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Development and implementation of effective pro-environmental campaigns: Psychological strategies and case study

Margit Hain

Faculty of Psychology and Neuroscience, Maastricht University
m.hain@student.maastrichtuniversity.nl

Abstract

It is generally acknowledged that human behavior is one of the main factors contributing to climate change. Therefore, there is an increasing need for campaigns addressing environmentally unfriendly habits while promoting an environmentally friendly lifestyle. These ecological campaigns are able to improve their effectiveness by integrating various psychological strategies and theories. Furthermore, statistical analyses enable campaigners to gain more insight into attitudes, norms and behaviors of their target group, and even enable the setting of benchmarks for further campaigns. Based on psychological studies this paper proposes a general design for such a pro-environmental campaign. This design comprises 1) identifying the target group, 2) identifying effective strategies, 3) implementing the campaign and 4) evaluating the implementation. In consideration of this proposed design the last section provides a practical example: the applied strategies of Opower - a company which claims to foster ecological behavior change in households.

I. Non-Environmental Behavior

It is common knowledge that the ongoing climate change is and will be one of our major global challenges in the future. Despite the urgency of this issue, there is still a lack of political, economical and civil action. The main paradox, hereby, is that people are aware of and concerned about environmental issues without taking any action (Ozaki, 2011; Vermeir & Verberke 2006). This human impact on the environment is, among others, triggered by minor non-ecological behaviors. These everyday behaviors begin with a certain action such as not switching off the lights when leaving a room. If the outcomes of an action are generally satisfactory, e.g., convenient, then this course of behavior will be maintained (Wood& Neal, 2007). The more frequent a certain combination of setting and behavior occurs, the more dominant and accessible the link between them becomes. Once that a non-ecological habit is formed, the more probable it is that an individual constantly follows this cognitive schema (Verplanken, Aarts & Van Knippenberg, 1998). In order to solve the aforementioned paradox, there is a need for effective campaigns intervening into these harmful habits. Although the broad persuasion research, the integration of psychological strategies into campaigns' messages is very limited (Bator & Cialdini, 2000). Accordingly, the amount of papers engaging with the design of pro-environmental campaigns is restricted. Therefore, this review paper aims to answer the research question on how psychological knowledge can trigger

pro-environmental behavior change within the framework of a campaign. First, the following section proposes a general framework for designing a campaign, from the initial analysis to the final evaluation. Hereby, the results of various studies regarding ecological behavior are integrated into this design. The concluding section looks closely at the realization of this theoretical knowledge into a real-life setting: A company called Opower claims to successfully incorporates psychological tactics and strategies into its ecological campaign. The applied method for data collection is a literature research gathering information about designing campaigns, persuasive strategies regarding ecological actions and the company Opower.

II. Designing and Implementing an Effective Pro-Environmental Campaign

Today's environmental challenge is rooted in a wide range of everyday issues from social awareness to technological options; it is an "ecological, technological and sociocultural problem" (Steg & Vlek, 2009). Therefore, the change towards more environmentally friendly attitudes and behavior cannot be mastered by one single discipline but requires a multidisciplinary approach. Designing and implementing a successful campaign requires a variety of expertise ranging from social psychologists (identifying target groups and strategies, data analysis and evaluation), engineers (designing the required software applications and websites) and policy makers (providing political and financial guidelines) (Steg & Vlek, 2009). In addition to a multidisciplinary approach the campaigners should apply psychological knowledge and strategies. The design of the proposed campaign includes 1) identifying the target population, 2) identifying effective strategies, 3) implementing the campaign and, 4) evaluating the results (Kok, Lo, Peters & Ruiter, 2011; McGuire, 1989).

II.I. Identifying the Target Group

The initial step in designing any effective campaign consists in identifying the target group: "Who are the people the campaign will act upon?" By understanding their attitudes, beliefs and norms towards environmental issues as well as their present (non-)environmental behavior, the campaign can be adapted accordingly. Hereby, this first analysis of the target group guides the manner of applied psychological strategies for the campaign. For example, some light may be shed on the difference between people engaging in a certain pro-environmental behavior and people who do not. Ideally, this comparison leads to the identification of specific barriers which can then be addressed, e.g., external barriers such as a lack of environmentally friendly technology or internal barriers such as a lack of required skills to properly apply this technology (Abrahamse et al., 2007). Moreover, this first analysis creates a benchmark allowing the campaigners to spot deviations in attitudes and behavior within the selected target group after the campaign has been implemented (Kok, Lo, Peters & Ruiter, 2011; McGuire, 1989). Within the subsequent section this paper is further responsive to several psychological strategies addressing determinants such as norms, attitudes and knowledge contributing to non-ecological behavior.

II.II. Identifying Effective Strategies

II.II.I. Moral Obligation and Social Norms

Moral Obligation and Social Norms

One psychological strategy is altering or strengthening the target group's moral obligation towards the environment. Moral obligation is rooted in the belief that climate change is something which has to be dealt with, followed by a perceived general responsibility (Ozaki, 2011; Roberts, 1996; Tanner & Kast, 2003). This moral sensation can also be regarded as a social norm – a belief on how one should act in a certain situation. Generally,

individuals tend to adapt to prevalent norms due to the urge not to deviate from the majority. Being part of the norm creates a sense of belonging to a greater group and assists maintaining a positive self-image. Normative and environmental concerns can highly influence behavioral intentions (Bamberg, 2003; Gadenne, Sharma, Kerr & Smith, 2011) and it is even argued that they provide the most solid base for pro-environmental acting compared to hedonistic or economic drives (Tanner & Kast, 2003; Lindenberg & Steg, 2007). Moreover, social norms regarding the environment can cause a domino-effect: The more individuals are prompted to act upon an ecological lifestyle, the more prominent this social norm of environmental awareness becomes. This increased awareness will trigger even more moral responsibility and the need to take action in other individuals provoking them to change their environmental behavior (Ozaki, 2011).

Descriptive and Injunctive Norms

Additionally, a group of researchers (Cialdini, Reno & Kallgren, 1990, 1991, 1993) distinguished between two different types of social norms: descriptive norms, what people actually do, and injunctive norms, what people approve or disapprove of. Studies point out that the failure of many campaigns are due to the emphasis on negative descriptive norms which might be followed by the so-called boomerang effect (Cialdini, 2003; Schultz, Nolan, Cialdini, Goldstein & Griskevicius, 2007). Negative descriptive norms communicate that the plurality of people engage in an undesirable negative behavior. This message, however, implies that this certain behavior is the general average, e.g., many people throw their trash directly into the environment. Hereby, the emphasis on the negative average withholds people from changing their behavior for the better. Additionally, people displaying positive behavior above the average are entrapped to adapt themselves to the lower general mean – leading to a decrease of one's pro-environmental behavior. Thus, the campaigners' intention to prompt positive behavior may lead to even more negative behavior: the boomerang effect. Therefore, descriptive norms should mainly focus on positive norms. Advertising that many people engage in a desired positive behavior induces more individuals to imitate their behavior, e.g., if many people place their compost in front of (instead of behind) their house then other individuals are also encouraged to compost (McKenzie-Mohr, 2000; Cialdini, 2003). By adding negative injunctive norms, what people disapprove, the boomerang effect can be additionally prevented, e.g., displaying that the majority disapproves that people throw their trash directly into the environment (Cialdini et al., 2006). In order to apply these descriptive as well as injunctive norms effectively, it is advisable that the displayed norms are rather specific than general (Bator & Cialdini, 2000). In the following section the importance of specificity is further illustrated, also in the field of attitudes, intentions and goals.

