovacool and Dietz, 2016b; Weaver et al., 2014). In this chapter, we take the Integrated Framework for Encouraging Pro-Environmental Behaviour (IFEP; Steg et al., 2014a) as a starting point for understanding and encouraging sustainable energy behaviour and acceptability of sustainable energy projects. More specifically, we argue that people's values influence the likelihood that people will engage in many different sustainable energy behaviours as well as influencing public acceptability of sustainable energy projects. In addition, the IFEP proposes that contextual factors affect the likelihood that people consider environmental consequences of their choices. We review cutting edge psychological literature on factors influencing sustainable energy behaviour and the acceptability of sustainable energy projects from the view of this framework.¹ Notably, sustainable energy projects often introduce new technology and/or require behavioural change, so similar factors are likely to influence sustainable energy behaviours and acceptability of sustainable energy projects. Next, we discuss

intervention strategies aimed at promoting sustainable energy behaviour and acceptability of sustainable energy projects. The interventions can change the context to enable and empower people to act sustainably, they can provide information and arguments to help people and motivate them to make sustainable choices and they can motivate people to act consistently. Finally, we discuss how factors related to the implementation of energy projects – in particular, fairness of procedures and people's trust in involved parties – influence public acceptability of these projects. We start with outlining the large variety of sustainable energy behaviours that people need to engage in to realise a truly sustainable energy transition.

17.2 Sustainable energy behaviour

Sustainable energy systems will rely more on low-carbon energy sources, particularly on renewable energy sources such as solar and wind power and hydroenergy, and less on fossil fuels, such as coal, oil and natural gas. The EU aims to raise the share of renewable energy sources to at least 27 per cent by 2030 (EC, 2016b). Currently, households in EU rely to a large extent on fossil fuels, especially natural gas, for their daily energy needs (Eurostat, 2014b). The adoption and use of renewable energy sources and technologies, including public acceptability of renewable energy projects (e.g., wind farms, hydropower plants), are important preconditions for realising a sustainable energy transition.

Shifting to renewable energy sources implies changes in energy systems. For example, energy production will be decentralised and energy supply may be intermittent because availability of wind and solar energy depends on weather conditions. To increase efficiency of renewable energy systems, people need to change their behaviour to reduce their overall energy demand and to match energy demand to availability of energy produced from renewable sources. Energy demand can be reduced by means of energy-efficient technology and energy retrofits in homes, for example replacing heating, ventilation and air conditioning appliances with energy-efficient models, insulating homes and installing water-saving appliances. In parallel, people can adjust their daily behaviours, for example reducing showering times, lowering the heating, turning off lights and appliances not in use and refraining from certain behaviours such as taking a bath. Besides direct energy use, also indirect energy use could be reduced in order to promote a sustainable energy transition. Indirect or 'embodied' energy use refers to the energy required for the production, transportation and disposal of goods and services used by households (Kok, Benders and Moll, 2006; Reinders, Vringer and Blok, 2003). To adjust energy demand to availability of energy supply, households can shift energy use in time, either by themselves or by installing technologies that automatically switch off or on specific appliances in peak or off-peak times (Van der Werff,

Perlaviciute and Steg, 2016). In addition, people could adopt storage technologies such as batteries and electric cars to store surpluses of renewable energy and secure energy supply when renewable energy production is low (Dunn, Kamath and Tarascon, 2011).

In sum, to realise a sustainable energy transition, people could engage in many different behaviours, including (1) adopting and using low-carbon energy sources and technologies, (2) investing in energy efficiency retrofits for buildings, (3) adopting and using energy efficient appliances and (4) changing energy use behaviour as to reduce overall energy use and match energy demand to the available supply from renewables (Steg et al., 2015; Stern et al., 2016a; Van der Werff et al., 2016).² An important question is how different energy behaviours are related and to what extent engagement in one sustainable energy behaviour reduces or increases the likelihood of engaging in a subsequent sustainable energy behaviour, phenomena known as negative or positive spillover, respectively. Some studies have found evidence for negative spillover effects. For example, people were more likely to increase their energy consumption after reducing their water use (Tiefenbeck et al., 2013), and people who reduced their electricity consumption as a result of time-off-use tariffs were less likely to adopt energy efficiency measures at home (McCoy and Lyons, 2016). Such effects have been attributed by some to people's feeling that engagement in one sustainable behaviour legitimates not acting sustainably in another occasion (Kaklamanou et al., 2015). Yet, other studies have found positive spillover effects. For example, individuals who recycled were more likely to buy organic food and use environmentally friendly modes of transport one and two years later (Thøgersen and Ölander 2003). Also, green buying promoted subsequent recycling, the use of public transport, carpooling, printing on both sides, saving water, and switching off lights (Lanzini and Thøgersen 2014). Research suggests that positive spillover effects are more likely when people see themselves as environmentally friendly persons, that is, when their environmental self-identity is strong (Van der Werff, Steg and Keizer, 2013, 2014a, b). Specifically, when people see themselves as energy saving and proenvironmental persons, they are motivated to engage in sustainable behaviours in subsequent situations as they want to be or appear consistent.