II.II.II. Specific Attitudes, Intentions and Goals

Several studies are in agreement with the fact that specific information and goals are more effective than broad information/goals (Gardener & Stern, 1996; Locke & Latham, 2006): A general concern about environmental and global changes is not very probable to prompt minor small-scale actions such as composting (Locke & Latham, 2006). Additionally, specific attitudes and beliefs, e.g., towards environmental protection, fair trade and local production, were found to result in more positive environmental behavior (Tanner & Kast, 2003). Hence, Pratkanis and Greenwald (1993) recommend to implement very particular message content. According to them the target group should be addressed with very clear instructions on how to solve specific problems. Additionally, superfluous and distracting information should be completely excluded, particularly in our overwhelming message-dense culture. As a result, the specificity of the information facilitates to overcome the interfering effect of deeply rooted

habits (Danner, Aarts, Papies & Vries, 2010). These habits are a consequence of the cognitive coactivation between a certain situation and a subsequent behavior. However, entering this familiar situation might trigger an automatic behavioral response in return, which is more easily accessible than the novel and unfamiliar action (Danner et al., 2010; Wood & Neal, 2007).

In practice, an encoding cue can be integrated into the campaign's message to facilitate the change towards new more pro-environmental routines (Bamberg, Hunecke & Blöbaum, 2007; Wood & Neal, 2007). An encoding cue is a certain object, setting or situation which will be associated by the target person with an appropriate ecological behavior (Neal, Wood, Labreque & Lally, 2012). By placing an encoding cue into the visual field the activation of the new behavioral response is facilitated, e.g., placing a recycling sign directly next to a trash bin. Due to the integration of such a cue, there is also an increased probability that the relevant social norms will be triggered at the appropriate time and situation (Bator & Cialdini, 2000). The inclusion of encoding cues and other specific rather than general attitudes, behaviors and goals should, therefore, be distinctly implemented into each ecological message.

II.II.III. Increasing Individual Knowledge and Involvement

Lacking Knowledge and Applied Heuristics

In order to shape a persuasive pro-environmental message, each individual of the target group has to have a feeling of personal relevance and importance (Vermeir & Verbeke, 2005). One possible strategy to reach this goal is the implementation of self-reports as a measurement method. The individual has to analyze his/her own environmental actions in order to be able to comprehend the consequences of his/her behavior and how it is related to resource use. Generally, studies revealed that individuals' knowledge about their own behavior-energy relation is insignificantly small (Steg, 2008). For instance, if individuals have to assess the energy use of an appliance they generally tend to use heuristic assumptions – such as "the bigger the appliance, the more energy consumed". This assumption that energy consumption of an appliance is directly linked to its size is obviously not always valid (Schuitema & Steg, 2005a). Similarly, the resource use which is required to heat up water is generally underestimated due to the lacking awareness that hereby energy is needed (Schuitema & Steg, 2005b). Individual self-reports are able to reveal absent knowledge/ applied heuristics and create, moreover, awareness for our human flaws (Steg, 2008). Particularly this consciousness between behavioral cause and environmental consequence is a necessity for any change in behavior. However, an effective message does not only have to illustrate what but also how to modify non-environmental actions for the better.

Action-Related Knowledge

One method which facilitates the change towards more ecological behavior is the integration of action-related knowledge into a campaign's message. Schahn and Holzer (1990) distinguish between two general types of environmental knowledge: factual and action-related. Factual knowledge embraces definitions, causes as well as the consequences of environmental issues: "What is the greenhouse effect?" However, only action-related type of knowledge incorporates information about potential human action: "Which human behaviors are related to the greenhouse effect?" This second category of knowledge has a higher probability to effectively guide individuals to act more pro-environmentally. Thus, the campaign's message is only sufficient if it specifically describes what action has to be changed as well as how the individual can execute a new alternative behavior as a replacement of the old habituated one (Tanner & Kast, 2003). The application of action-related knowledge can also be reinforced by integrating the already mentioned encoding cues. An additional and highly effective strategy is the

usage of tailored feedback (Gatersleben, Steg & Vlek, 2002; Steg & Vlek, 2009) which will be further elaborated within the following section.

Increased Individual Involvement through Tailored Feedback

By integrating tailored information and action-related feedback campaigners are able to assist each single individual at a very personal level. First, each individual can comprehend the relation between his/her environmental behavior and subsequent resource use. Secondly, the individual can overcome his/her own informational barriers (Abrahamse et al, 2007; Daamen, Staats, Wilke & Engelen, 2001). Frequently, the campaigners address their target group in the style of mass media, such as broad advertisements. Hereby, these campaigns are not completely adapted to the knowledge level, cognitive abilities, interests, beliefs and behavior patterns of their individual receiver. Addressing the general public and, thereby, neglecting the specific characteristics of the individual causes less attention, less receptiveness and less impact on beliefs, attitudes and behavior (McGuire, 1989). This approach can in the end lead to the failure of a campaign. In order to reduce the investment of time and money incurred by approaching and assessing each single person, the pro-environmental campaigners might address a higher-ranking person such as the management of a company or a prominent person of a community. This indirect approach is able to provide the supervisors with information about tailored possibilities on how to reduce the impact of the greenhouse effect within their area of management. This simplified, cost and time reduced, method can lead to significantly more knowledge about causes and subsequent consequences of behaviors while supporting the individual to stay on track (Daamen et al., 2001). Thus, tailored feedback is able to strengthen the intention as well as the action-related knowledge of an individual which consequently leads to more pro-environmental action.

II.III. Implementing the Campaign

After the decision of which strategies should be integrated is made, the designers can test a preliminary version of the campaign on a small sample group. During this testing phase individual components of the campaign can be pilot tested and examined. This whole process is based on an experimental research design, thus on comparing a control with an experimental group (Bartholomew, Kok & Parcel, 1998). Based on the results the message can be modified in order to maximize its impact. Ideally, the same pretesting phase should be repeated with the almost finished campaign to analyze the gathered reactions and effectiveness of the message (Bator & Cialdini, 2000). After this fine tuning, the campaign can be implemented. If the designers and implementers of a campaign work for the same organization, as is the case with the pro-environmental company Opower (see III. An Illustrative Example: The Company Opower), the implementation question "Who has to do What implementation behavior and Why would they do that?" (Kok et al., 2011) is not difficult to answer. However, if the final implementation is conducted by an external institution then the designers have to search for an adequate external organization willing to take over their design. Hereby, it is of particular importance that the designers ensure that the campaign is correctly implemented in order to avoid any loss of its effectiveness (Kok et al., 2011). One might assume that the implementation might be the last step, however, one essential part in creating and conducting an effective pro-environmental campaign is its evaluation.

II.IV. Evaluating the Campaign

The final step of each campaign is analyzing the real-life effectiveness of the implemented message by using an experimental design. This evaluation should occur during as well as after the campaign's implementation (Flay & Cook, 1989). Steg and Vlek (2009) state that the emphasis of the evaluation should be mainly on three aspects: behavioral determinants, en-

vironmental impact and people's quality of life. The first aspect can shed light on the grade and the underlying reasons for a (non-)effective campaign. As it is the greater goal of each environmental campaign to change certain behaviors in order to diminish environmental impact, the evaluation should measure the change by statistical methods. The last aspect of people's quality of life is aligned with the more general notion of sustainable living. An effective environmental intervention can only be long-lasting if its strategies do not severely restrict people's lives. This can be examined by analyzing attitudes, social norms and specific beliefs which can be compared to the previously measured attitudes. In short, the evaluation of the campaign should not only focus on environmental behaviors but also on the more general terms of ecological and human sustainability. The evaluation is an essential step within the framework of the campaign because it enables the campaigners to recognize failures and successes, which might be the guidance for further campaigns. Although the evaluation might be time and cost consuming in the short-term, it allows the campaigners to identify more powerful strategies and determinants for environmental behavior in the long run. Besides its function of implicating possible improvements, the evaluation can also be a tool for providing feedback. By informing the target group of monitored changes the personal commitment might be increased and the positive changes are easier to be maintained (Steg & Vlek, 2009). Therefore, the final step of evaluating the process as well as the results of the campaign is essential in designing and conducting a campaign.

In the previous section information was provided towards a possible design of a pro-environmental campaign including various strategies and determinants of environmental behavior. But how come that there are still many pro-environmental campaigns that do not receive a lot of attention? It has been suggested that the failure of pro-environmental campaigns is due to the underestimation of environmental behavior change (Costanzo, Archer, Aronson & Pettigrew, 1986). The standardized pro-environmental campaign is based on traditional marketing techniques. However, prompting more sustainable actions cannot be advertised like a product. Changing behavior is far more complex than just purchasing a new attractive product due to the fact that the process of behavior change includes many cognitive, financial and temporal barriers to overcome (Costanzo et al., 1986). As can be seen designing and implementing a campaign, which triggers people to change their inherited and convenient behaviors in order to act more environmentally friendly, is an enormous challenge. As a result, the successful integration of theoretical strategies into practices has been shown to be difficult (Kok et al., 2011). The final section illustrates the psychological strategies of the company Opower which aims to master this challenge.

III. An Illustrative Example: The Company Opower

III.I. Introducing Opower

Founded 2007 in San Francisco, Opower has evolved into an international company whose "mission [...] is to motivate everyone on earth to save energy" (`http://opower.com/`). The company acts as a mediator between utilities and their customers aiming to persuade the latter to reduce energy consumption and to save money. According to Opower, the company reaches up to 22 million homes in the U.S., the U.K., Australia, New Zealand, France and Canada, and therefore contributes to reduce carbon emissions (`http://opower.com/`). The high demand for a company such as Opower can be explained by the fact that utilities are nowadays required to meet energy-efficiency targets. However, these utilities struggle to realize residential energy-efficiency portfolios as they cannot control the individual energy consumption of their customers: Even ecological light bulbs can consume a tremendous amount of energy if utilities' costumers let them con-

stantly switched on. Opower's role, then, is to intervene in this non-ecological behavior. In accordance with the framework of the aforementioned design, Opower 1) collects and analyzes data on energy consumption, 2) applies several strategies such as sending tailored and personalized energy reports to each customer, 3) conducts the implementation, and 4) evaluates its efficiency by comparing new with old data. Hereby, it should be noted that this process from data collection to individual feedback is continuous and that everything is generated and conducted by the company itself (`http://opower.com/`). The following sections take a closer look at the second step of the framework - applying effective strategies. The aim here is to illustrate the practical realization of several strategies and contrast them with the aforementioned theoretical findings.

III.II. Illustration of Several Applied Strategies

Social Norms

The foundation of Opower began with a field experiment which evolved to be "the largest continuing behavioral field experiments in the world" (Opower, 2013c). The initial aim of this field experiment was to filter out the most effective message in persuading households to turn off their air conditioning and, alternatively, to turn on their fans. The result of this long-lasting study is a very descriptive example of the persuasive power of social norms in comparison to other strategies. For the field experiment, Opower asked graduate students to approach households and to distribute some information about air conditioning/fans. Additionally, the students advertised this particular behavior change with a persuasive message which was printed on a door hanger (Fig. 1.). Each of the households received one of the following messages: "Save money", "Save the planet", "Be a good citizen" or "Your neighbors are doing better". Interestingly, none of the first three messages had any impact on the air conditioning behavior of the approached households (Opower, 2013a). The result of the "Save money" message is in accordance with the previous theoretical findings of Tanner and Kast (2003), and Lindenberg and Steg (2007). Their studies found that social norms are a more effective tool in prompting pro-ecological behavior than economic motives, such as "Save money". The other two messages "Save the planet" and "Be a good citizen" merely emphasize characteristics of "universalism", that is, the engagement in the welfare of humanity and nature. However, if individuals do not display any intention to engage with pro-environmental behavior, such as turning on the fans, then these universal messages are not a very effective approach for this target group (Vermeir & Verberke, 2006). In contrast to the former messages, the statement "Your neighbors are doing better" significantly affected the addressed households to switch from air conditioning to fans (Opower, 2013a). As the theoretical findings state, modeling and providing behavior about other people informs individuals about environmental issues and points these issues out (Staats, Haarland & Wilke, 2004). By displaying that one's neighbors are "doing better", thus having a lower average of energy consumption than oneself, one is confronted with a positive descriptive norm, what people actually do. In this case, the particular household has to adapt its behavior to its surrounding in order to keep up its moral standards, which is completely in accordance with studies focusing on social norms (Cialdini et al., 1990, 1991, 1993). As a result of this field experiment, Opower continued sending its customers not only reports about their individual energy consumption but also charts representing their individual energy development compared to approximately to one hundred of their neighbors (Opower, 2013a).

Descriptive and Injunctive Norms

This integration of social norms into Opower's home energy reports can be seen in Fig.2.. The "Last Month Neighborhood Comparison" displays, on the left hand side, the individual's energy consumption compared to his/her neighbors and, on the right hand side, the