Which factors influence the extent to which people are willing to engage in many different sustainable energy behaviours and accept sustainable energy projects? Studies suggest that the (perceived) risks, costs and benefits of sustainable energy behaviours and energy projects influence people's actions and acceptability judgements; we review the relevant findings later in this chapter. Importantly, a truly sustainable energy transition requires changes in a wide range of energy behaviours and acceptability of different energy projects. This requires insights into general factors that can explain many different behaviours and acceptability judgements. Based on the IFEP, we argue that people's values and contextual factors play an important role in this respect, as we will explain in this chapter.

17.3 Perceived Risks, Cost and Benefits

People are more likely to engage in energy behaviours and accept energy projects that are seen as having more benefits, less costs and fewer risks. People consider individual as well as collective risks, costs and benefits in their decisions. Additionally, the distribution of these risks, costs and benefits affect people's behaviours and acceptability judgements.

17.3.1 Individual Risks, Costs and Benefits

Individual risks, costs and benefits reflect consequences that affect people's self-interest, for example financial costs, time, pleasure and comfort. People are more likely to engage in sustainable energy behaviours which they believe, have relatively low individual costs and high individual benefits, resulting in overall positive evaluations of the relevant actions. For example, people are more likely to invest in energy-efficiency measures, such as insulation, when they expect financial benefits (rather than costs) and an increase (rather than a decrease) in their daily comfort from such investments (Kastner and Stern, 2015). People may expect renewable energy technology to be costly, which could hinder adoption of such technology. Similarly, expected personal costs such as higher energy bills may hinder the acceptability of renewable energy projects (Leijten et al. 2014; Perlaviciute and Steg, 2014). Similarly, the more concerned people were about energy affordability, the less acceptable they found demand-side management measures in renewable energy systems, such as technology that automatically turns appliances off and on (Spence et al., 2015). Yet, people do not always engage in energy behaviours with the lowest financial costs and the highest financial gains. Indeed, people may not invest in energy-efficiency measures even if this would cut down energy costs in the long run (Darby, 2010; Frederiks, Stenner and Hobman, 2015). People take various other types of costs, risks and benefits into account, and, as we will explain later in this chapter, individual and contextual factors influence which consequences are considered and how people weigh these different costs, risks and benefits.

People are less likely to engage in sustainable energy behaviours and to accept sustainable energy projects if they see such actions as a hassle and as a burden on their daily comfort. This may explain why people sometimes prefer adopting energy-efficient technologies over changing their behaviours to save energy (Poortinga et al., 2003; Steg, Dreijerink and Abrahamse, 2006): the former may be seen as less effortful and demanding than the latter. Furthermore, privacy concerns may inhibit adoption and/or acceptability of sustainability measures, such as energy use monitoring technology at people's homes (Hess, 2014; Krishnamurti et al., 2012). Yet, a study found that privacy concerns were most prominent when people anticipated negative individual consequences (e.g., higher financial costs) from implementing the monitoring technology,

while privacy concerns were less strong when people expected to benefit from adopting the technology (Bolderdijk, Steg and Postmes, 2013a).

Besides, people also take into account social costs and benefits. People are more likely to engage in sustainable energy behaviours when they expect that others would approve of them (Harland, Staats and Wilke, 1999; Schultz et al., 2007) and when they think that others engage in these behaviours too (Nolan, Schultz, Cialdini, Goldstein and Griskevicius, 2008). Yet, this is not always the case (Abrahamse and Steg, 2011; Midden and Ritsema, 1983) and may depend on other factors, for example whether people learn about the behaviour from others in face-to-face interactions or anonymously and the extent to which others actually act sustainably (Abrahamse and Steg, 2013). People may also engage in sustainable energy behaviour when they expect that doing so enhances their status, particularly when the behaviour is somewhat costly, as in this case the behaviour signals to others that people have sufficient resources to make altruistic sacrifices (Griskevicius, Tybur and Van den Bergh, 2010). Indeed, people were more likely to accept sustainable energy innovations, such as electric cars and (smart) renewable energy systems, when they evaluated the symbolic aspects of these innovations favourably, that is, when they believed these innovations signal something positive about the owner or user to others and themselves (Noppers et al., 2014, 2015, 2016). Positive symbolic outcomes may thus encourage people to adopt sustainable innovations, even though such innovations may still have some instrumental drawbacks, which is often the case in the early introduction phases. In fact, evaluations of the symbolic aspects of sustainable energy innovations more strongly predicted interest in such innovations when people thought the innovations have some instrumental drawbacks, probably because these drawbacks enhance the signalling function of the relevant behaviour (Noppers et al., 2014, 2015). When engaging in sustainable energy behaviour is somewhat costly or effortful, it is more likely to signal that people care about others and the environment than when it is very easy, convenient or profitable (Van der Werff et al., 2014a).