normative (dis-)approval of the individual's behavior. The function of the left bars "you", "efficient neighbors" and "all neighbors" is not only provide individual feedback on energy consumption but also presents how the individual's surrounding community acts, thus presenting descriptive norms. Along with the theoretical findings, the underlying idea here is that individuals deviating from a positive general norm have to adjust their behavior to restore a positive self-image (Gadenne et al., 2011). In this case, the household is ranked not below but above the descriptive norm (that is, the average behavior of the neighbors). This means, however, that this household runs the risk to adjust its energy use to the lower average of "all neighbors". As already stated, the integration of social norms can not only have constructive but also deconstructive power (Schultz et al., 2007), hence evoking the previously explained boomerang effect. In order to avoid this undesired phenomenon, Opower additionally added the right chart displaying injunctive norms, what people approve or disapprove of. Here, these injunctive norms are expressed by either happy, neutral, or sad smileys, which ought to indicate the moral consent about the customer's energy consumption. This method encourages the "great" and "good" energy users, such as the household in Fig.2., to maintain their already positive environmental behavior (`http://opower.com/`). This practical approach of Opower, applying descriptive as well as injunctive norms, is highly consistent with already existing psychological theories mentioned in the previous framework (Cialdini et al., 1990, 1991, 1993, Schultz et al., 2007). However, this approach has also been criticized, most notably by Allcott (2010) who analyzed the effectiveness of the injunctive norms used by Opower. Allcott's study compared households receiving injunctive norms to control households solely receiving descriptive norms. The results indicated that the different categories of injunctive messages, e.g., "good", were insignificant for energy-efficiency results. According to Allcott (2010), the undesired boomerang effect of the descriptive norms is eliminated by either energy conservation tips or by the fact that every household is similarly affected by injunctive norms, regardless of the category. Although this study raises questions regarding the significance of injunctive norms, Opower's behavioral program shows that the integration of social norms is effective (Opower, 2013c). In Opower's international and multi-year study "Five Universal Truths about Energy Consumers" (Opower, 2013c), the company analyzed similarities of energy users around the world and found that social norms are an efficient tool for approaching their customers, regardless of cultural background. However, Opower does not solely integrate social norms into its design; it also employs other strategies, such as increasing energy-related knowledge in an effort to assist households in saving energy.

Energy-Related Knowledge

Another issue addressed by Opower is the lacking energy-related knowledge of the single households. In the U.S., for example, half of the energy consumption in the average household arises unknowingly from heating and cooling (`http://opower.com/`). One reason for this high contribution to energy consumption as a result of improper temperature regulation is that 90 percent of all thermostats are not properly programmed. Therefore, Opower developed a mobile application in an attempt to simplify this regulation and to support costumers to adapt the temperature to their daily schedule, see Fig. 3.. Furthermore, customers are provided with information pertaining to energy consumption and the energy-usage habits of their neighbors, which serves to challenge households to improve their behavior (`http://opower.com/`). This example is in accordance with the previously mentioned theoretical result that people's knowledge on energy-related issues is frequently built on heuristics and/or estimations (Schuitema & Steg, 2005a, 2005b), e.g., energy consumption of electrical devices might be overestimated in comparison to temperature regula-

tion. Furthermore, the absence of knowledge and/or skills can result in a lack of, or inappropriate, action being taken by customers (Schuitema & Steg, 2005a, 2005b). Therefore, the mobile application of Opower combines a variety of strategies, such as increasing customer knowledge, uncovering social norms, and strengthening the customer's engagement (`http://opower.com/`). Here, it can be seen that Opower not only explain the "what" (i.e., the cause of high energy consumption), but also the "how" (i.e., the actual means to lower household temperature and therefore reduce energy consumption). This strategy is in accordance with studies proving that an effective campaign has to increase the action-related knowledge about the link between one's own behavior and environmental issues (Schahn & Holzer, 1990; Tanner & Kast, 2003). In order to provide customers with individual instead of general action-related knowledge/ information, Opower integrated the following methods into their design.

Tailored Energy Measurements and Communication Channels

"Every recommendation we make is in practice bound to run up against roadblocks, which are different for everyone", states Opower about individual barriers and problems (`http://opower.com/`). In order to be responsive to these obstacles, Opower integrates 1) improved energy gauges enabling individual feedback, 2) tailored energy feedback via several channels and, 3) local characteristics. The first advancement seen in the last decade was utilities across the globe investing in Smart Meter deployments. Smart Meter is a developing technology of refined energy gauges providing utilities every 15 minutes with energy readings of households. In contrast, traditional meters only take readings every 12 months. By integrating these gauges, Opower can analyze more than 100 billion meter readings each year enabling their costumers and utility partners to keep track of real-time information. Consequently, the detailed Smart Meter data allows the sending of each household feedback and information which is adapted to its individual barriers (`http://opower.com/`). Opower's second technique is enabling households to survey their energy consumption across several communication devices (Fig.3). A comprehensive study, comparing several countries on their expectations concerning utilities, revealed that customers world-wide would like to receive information by diverse channels. The most demanded media are email, mail and the internet (Opower, 2013b). Even low-income and/or low-technology households can still receive their energy-saving reports via mail. These reports also include tailored information as well as no-cost recommendations for saving money through habit change. Thus, all customers can be reached through their preferred channel(s) of communication. However, this current trend will shift towards an increased demand for mobile applications playing a more important role in creating a personal link between utilities and households. Despite all these customer preferences there are still, according to Opower, few utilities meeting this high level of outreach (Opower, 2013b). As a third strategy for tailoring information Opower modifies its program to local circumstances. In detail this means that the company adapt its messages to the prevalent cultural means of communication, e.g., in Japan there is a long tradition of approaching potential consumers/costumers with clear slogans and direct calls to action (Opower, 2013c). All of these three examples of enhanced tailored feedback/ information are based on psychological theories: Each individual should be addressed with clear instructions on how to solve specific energy-related problems (Pratkanis & Greenwald, 1993), ideally combined with interesting and tailored information to increase action-related knowledge, customer involvement and goals (Locke & Latham, 2006; Gardener & Stern, 1996; Gatersleben et al., 2002; Steg & Vlek, 2009). Hereby, the adaption of the campaign can finally overcome individual barriers and demands (Abrahamse et al., 2007; Daamen et al., 2001). Thanks to the combination of several approaches, such as communication

channels and tailored feedback, the behavioral programs can have a more profound impact on attitudes, beliefs and behavior (McGuire, 1989).

Monitoring Changes

Another example of personally addressing and involving customers is provided on Opower's homepage. The homepage measures how many kilowatt hours and US dollars were saved / pounds of CO2 offset since the company's establishment in 2007 (`http://opower.com/`). This measurement is in line with the theoretical results of Steg and Vlek (2009) that personal commitment might be increased by monitoring changes. Consequently, this engagement leads to sustainable behavior change. These rather abstract numbers are presented in an illustrative way ensuring that customers are able to relate to the monitored changes. As an example, the amount of saved US dollars is clarified with slogans such as "We've saved enough to maintain Mount Rushmore for more than four decades!". And following analogy is applied for the meaning of several million pounds of offset CO2: "We've taken the equivalent of more than 200, 00 cars off the road" (`http://opower.com/`). Moreover, Opower does not only promote its program via their homepage but also through social media.

Social Media

The cooperation between human beings and ecological institutions is more and more based on socio-technological interaction. Hereby, platforms such as Facebook and Twitter are supportive tools for triggering behavior change on a large scale (Sovacool, 2009). Also Opower aims to increase the relevance of energy consumption by embedding it into a social context, "whether it's sharing tips with friends, running energy-savings challenges on Facebook, or claiming money-saving offers" (`http://opower.com/`). On the one hand, the characteristics of online platforms enable sharing positive descriptive norms. According to Bator and Cialdini (2000) an increased environmental awareness in society invites individuals to engage more deeply with this topic. And on the other hand, these platforms do not only encompass social norms but also enable to address individual customers, e.g., by positive feedback and additional motivation. As already mentioned in the previous theoretical framework, providing specific action-related knowledge and tailored information is necessary for any behavior change (Abrahamse et al., 2007; Daamen et al., 2001; Tanner & Kast, 2003). Hereby, the intention of individual customers „to act appropriately" is prompted and supports them in decreasing their energy consumption (Lindenberg & Steg, 2007). These platforms are, therefore, a powerful tool to provide information through an "intuitive design, personalized insights, and recommendations on the go" (`http://opower.com/`).

III.III. Current Upshot and Future Outlook

As previously illustrated, Opower successfully managed to implement theoretical knowledge into real-life settings. According to the company, the extent of its effectiveness can be easily visualized: Opower's customers save every year the equivalent of 30 percent of the energy produced by the US solar industry, the behavioral programs motivate about 85 percent of recipients to take action and, hereby, save on average 2 percent of their usual household expenditures (Opower, 2013a). Moreover, the behavioral programs can trigger a domino-effect: the wider impact of Opower's energy-conservation-program generate broader ecological behavior leading to an overall change in purchase. The total spill-over effects for energy efficiency, beyond the scope of Opower's measures, is stated to be around 20 percent (Opower, 2013a). As psychological theories also acknowledge: the more prevalent environmental awareness is, the more present is a sensation of moral responsibility to take action (Ozaki, 2011). Due to the changing environmental and political circumstances as well as the customers' expectations, it is probable that companies following the principle of Opower

will be higher demanded in the future. As a result of increased costumers' expectations concerning their utilities, customers are likely to demand more comprehensive services than purely transaction-based ones. Simply signing up for utilities, paying bills and dealing with outages seems to be not satisfying any longer e.g. in Asia only 28 percent of the costumers have the feeling that their utility performs well (Opower, 2013c). The question is "How to fulfill customers' expectations and needs to interact with an environmental utility?" The customer's perception relies, hereby, on the service and not on the costs: If they have the feeling that they can trust their utility and enjoy valuable services they are satisfied. According to Opower, factors triggering this satisfaction are the quality of tailored information, communication channels and perceived relationship with the utility. Hence there is an even higher demand for personalized information and greater outreach in the future (Opower, 2013c).

IV. Conclusion

Environmental protection is undoubtedly one of the main challenges of the 21st century, in which everyday actions of individuals are one of the main sources of the greenhouse effect. In order to effectively master this ecological challenge, the cause itself has to be tackled. This paper investigated the research question on how individual small-scale behavior regarding sustainability can be positively changed. Therefore, the results of several studies were embedded into an overall design. Furthermore, the paper highlighted the effective power of behavioral change with regards to environmental issues by using the real-life example of the company Opower. If environmental campaigns are geared to the above described steps from identifying the target group, integrating adequate psychological strategies, implementing the campaign and finally evaluating the campaign's effects, then campaigners could significantly modify people's minor everyday behavior and, thereby, positively contribute to the protection of our environment.

Figures and tables

Figure .1: *Door hangers displaying the four different messages which were used in the field study*

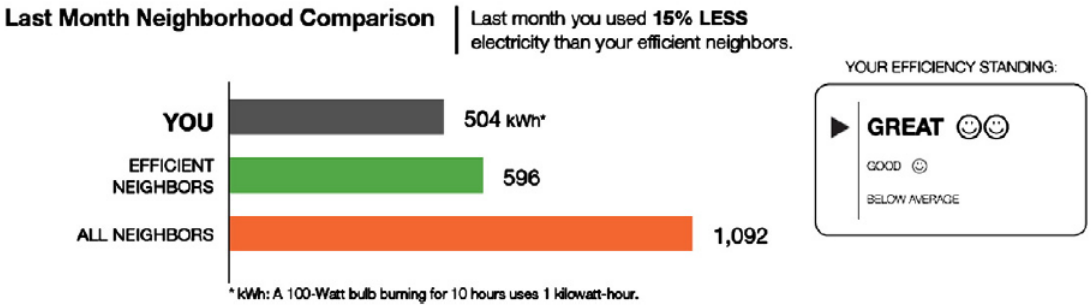

Figure .2: *Home energy reports integrating social norms*

Figure .3: *Tailored feedback and information via several communication channels*

References

Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, T. (2005). A review of intervention studies aimed at household energy conservation. Journal of Environmental Psychology, 25(3), 273-291.

Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, T. (2007). The effect of tailored information, goal setting, and tailored feedback on household energy use, energy-related behaviors, and behavioral antecedents. Journal of Environmental Psychology, 27(4), 265-276.

Allcott, H. (2011). Social norms and energy conservation. Journal of Public Economics, 95(9), 1082-1095.

Bamberg, S. (2003). How does environmental concern influence specific environmentally related behaviors? A new answer to an old question. Journal of environmental psychology, 23(1), 21-32.

Bamberg, S., Hunecke, M. & Blöbaum, A.. (2007). Social context, personal norms and the use of public transportation: Two field studies. Journal of Environmental Psychology, 27(3), 190-203.

Bartholomew, L. K., Parcel, G. S., & Kok, G. (1998). Intervention mapping: A process for developing theory and evidence-based health education programs.Health Education & Behavior, 25(5), 545-563.

Bator, R., & Cialdini, R. (2000). The application of persuasion theory to the development of effective proenvironmental public service announcements.Journal of Social Issues, 56(3), 527-542.

Cialdini, R. B. (2003). Crafting normative messages to protect the environment.Current directions in psychological science, 12(4), 105-109.

Cialdini, R. B., Demaine, L. J., Sagarin, B. J., Barrett, D. W., Rhoads, K., & Winter, P. L. (2006). Managing social norms for persuasive impact. Social influence, 1(1), 3-15.

Cialdini, R. B., Reno, R. R., & Kallgren, C. A. (1990). A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. Journal of personality and social psychology, 58(6), 1015.

Cialdini, R. B., Reno, R. R., & Kallgren, C. A. (1991). A focus theory of normative conduct: A theoretical refinement and reevaluation of the role of norms in human behavior. Advances in experimental social psychology, 24(20), 1-243.

Cialdini, R. B., Reno, R. R., &. Kallgren, C. A. (1993). The transsituational influence of social norms. Journal of personality and social psychology, 64(1), 104.

Cialdini, R. B., Demaine, L. J., Sagarin, B. J., Barrett, D. W., Rhoads, K., & Winter, P. L. (2006). Managing social norms for persuasive impact. Social influence, 1(1), 3-15.

Costanzo, M., Archer, D., Aronson, E., & Pettigrew, T. (1986). Energy conservation behavior: The difficult path from information to action. American psychologist, 41(5), 521.

Daamen, D. D., Staats, H., Wilke, H. A., & Engelen, M. (2001). Improving Environmental Behavior in Companies The Effectiveness of Tailored Versus Nontailored Interventions. Environment and Behavior, 33(2), 229-248.

Danner, U. N., Aarts, H., Papies, E. K., & de Vries, N. K. (2011). Paving the path for habit change: Cognitive shielding of intentions against habit intrusion. British journal of health psychology, 16(1), 189-200.

Flay, B. R., & Cook, T. D. (1989). Three models for summative evaluation of prevention campaigns with a mass media component. Public communication campaigns, 2, 175-195.