17.3.2 Collective Risks, Costs and Benefits

Besides individual consequences, people consider collective consequences of their choices, including consequences for others and the environment. Many people care about the environment, and take environmental considerations into account when they make decisions (Steg and De Groot, 2012). People are motivated to see themselves as morally right, which may encourage sustainable energy behaviours, as this indicates that one is doing the right thing (Bolderdijk et al., 2013b). Several studies revealed that moral, and more specifically environmental, considerations affect sustainable energy behaviour, such as using energy-saving light bulbs and reducing meat consumption (Harland et al., 1999), electricity saving at work (Zhang, Wang and Zhou, 2013), energy-saving behaviours at home (Van der Werff and Steg, 2015) and participation in

smart energy systems (Van der Werff and Steg, 2015), sustainable energy behaviours at work (Ruepert et al., 2016), investments in energy-efficiency measures (Kastner and Stern, 2015), as well as acceptability of energy projects, such as (further) development of nuclear energy (De Groot and Steg, 2010; Steg and De Groot, 2010) and pricing policies to foster sustainable energy use (Steg, Dreijerink and Abrahamse, 2005). Acceptability of energy policies is higher when people are more aware of energy problems and feel morally obliged to reduce these problems (Steg et al., 2005). Interestingly, engaging in sustainable energy behaviour may make people feel good because they derive pleasure and satisfaction from doing the right thing and doing something meaningful (Bolderdijk et al., 2013b; Venhoeven, Bolderdijk and Steg, 2013; Taufik, Bolderdijk and Steg, 2015). Engaging in sustainable energy behaviour may promote eudaimonic well-being, which is derived from leading a good life and pursuing the right goals (Venhoeven et al., 2013). People may even physically feel warmer by engaging in sustainable energy behaviour; this phenomenon is known as a warm-glow effect (Taufik et al., 2015).

17.3.3 Distribution of Risks, Costs and Benefits

Energy projects aimed at fostering a sustainable energy transition can be seen as unfair (and hence less acceptable) if they are perceived as benefiting some groups in society while burdening other groups (Schuitema and Jakobsson Bergstad, 2012; Sovacool et al., 2016). For example, communities hosting renewable energy projects such as wind farms may experience noise and spoiled views, while the possible benefits, such as reduced CO₂ emissions, affordable energy and energy independence are shared on a national or even global scale. As a consequence, people may be reluctant to accept such projects (Huijts, Molin and Steg, 2012; Perlaviciute and Steg, 2014). When judging the perceived fairness and acceptability of sustainability policies, people also take into account the consequences for nature and the environment and future generations (Schuitema, Steg and Van Kruining, 2011).

17.4 Values

Given that various perceived risks, costs and benefits affect sustainable energy behaviour and acceptability of sustainable energy projects, the next question is which factors determine how people evaluate and weigh different risks, costs and benefits. We propose that values are an important factor in this respect. Values reflect general life goals or ideals that define what is important to people and what consequences they strive for in their lives in general (Rokeach, 1973; Schwartz, 1992). Values are general motivational factors that affect a wide range of evaluations, beliefs and actions (Dietz, 2016; Steg et al., 2014b). Four types of values are particularly important to understand people's

evaluations and behaviour in the sustainability domain: hedonic values, which make people focus on pleasure and comfort; egoistic values, which make people focus on safeguarding and increasing their personal resources (e.g., money, status); altruistic values, which make people focus on the well-being of other people and society; and biospheric values, which make people focus on consequences for nature and the environment (De Groot Steg, 2008; Steg and De Groot, 2012; Steg et al., 2014b).