Gadenne, D., Sharma, B., Kerr, D. & Smith, T. (2011). The influence of consumers' environmental beliefs and attitudes on energy saving behaviours.Energy Policy, 39(12), 7684-7694.

Gardner, G. T., & Stern, P. C. (1996). Environmental problems and human behavior. Allyn & Bacon.

Gatersleben, B., Steg, L., & Vlek, C. (2002). Measurement and determinants of environmentally significant consumer behavior. Environment and Behavior,34(3), 335-362.

Kok, G., Lo, S. H., Peters, G. J. Y., & Ruiter, R. A. (2011). Changing energy-related behavior: An Intervention Mapping approach. Energy Policy, 39(9), 5280-5286.

Lindenberg, S., & Steg, L. (2007). Normative, gain and hedonic goal frames guiding environmental behavior. Journal of Social issues, 63(1), 117-137.

Locke, E. A., & Latham, G. P. (2006). New directions in goal-setting theory. Current Directions in Psychological Science, 15(5), 265-268.

McGuire, W. J. (1989). Theoretical foundations of campaigns. Public communication campaigns, 2, 43-65.

McKenzie Mohr, D. (2000). New Ways to Promote Proenvironmental Behavior: Promoting Sustainable Behavior: An Introduction to Community Based Social Marketing. Journal of social

issues, 56(3), 543-554.

Neal, D. T., Wood, W., Labrecque, J. S., & Lally, P. (2012). How do habits guide behavior? Perceived and actual triggers of habits in daily life. Journal of Experimental Social Psychology, 48(2), 492-498.

Opower (2013a). Fitting a Square Peg into a Round Hole: Behavioral Energy Efficiency at Scale. Retrieved from http://opower.com/company/library/white-papers

Opower (2013b). Is mobile turning into a missed opportunity? Retrieved from http://opower.com/company/library/white-papers

Opower (2013c). Five Universal Truths about Energy Consumers. Retrieved from http://opower.com/company/library/white-papers

Ozaki, R. (2011). Adopting sustainable innovation: what makes consumers sign up to green electricity?. Business Strategy and the Environment, 20(1), 1-17.

Pickett-Baker, J., & Ozaki, R. (2008). Pro-environmental products: marketing influence on consumer purchase decision. Journal of Consumer Marketing,25(5), 281-293.

Pratkanis, A. R., & Greenwald, A. G. (1993). Consumer involvement, message attention, and the persistence of persuasive impact in a message dense environment. Psychology & Marketing, 10(4), 321-332.

Roberts, J. A. (1996). Green consumers in the 1990s: profile and implications for advertising. Journal of business research, 36(3), 217-231.

Schahn, J., & Holzer, E. (1990). Studies of Individual Environmental Concern The Role of Knowledge, Gender, and Background Variables. Environment and Behavior, 22(6), 767-786.

Schuitema, G., & Steg, L. (2005a). Percepties van energieverbruik van huishoudelijke apparaten (Perception of energy use of domestic appliances). Ontwikkelingen in het marktonderzoek. Jaarboek, 2005, 165-180.

Schuitema, G., & Steg, L. (2005b). Factors that affect the acceptability of pricing policies in transport. In 7th Nordic Environmental Social Science (NESS) Research Conference, Göteborg, Sweden (pp. 15-17).

Schultz, P. W., Nolan, J. M., Cialdini, R. B., Goldstein, N. J., & Griskevicius, V. (2007). The constructive, destructive, and reconstructive power of social norms. Psychological science, 18(5), 429-434.

Sovacool, B. K. (2009). Rejecting renewables: the socio-technical impediments to renewable electricity in the United States. Energy Policy, 37(11), 4500-4513.

Steg, L. (2008). Promoting household energy conservation. Energy policy,36(12), 4449-4453.

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

Tanner, C., & Wölfing Kast, S. (2003). Promoting sustainable consumption: Determinants of green purchases by Swiss consumers. Psychology & Marketing, 20(10), 883-902.

Verplanken, B., Aarts, H., & Knippenberg, A. (1998). Predicting behavior from actions in the past: Repeated decision making or a matter of habit? Journal of Applied Social Psychology, 28(15), 1355-1374.

Vermeir, I., & Verberke, W., (2006) Sustainable Food Consumption: Exploring the Consumer "Attitude – Behavioral Intention" Gap. Journal of Agricultural and Environmental Ethics, 19(2), 169-194.

Wood, W., & Neal, D. T. (2007). A new look at habits and the habit-goal interface. Psychological review, 114(4), 843.

Hives of activity: Contestation and coalitions around pesticides, policies and pollinators

Michael Veale

Lucy Hunt

Juan Guevara

International Centre for Integrated assessment and Sustainable development (ICIS), Maastricht University
Correspondence: michaelrveale@gmail.com

Abstract

Apian decline is a severe problem threatening ecosystems around the world. The exact reasons for it are as yet unknown. In this atmosphere of uncertainty, some have blamed a widely used family of pesticides known as neonicotinoids for the decline, while others claim that there is no evidence for the alleged effects. This paper reviews the knowledge products that both coalitions use to support their claims, and identifies common core policy beliefs held by each side. It argues that some unanswered questions with particularly uncertain outcomes are systematically ignored by both coalitions in research and discussion, and that these areas are crucial to understanding the true nature of the problem. Furthermore, it argues that the qualitative features of prominent science policy boundary objects provide some insight into why cross-coalition progress has been so slow. A facilitator perceived by both sides as impartial appears to be needed to achieve more consensus and credible understanding about the issue, but questions persist regarding who could be accepted for this role.

I. Introduction

The issue of declining bee populations has become an increasingly salient policy issue in recent years. Pollinators, such as bees, have been observed to be dwindling in number in many regions of the world (vanEngelsdorp et al., 2012; van der Zee et al., 2012). If this trend continues, this is expected have severe negative impacts on both agriculture and natural ecosystems. New and old groups of activists and researchers have been mobilised and created with the specific aim of understanding and communicating what they believe to be the main causes of this decline, as well as lobbying for relevant policy and behavioural change.

Recently, one particular practice has been brought to attention and has been alleged to be at least partly responsible for apian decline – the use in varying forms of a chemical family of insecticides known as neonicotinoids. This caused a rise in the prominence both of coalitions advocating precautionary regulatory action against these products, and opposing coalitions which have denied their relevance to the problem, or requested further research

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in the field before action. These coalitions further crystallised when the European Commission (EC) initiated legislative action to ban three common neonicotinoids, imidacloprid, clothianidin and thiamethoxam, being used on or in relation to the main bee-attractive crops within the European Union (EU). At this point, governments and other actors initially less involved revealed their stance on both the issue and the current state of the scientific literature. Despite no qualified majority for or against the legislation in the Council of Ministers, the nature of the issue allows the EC to implement immediate action, which it did with a ban that entered into force at the beginning of December 2013, and will be reviewed in 2015.