People tend to particularly consider consequences that have significant implications for their important values (Dietz, 2016; Perlaviciute and Steg, 2015; Steg et al., 2014b). Sustainable energy behaviours and projects typically imply positive collective consequences (e.g., reducing CO₂ emissions), and negative individual consequences (e.g., expensive technology). In line with this, research has revealed that, in general, people have more favourable evaluations of and are more likely to engage in sustainable energy behaviours if they have strong biospheric and, to a lesser extent, altruistic values, while they are less likely to do so if they have strong egoistic or hedonic values (Steg and De Groot, 2012). In some cases, strong altruistic values can inhibit sustainable energy behaviour, for example, when altruistic and biospheric goals are in conflict (De Groot and Steg, 2008). Similar results have been found for the acceptability of energy projects. For example, the stronger their biospheric values, the more positively people evaluated development and implementation of renewable energy sources, probably because renewable energy sources are generally seen as having positive (or relatively little negative) consequences for nature and the environment (Bidwell, 2013; Perlaviciute and Steg, 2015). In contrast, stronger egoistic values were related to less positive evaluations of renewable energy sources, probably because renewable energy sources are generally seen as expensive and intermittent (Perlaviciute and Steg, 2015).

People's values not only affect which consequences people find important, but also how people evaluate various risks, costs and benefits. The stronger their biospheric values, the more positively people evaluated renewable energy sources, including personal consequences of these renewable energy sources, such as financial costs (Perlaviciute and Steg, 2015). Similarly, stronger altruistic values led to positive evaluations of wind energy, and more positive evaluations of various pros and cons of wind energy, including effects on the landscape (i.e., wildlife, noise and scenic views) and the local economy (Bidwell, 2013). Thus, people seem to base their evaluations of energy projects on aspects that are most relevant for their important values, which guide their overall acceptability judgements. These value-based judgements may in turn affect the evaluation of various risks, costs and benefits of energy projects that may be less important to people based on their values. In other words, people evaluate energy projects in an overly positive or negative way, in line with their value-based judgements.

Values can influence sustainable energy behaviours via environmental self-identity (Steg et al., 2014a; Van der Werff et al., 2013, 2014b). The stronger

people's biospheric values, the more they perceive themselves as a person who acts proenvironmentally. A strong environmental self-identity, in turn, encourages engagement in sustainable energy behaviours, as people are motivated to consistently act in line with how they see themselves (Ruepert et al., 2016; Van der Werff et al., 2013; Whitmarsh and O'Neill, 2010). Besides values, environmental self-identity is also influenced by one's previous behaviours. Having previously engaged in sustainable energy behaviours increases the likelihood that people see themselves as an energy-saving and proenvironmental person, which motivates them to engage in other sustainable energy behaviours (Van der Werff et al., 2014a, 2014b). This can explain why initial sustainable energy behaviour can motivate people to engage in many other sustainable energy behaviours, thereby promoting positive spillover.

In sum, values can influence a wide range of sustainable energy behaviours and acceptability of energy projects. Particularly biospheric values seem to be a stable and reliable basis for sustainable energy behaviours and public support for sustainable energy projects (Steg et al., 2014a). Stronger biospheric values make people prioritise the environmental consequences of energy behaviours and projects and evaluate the related risks and cost less negatively. Furthermore, stronger biospheric values are associated with a stronger environmental self-identity, which, in turn, facilitates engagement in many different sustainable energy behaviours.

In general, people care about the environment and endorse biospheric values relatively strongly. Yet, many people do not consistently engage in sustainable energy behaviour. The IFEP proposes that in addition to individual factors, contextual factors influence sustainable energy behaviours and acceptability of energy projects; contextual factors can influence the extent to which people act upon their biospheric values.

17.5 Contextual Factors

We conceptualise contextual factors broadly as everything that characterises sustainable energy behaviours and projects, for example the characteristics of energy technology, the laws and regulations that apply to energy behaviours and projects and the physical, economic, political and social context within which energy behaviours and energy projects are embedded (Steg et al., 2014a; Perlaviciute and Steg, 2014). Contextual factors define the (distribution of) costs and benefits of energy behaviours and projects, thereby influencing individual motivations and behaviour (Ölander and Thøgersen, 1995; Stern, 1999; Thøgersen, 2005; Lindenberg and Steg, 2007; Steg and Vlek, 2009). The context can influence sustainable behaviour directly, by facilitating or inhibiting sustainable behaviour. The context may introduce barriers that are too strong, that prevent people from acting sustainably even if they want to, or the context can strongly facilitate sustainable behaviour, making everyone act

sustainably despite people's values (Corraliza and Berenguer, 2000; Guagnano, Stern and Dietz, 1995; Ruepert et al., 2016). Next, contextual factors can influence the extent to which people are focussed on the environmental consequences of their behaviour (Steg et al., 2014a). For example, the high costs can make people focus particularly on these costs and the values related to these costs, notably hedonic and egoistic values, which makes it less likely that people will act upon their biospheric values (Steg et al., 2014a; Steg, 2015, 2016). Relatedly, the behaviour of others can make people focus on specific values, thereby affecting their behaviour (Keizer, Lindenberg and Steg, 2008, 2013).

17.6 Interventions to Promote Sustainable Energy Behaviour

As explained in the preceding, biospheric values are likely to encourage engagement in many different sustainable energy behaviours and public support for different sustainable energy projects, which is crucial to speed up the sustainable energy transition. For this reason, strategies could be employed to strengthen biospheric values. Yet, values are believed to be relatively stable across time (Feather, 1995; Rokeach, 1973; Stern and Dietz, 1994), and little is known about whether and how biospheric values can be strengthened (Steg, 2016). In this section, we review strategies that can foster sustainable energy behaviour and acceptability of sustainable energy projects by increasing the likelihood that people act upon their biospheric values (Steg et al., 2014a).

17.6.1 Changing the Context

It is important to remove major contextual barriers that prevent people from engaging in sustainable energy behaviours (Steg et al., 2014a). Such interventions can change the actual costs and benefits of sustainable energy choices (Bolderdijk, Lehman and Geller, 2012; Geller, 2002; Steg and Vlek, 2009). For example, major investments in energy efficiency retrofits at home or in renewable energy systems may not be affordable to some people (Kastner and Stern, 2015). Incentives such as subsidies could be implemented in these cases (Bolderdijk and Steg, 2015). Similarly, interventions could make certain energy behaviours easier and less burdening to people. For example, in renewable energy systems, appliances such as washing machines or dishwashers could best be operated at times when energy supply from renewables is abundant, but people may not be able or willing to constantly monitor energy supply or they may simply not be at home to switch on or switch off their appliances. In such cases, technologies can be implemented that automatically switch appliances off and on at different times, thereby making the sustainable behaviour easier and more feasible for people.

Next, it may be important to introduce incentives that enable risks, costs and benefits to be distributed (more) fairly across groups in society. On the one hand, the risks and costs for most affected groups could be reduced as much as possible in order to promote acceptability of energy projects. On the other hand, additional benefits could be provided to those who have to bear most costs and risks. For example, local funds could be established in communities hosting renewable energy projects; the funds could be used to reduce energy bills for local people, to stimulate the local economy or to create or improve local facilities (e.g., sports facilities; Walker, Wiersma and Bailey, 2014). Indeed, offering reductions on energy prices increased people's willingness to host wind farms (Groothuis, Groothuis and Whitehead, 2008). Yet, offering compensations for hosting renewable energy projects can be perceived by people as attempts to buy local support, which can fuel rather than reduce resistance (Ter Mors, Terwel and Daamen, 2012). It has been proposed that collective benefits (e.g., investing in local facilities) may be less likely to be seen as bribes than individual financial compensations (e.g., one-time payments to residents; Ter Mors et al., 2012).

Yet, incentives may be less effective than sometimes assumed, and can sometimes even be counterproductive (Bolderdijk and Steg, 2015). Incentives can make people focus on values related to immediate personal costs and benefits, notably egoistic or hedonic values, which provide a fickle basis for consistent sustainable energy choices (Steg et al., 2014a; Steg, 2015, 2016). Incentives that make people focus on their hedonic or egoistic values will particularly promote engagement in sustainable energy behaviours and acceptability of energy projects when these have clear benefits and when they support their egoistic or hedonic values (Bolderdijk et al., 2011; De Groot and Steg, 2009). In addition, incentives can inhibit positive spillover effects when subsequent actions have no clear personal benefits, which is not uncommon in the energy domain (Thøgersen, 2013). For example, people who were focussed on economic rather than environmental reasons for one proenvironmental act, in this case car-sharing, were less inclined to engage in another sustainable behaviour on a following occasion, in this case recycling (Evans et al., 2013). In addition, incentives will particularly result in behaviour changes when such changes are perceived to be worth the effort (Bolderdijk and Steg, 2015). Many single sustainable energy behaviours, such as unplugging a single coffee machine or microwave, yield small benefits and may therefore be perceived as not worth the effort (Dogan, Bolderdijk and Steg, 2014).

In sum, increasing the benefits and reducing the costs of sustainable energy choices and distributing the risks, costs and benefits fairly across groups in society may be necessary when these choices are too costly and/or too difficult for (some) people. Yet, such strategies should be used with caution since emphasising costs and benefits may make people focus on egoistic and hedonic values, making these values more influential, which may inhibit durable engagement in sustainable energy behaviour.