This paper positions the actors in two main coalitions, those in favour of an immediate regulatory ban and those opposed. It examines the use of information by these two coalitions, and how their competing views and framings of the problem, current research, and types of knowledge interact to produce stances and policy outcomes. We consider how the framings of the coalitions connect to their view of research, and conceive each coalitions view of what they know and don't know using the concepts of knowledge, nonknowledge and negative knowledge. This allows us to consider what each coalition think they know, what they want to know, and what they don't want to or don't think they can currently know, and identify similarities between the coalitions at deeper levels. We then move on to analyse the approach and roles adopted by scientists and organisations in four salient knowledge products and three main science-policy interface texts with some core frameworks largely derived from the STS literature. We conclude with discussing some of the key barriers to communication and progress across the coalition, and some comments on anticipated future directions and disrupters of the current structure.

II. Problem Framing

II.I. Identifying and placing actors

The approach taken in this paper is the identification of coalitions and their environments in line with the Advocacy Coalition Framework (ACF), as adapted for European policy-making (Sabatier, 1998). This framework combines the literatures on policy implementation with the literatures on technical knowledge used in public policy, and therefore appears well-suited for our case study. However, this paper is not a full application of the framework, as it deals mostly with a set of decisions made within a short time period, largely beginning from a series of acute apian poisoning in the south of Germany in 2008, which brought the issue into the policy arena. The ACF requires a more longitudinal study of issue development over a decade or more, while our case study is certainly only in an early phase of existence and understanding. However, we seek to apply the basic premise of the ACF: that the two main causal drivers of policy change are changes in the core values of coalition members, and external perturbations.In the ACF, a coalition is defined as a group of "actors from various governmental and private organizations who both (a) share a set of normative and causal beliefs and (b) engage in a non-trivial degree of co-ordinated activity over time" (Sabatier, 1998, p. 103). They hold both deep-set normative beliefs as well as less rigidly held policy core beliefs, an example of the latter being the relative importance of economy to environment, or the structure or causal connections of a problem. We identify two main coalitions in the neonicotinoid debate: the first, which we call Coalition A, is in favour of the ban. They envision the problem as mainly concerned with long term agricultural and environmental issues. The second, Coalition B, perceives the problem as largely about medium term agricultural and economic interests. Important members of the two coalitions can be seen in Figure 1.

Coalition A includes several European governments, for a variety of reasons. Some countries, like France, had already placed a ban due to public support despite having powerful farmers' unions. Consequently, their position has often been stated in terms of competitive benefits of harmonised policy (EurActiv, 2013). Germany's position was less certain, as while it had banned application of certain neonicotinoids on corn and maize following deaths of managed bee colonies from acute poisonings in 2008 (Benjamin, 2008), it is also the home of one of the main manufacturers of this type of pesticide, Bayer AG. This may explain its abstention in the first round of voting on the ban on March 15 2013, compared to its affirmative vote in the final round on April 29 2013. The Netherlands, one of the countries to first formally request the European Commission to undertake legislative action, declared themselves in this coalition at an early stage (Dutch Delegation to the Council of the European Union, 2013).

Coalition B includes the UK Government, usually represented in publications by the Department for Environment, Farming and Rural Affairs (DEFRA); the main pesticide manufacturers including Bayer CropScience and Syngenta, the former turning over €697m from neonicotinoid sales in 2007 (Garwood, 2010); and farmers' unions and crop protection associations at national and supranational levels.

II.II. Issue framing by the identified advocacy coalitions

We argue that the coalitions have shared core policy beliefs, especially regarding the nature and structure of the problem. While they may individually have different priorities and precise beliefs, each coalition shares general concerns about the ways the other coalition frames the neonicotinoid debate. Consequently, their views are best visualised in a table, as coalitions are both defined by what they think and what they do not think. Our tabular visualisation of the views of the two coalitions can be found in Table 1. Both coalitions share general concerns about the issue at hand. It is in no-one's benefit to see pollinator numbers decline, as in addition to having intrinsic value, they provide a crucial ecosystem service for agriculture. The worldwide value of pollinators has been placed at €153bn (Gallai, Salles, Settele and Vaissière, 2009), although it has also been claimed that our current understanding of the role of pollinators means that many benefits are unable to be quantified (Losey & Vaughan, 2006). Consequently, they have a shared definition of the larger problem of reducing the occurrence of pollinator decline. On more specific topics, divisions begin to appear. Coalition A believes that the evidence indicating dangerous side-effects of neonicotinoid pesticides are sufficient to warrant a European ban. They emphasise indirect effects as well as acute direct toxicity, such as reducing bees' immune capabilities, their homing or memory skills, communication and foraging abilities. In general, although some coalition members view the problems through more complex lenses, a large number see apian decline fundamentally as a man-made problem, which equally has relatively linear human solutions. Neonicotinoids are framed by this coalition as being a central enabling factor to a large number of identified causes of the decline, although it is unclear to what extent this is a belief held by all coalition members, and how much some members are using this framing instrumentally to support a ban they feel to be at least partially constructive. Despite this lack of belief in problem complexity, they tend to trust methodologically complex research, believing that the current paradigm of proof of safety in toxicology research is inadequate to demonstrate the true dangers of many chemical products.

Coalition B, on the other hand, uses the uncertainty present in current research to frame the ban as a rushed and potentially economically damaging move with little or no proven positive environmental consequences. Instead of framing neonicotinoids as a central causal factor, they point to other causes of decline, both natural and man-made, such as habitat

loss, disease and weather. Coalition B fundamentally weights environmental precaution less heavily than economic factors compared to Coalition A. Consequently many of their arguments are termed in the language of monetary valuation, especially when compared to reports produced by members of Coalition A. Coalition B tends to express the belief that the traditional methodologies and paradigms of proving toxicological safety to the environment are adequate to understand problems, and we should be wary of drawing conclusions from new methods, for example, those that extrapolate field conclusions from allegedly unrepresentative lab results.

III. Knowledge products

III.I. Approach and methodology

In order to choose knowledge products to analyse, we initially ran searches for the term "neonicotinoids" and its respective translation(s) in French, German, Spanish and Dutch through government websites we were aware of, national and European parliamentary debate records, and the ProQuest, Nexis and Factiva news databases. By reading the documents we identified further stakeholder organisations and reports that had not initially been raised in our search. By the end of the search period we had filed 380 journal articles, reports, press releases, presentations and regulatory documents. Some knowledge products, while extensive, were not referenced heavily by key actors, whereas others were referred to by the actors that we initially noted to be important in decision-making and problem framing. We observed that four products were extensively used, discussed and debated by actors on both sides of the coalition. These are listed in Table 2.

III.II. Competitive knowledge claims

Competing knowledge claims exist both between actors and between the reports. Because many of the knowledge products in this field were either commissioned or funded by stakeholder bodies, it is difficult to precisely delineate the views of actors' from the views of researchers. We do not believe, however, that an academic paper is the right venue for building allegations of bias, especially not without primary interviews or communication with authors and clients to establish story lines. Instead, we use concepts of meta-knowledge to argue that many of the key disagreements between actors and research can be understood through how each has understood the quality of our nonknowledge and negative knowledge surrounding neonicotinoid effects and pollinator behaviour in general.