17.6.2 Social Influence

Social influence strategies, in which other people or groups are used to influence individual choices, can be employed to encourage sustainable energy behaviours (Abrahamse and Steg, 2013). Social influence approaches that make use of face-to-face interaction seem most effective in this respect, such as block leader approaches and behaviour modelling. Block leader approaches, in which local volunteers help inform other people in their neighbourhood about a certain issue, seem to be one of the most effective social influence strategies. Behaviour modelling entails the use of confederates or ‘models’ who demonstrate a recommended behaviour, thereby potentially helping people to learn the behaviour, as well as demonstrating what others do and what behaviour is socially approved (Sussman and Gifford, 2013; Winett et al., 1985). Social influence strategies that happen in a fairly anonymous way, such as descriptive norm information (i.e., information on the behaviours of others) and social comparison feedback, where people receive feedback about their own performance compared with the performance of others, can also encourage sustainable energy behaviour, although they are less powerful than strategies that rely on face-to-face interactions (Abrahamse and Steg, 2013). Social norm information and social comparison feedback may not be very effective when most (significant) others do not act sustainably. Some studies found that low energy users used more energy after receiving social feedback (Brandon and Lewis, 1999; Schultz et al., 2007), which could potentially be because they found out that others use more and acted in line with the norm. Such undesired effects may potentially be attenuated by additionally showing approval of sustainable energy behaviours and disapproval of unsustainable energy behaviours (Schultz et al., 2007).

17.6.3 Providing Information and Arguments

People may have limited or inaccurate understanding about the environmental impact of their behaviours, as well as about how they could change their behaviours in order to reduce energy use and the related CO₂ emissions (Steg et al., 2015; Stern et al., 2016a). For example, they may overestimate the costs and/or underestimate the environmental benefits of sustainable behaviour or energy projects. In such cases, it is important to change the misperceptions of risks, costs and benefits of sustainable choices via information strategies (Abrahamse and Matthies, 2012; Steg and Vlek, 2009). Next, information can be provided to change people’s beliefs about and to increase their awareness of environmental problems caused by their current behaviour, which may enable and motivate them to help reduce these problems by changing their behaviour. There is some evidence to suggest that such information will be particularly effective if people strongly endorse biospheric values. Indeed, an environmental campaign increased knowledge among all exposed to the campaign, but only increased sustainable

behavioural intentions and policy acceptability for those who strongly endorsed biospheric values (Bolderdijk et al., 2013c). This suggests that information is more likely to affect policy acceptability and behaviour when it resonates with people's important values. Conversely, information and arguments may not be effective if they do not resonate with people's value-based views. For example, natural gas is often promoted as a relatively clean energy source and an important energy source to facilitate a sustainable energy transition, which implies positive implications for people's biospheric values. Yet, people with stronger biospheric values did not evaluate natural gas more positively when it was promoted as sustainable, probably because they see gas primarily as a fossil fuel and hence not sustainable (Perlaviciute, Steg and Hoekstra, 2016).

People can also be informed about which actions are effective to reduce environmental and energy problems by providing them with feedback about the environmental impact of their energy behaviours. Feedback appears to be an effective strategy for reducing household energy use (Abrahamse et al., 2005), although not always (Fischer, 2008). For example, feedback about environmental and health risks of high energy consumption resulted in a reduction in household energy consumption by 8.2 per cent, thereby outperforming financial feedback, which did not result in a significant reduction in household energy use (Asensio and Delmas, 2015). Participants' willingness to engage in energy-saving programs was higher when environmental benefits were highlighted, compared to when monetary benefits and even both types of benefits were highlighted (Schwartz et al., 2015). Interestingly, however, more participants reported that they would enrol in the energy-saving programs for monetary rather than environmental reasons (Schwartz et al., 2015), and in other studies people preferred to receive financial feedback rather than environmental feedback (Krishnamurti et al., 2013; Karjalainen, 2011). This suggests that people may not know what motivates them most to engage in sustainable energy behaviour. Besides feedback content, the way in which feedback is given may influence the extent to which feedback induces behavioural change. Feedback is more effective when it is given immediately after the behaviour occurs, as this enhances people's understanding of the relationship between the feedback and their behaviour (Geller, 2002). Smart meters offer possibilities for providing immediate and frequent feedback on household energy use and ways to reduce it, via different means such as websites, mobile phones and home displays (Mack and Tampe-Mai, 2016; Van der Werff et al., 2016). Furthermore, it has been advocated that feedback on a more detailed level, for example, on an appliance level, may be more effective than feedback on overall electricity consumption (Fischer, 2008). People indeed indicate they would like to receive information about energy consumption per appliance (Asensio and Delmas, 2015; Karjalainen, 2011; Krishnamurti et al., 2013; Fischer, 2008). Yet, receiving specific information about energy use of many different appliances may cause information overload (Krishnamurti et al., 2013), reducing the effectiveness of such feedback strategies. Given that people may

be reluctant and/or unable to process extensive and/or complicated information or feedback on their energy behaviours, ambient persuasive technologies can be offered that promote behaviour change without the need for users' conscious attention and hence with little cognitive effort (Midden and Ham, 2012). For example, processing interactive lighting feedback, such as a light that turns green, may be less cognitively demanding than processing factual feedback, such as statistics on energy use, and may help and motivate people to engage in sustainable energy behaviour even in cognitively demanding situations (Midden and Ham, 2012). Helping people to better envision and understand their energy use via thermal images of their homes proved to be effective in motivating them to reduce their energy use (Goodhew et al., 2015). Furthermore, introducing default options may reduce cognitive load needed to make sustainable choices. Indeed, more people chose 'green' rather than 'grey' electricity when the 'green' option was the default option, possibly because going for the default option requires less time and effort. Additionally, default option may communicate the social norm, which can also be motivating for people (Pichert and Katsikopoulos, 2008).

17.6.4 Motivating People to Act Consistently

Even if people aim to engage in sustainable energy behaviours, they may be tempted to act differently in specific situations. Interventions can be employed that motivate people to consistently engage in sustainable energy behaviours. Commitment strategies are promising in this respect, where people make a promise to engage in sustainable energy behaviour. Additionally, they could indicate how and when they will engage in sustainable behaviour, and how they will tackle any barriers faced in the future; the latter is called implementation intention. Both strategies appear to be effective in encouraging sustainable energy behaviour (Abrahamse et al., 2005; Abrahamse and Steg, 2013; Lokhorst et al., 2013). Commitments are more effective when made in public rather than private (Abrahamse et al., 2005). Although little is known about the processes through which both strategies promote sustainable energy behaviour, one plausible explanation is that people want to be consistent by acting in line with their promise (Abrahamse and Steg, 2013). Evoking cognitive dissonance between individuals' reported attitudes and behaviour is another strategy that is based on people's desire to be consistent, which proved to be effective in promoting sustainable energy behaviour. People who first reported a favourable attitude towards energy conservation, and later were made aware of their relatively high energy usage, significantly reduced their energy use (Focella and Stone, 2013).

Reminding people of their previous proenvironmental actions can promote sustainable behaviour by strengthening environmental self-identity, as previously explained. Environmental self-identity is more likely to be strengthened when people are reminded of a range of sustainable energy actions they engaged in, or when they are reminded of behaviours that were somewhat

costly or uncommon, probably because in such cases it is more likely that one engaged in the behaviour out of conviction and not because it happened to be the most attractive option (Van der Werff et al., 2014a). This implies an interesting paradox, when considered together with the previously discussed social influence strategies. On the one hand, it may be beneficial to stress that many others act sustainably, as people are likely to act in line with the behaviour of others. Yet, on the other hand, it seems that stressing that only few people acted sustainably can also encourage sustainable energy choices, via a different process, as engaging in such uncommon behaviour can strengthen one's environmental self-identity. Employing strategies that strengthen people's proenvironmental self-identity could potentially alleviate the possible counter-effects of incentive strategies. If people engage in sustainable energy behaviour because the behaviour is incentivised, the behaviour may have a weaker signalling effect, because people attribute the behaviour to the situation rather than to themselves. In such cases, it may be important to emphasise the environmental benefits of such behaviours, which could potentially strengthen environmental self-identity, thereby decreasing the likelihood of negative spillover and increasing the likelihood of positive spillover effects.

In many cases, the previously described strategies are not implemented separately. Combining interventions may be more effective, as this enables addressing multiple barriers and motivations to engage in sustainable energy behaviour at once. For example, several interventions described in the preceding were combined in an educational programme on household energy use delivered to Girls Scouts in the United States (Boudet et al., 2016). The Girl Scouts received information about sustainable energy behaviours, they rehearsed these behaviours, observed others in the group engage in these behaviours, received items to facilitate sustainable energy behaviours (e.g., reminder stickers), made pledges to engage in sustainable energy behaviours and monitored and reported their energy behaviours. The programme influenced not only Girl Scouts but also their parents to increase their residential energy-saving behaviours immediately after the intervention up to seven months later (Boudet et al., 2016). The study demonstrates that such combined interventions that target children have a high potential in fostering sustainable energy behaviours of households. Another study involving several intervention strategies (e.g., tailored information, commitment) found that interventions may be more likely to enhance sustainable energy behaviour when people recently relocated to another house, making it more likely that they reconsider initial behavioural choices (Verplanken and Roy, 2016).

17.7 Fair Procedures and Trust

How and by whom sustainable energy projects are implemented will affect public acceptability of these projects. In particular, fairness of

decision-making procedures and people's trust in parties involved in a sustainable energy transition are important in this respect.

17.7.1 Procedural Fairness

Public engagement in decision-making affects the extent to which procedures of decision-making around energy are seen as fair (see Bidwell, 2016; Huijts et al., 2012; Perlaviciute and Steg, 2014; Sovacool et al., 2016). People may be more likely to accept energy projects if they think that the decision-making process is fair, and if they feel they are sufficiently involved in decision-making and that their interests are considered (Huijts et al., 2012; Perlaviciute and Steg, 2014). However, relatively little is known about how public participation processes should be organised to ensure that procedures are perceived to be fair (Bidwell, 2016). Information provision is a necessary precondition for public involvement: decision-making processes need to be transparent, and people should be fully informed from the beginning, rather than only afterwards when all decisions are already made. Yet, information provision alone is a passive form of public involvement and not sufficient to ensure fair procedures. Collaborative approaches that take people's concerns into account are more likely to be seen as fair than technocratic top-down decision-making processes, which could (partly) explain why the former are evaluated more positively by people than the latter (Walker and Devine-Wright, 2008; Wolsink, 2007, 2010; Wolsink and Breukers, 2010). Importantly, true public engagement means not only that people have an opportunity to express their opinion, but also that their opinion is seriously considered in decision-making and can have an actual impact on decisions around energy (Dietz and Stern, 2008; Hindmarsh, 2010). If people express their opinion but this opinion is eventually not taken into account and will not change energy policies (i.e., 'fake engagement'), this will probably not be seen as fair. Actively engaging people can provide important input to decision-making, which could substantially improve the development and implementation of sustainable technologies and energy projects (Bidwell, 2016). For example, the public could consult on how to develop home technology that is user-friendly and acceptable for direct users. Importantly, however, systematic empirical evidence is lacking on whether and how more public participation leads to higher acceptability of sustainable energy projects. There is even some evidence that more participation may strengthen opposition and social conflict if people are not satisfied with the information given, the neutrality of intermediate parties, the ways opportunities for public voice are organised and the consideration of local context (Colvin, Witt and Lacey, 2016). It is important to study the conditions under which public participation increases acceptability of energy projects, as well as boundary conditions.

17.7.2 Trust

A sustainable energy transition includes complex innovative technology, infrastructure and changes in energy systems, which are difficult to comprehend for the public. Therefore, trust in responsible parties – for example, energy companies that site energy technologies and provide energy services, scientists that develop energy technologies and governments that implement energy policies – influences public acceptability of energy projects and people's willingness to change their behaviour and adopt the proposed technology (Frederiks et al., 2015; Huijts et al., 2012; Perlaviciute and Steg, 2014). Trust in involved parties will especially affect behaviours and acceptability judgements when people have little knowledge about the proposed energy projects and technology, more likely so when such measures are highly complex (Siegrist and Cvetkovich, 2000). Research puts forward four factors that influence trust, namely (1) perceived knowledge and expertise of responsible parties to carry out their activities; (2) past behaviours of these parties; (3) whether the parties are seen as open, honest and taking people's interests into account; and (4) whether people think these parties endorse values similar to their own values (Earle and Siegrist, 2006; Huijts et al., 2007; Terwel et al., 2009). These factors are closely related. For example, if people think that responsible parties endorse values similar to their own, they also are more likely to think that these parties have sufficient skills and competencies (Huijts, Midden and Meijnders, 2007). As yet, little is known under which conditions specific factors are most predictive of overall trust judgements and about the direction of relationships between these factors and overall trust judgements, since overall judgements could influence evaluations of (some of) these specific factors.

17.8 Conclusion

To achieve a sustainable energy transition, it is important that people engage in a large variety of sustainable energy behaviours and accept different sustainable energy projects and policies. We proposed the IFEP, a general framework to understand and encourage sustainable energy behaviour (Steg et al., 2014a). We discussed that values influence sustainable energy behaviours and public acceptability of sustainable energy projects and policies by influencing how people evaluate the related risks, costs and benefits, and by strengthening (or weakening) people's environmental self-identity. Next, contextual factors can influence sustainable behaviours directly as well as by making people focus on certain values and enabling them to act upon these values. Various interventions can be implemented to encourage sustainable energy behaviour, by changing the context so as to enable and empower people to act sustainably, providing information and arguments so as to help people and motivate them to make sustainable choices, and by motivating people to act

consistently. When developing and implementing sustainable energy projects, it is important to consider procedural fairness and people's trust in parties involved in a sustainable energy transition, to secure responsible decision-making and public support.

Notes

- 1 This chapter builds on and extends a previous review article on human dimensions of a sustainable energy transition (Steg, Perlaviciute and Van der Werff, 2015).
- 2 We focus particularly on energy behaviours at home, and will not discuss factors influencing sustainable transportation (e.g., shifting to low-carbon means of transport, sharing transportation, using public transport).

17.9 References

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