Nonknowledge (Gross, 2010) can be thought of as knowledge about the extent of not knowing, with an intention to explore it. Actors gain nonknowledge in response to unexpected events, developments or demands. For example, theories may be lacking to explain certain phenomena or adequately develop hypotheses, or data insufficiencies may cause large uncertainties in results, making them uninterpretable. In a similar vein is the idea of negative knowledge (Knorr-Cetina, 1999), which is similar to nonknowledge but differs insofar as actors do not wish to explore what they do not know, because they may think it futile, counterproductive or even dangerous given their values and goals.

As discussed, the coalitions in favour of the ban tend to believe that laboratory tests can be extrapolated to field effects, and dispute the findings and methodologies of field tests. The coalition opposed to the ban argues the opposite, that laboratory tests are unrealistic and methodologically questionable, while field tests represent real risks and are methodologically defensible. This divide is at the heart of the debate on valid research, since high profile laboratory tests (e.g. Gill, Ramos-Rodriguez,

& Raine, 2012; Henry et al., 2012; Whitehorn, O'Connor, Wackers, & Goulson, 2012) have demonstrated adverse affects, while high profile field tests (Pilling, Campbell, Coulson, Ruddle, & Tornier, 2013; e.g. Thompson et al., 2013) have concluded that there is no significant risk.

Table 3 shows examples how the different coalitions classify topics as already known (knowledge), not yet known but with intention to know (nonknowledge), and not yet known with no intention of knowing (negative knowledge). We have provided evidence for the first two categories, which is primarily found in the parts of reports reviewing or consolidating knowledge, and the parts calling for further research respectively. The final category of negative knowledge is harder to locate and evidence, due to its nature. Regarding negative knowledge, coalitions wish to reduce the salience of such questions, due often to uncertainty about how this knowledge may change conclusions. Consequently, one major caveat of our methodology is the heuristic identification of the contents of this section, which can be subject to the perspectives of individual readers.

The first category of knowledge is quite simply analysed. The coalitions represent two diametrically opposite views and readings of data. One set of claims from Coalition A argue that we know 'worst case' field doses, and that these doses are common enough to cause harm to individual bees, which is a cause for concern. Furthermore, there is no evidence that successful farming requires neonicotinoids, and examples of countries where they have been banned already, such as Italy, are given to support this. The claims from Coalition B note that general field doses, which are what we should base risk assessments on, are within a known, safe range to colonies. Moreover, farming without neonicotinoids would be riskier and less productive, and not necessarily beneficial to bees. Australia is often cited as an example of a country where neonicotinoids are used heavily but bees are flourishing, arguably due to the lack of the varroa mite. The disputes between these claims are twofold. Firstly, there is an argument over which data, examples and methodologies are reliable, which result in data claims. Secondly, there is an argument about framing. This is most clearly seen in the way that Coalition A points to data of individual bee harm, and Coalition B uses data pointing to colony safety. This will be returned to shortly.

The second and third categories of nonknowledge and negative knowledge become more strategic in nature. These represent tactics which are beneficial for each coalition. Areas of nonknowledge are in this case areas where coalitions hold prior beliefs about what exploration of these areas would show, and wish to explore these areas to gain knowledge that can support both their strategic positions and their cognitive framework. Nonknowledge for each coalition is often a direct extension of their own perceived knowledge. For example, Coalition A indicates wishes to further explore bee behaviour, alternative pathways of transmission, and interaction effects, as these under-researched areas have shown promise of highlighting methodological problems in field trials. Coalition B highlights other research directions, such as how far bees avoid neonicotinoid forage sources, and alternative causes of decline, as these often undermine laboratory trials' claims to field-relevance.

Finally, negative knowledge indicates areas which are not currently known about, but a coalition is actively avoiding pursuing research into. This is likely because the expected conclusions have an unacceptably high perceived chance of being contrary to a coalition's argumentation and worldview. Interestingly, perhaps due to the high uncertainty in these areas, both coalitions share topics in this category. We could not find evidence of a coalition seeking to pursue research in how individual bees affect their colonies, which has been noted to be a large gap in knowledge (Cresswell & Thompson, 2012). This is intuitive: little knowledge exists on the intricacies of complex systems like bee colonies, so predicted results from research, if it were at all possible, would

be unclear. To find that individual bee death do not endanger colonies would largely undermine the laboratory studies, which have shown stronger evidence for individual level effects than colony collapse. Equally, to find that they do would cast the credibility of all contradictory field studies into doubt. This is an interesting finding, because it indicates that advocacy coalitions, who often wield significant funds for scientific research, may actively wish to neglect the more complex, foggy and uncertain questions in a field.

III.III. Differing roles of scientists

Scientists take many roles, both independently and in relation to policy. As independent researchers, Stokes (1997) classifies those solely interested by use, such as Thomas Edison, those solely interested in basic research for research's sake, such as Niels Bohr, and those who conduct 'use-inspired basic research' such as Louis Pasteur. Pielke Jr (2007) argues for a typology in four parts: pure scientists disinterested in policy, science arbiters answering specific questions posed by policymakers, issue advocates who limit scope of choice by using scientific research and/or authority to advance particular ideas they believe in, and honest brokers, who widen the scope of choice for policymakers by linking research to different paths of action. Jasanoff (1987) notes that the perception and definition of science's objective nature and its link to policy is inherently political and constantly redrawn by both scientists who may see politicisation as potentially endangering their cognitive authority and policymakers, who often strategically demand arrangements allowing 'science' to legitimise policy in uncertain, grey areas. Finally, Cash et al. (2003) provide a useful framework of salience, credibility and legitimacy, with which to analyse the success and acceptability of knowledge products. Since all of our case studies are chosen based on salience, we focus here on credibility and legitimacy. We take the lexicon of these frameworks to analyse our four knowledge products (see Table 2) in an attempt to conceive both some of the roles that scientists are taking, and the roles they are perceived as taking.

III.III.I. Thompson et al. (2013)

This study was carried out with the explicit intention of field testing the laboratory-based conclusions of Whitehorn et al. (2012) that neonicotinoids have a an effect on colony growth and queen production. To this extent, it is clear that it is a report that seeks to contribute to basic knowledge on this topic. Indeed, the study claims that there were at time of publishing "no published field data evaluating such effects on bee species other than honeybees" (Thompson et al., 2013, para. i). Yet in addition to this, it is a document which has been produced with policy relevance in mind. The initial publication on the FERA website was in March 2013, which coincided with the voting rounds in the European Union on March 15 and April 29. The report states that peer review was opted out of for this publication, as "it was considered that the data should be available for review in a shorter timescale than is achievable through peer reviewed publication". In this sense, the report already indicates a trade-off being made across the worlds of science and policy. This would perhaps initially place them in the position of a science arbiter, answering the question provided by DEFRA, and undertaking use-inspired basic research, with the use being that of regulatory advice.

However, other actors have perceived the roles that the researchers took differently. These actors, many of which exhibit views or conclusions consistent to those described of Coalition A, seek to cast doubt upon the cognitive authority of the FERA scientists in two ways.

Firstly, they question the credibility of their findings. The Advisory Committee on Pesticides, which is an UK government body comprised of experts, the House of Commons Environmental Audit Committee and the EFSA

all concluded that the report's conclusion of no risk was difficult to justify. The reasons given were the report being hastily set up in the two weeks following the EFSA report, it being difficult to reproduce due to problems with the control colonies being introduced at a later date, and some colonies being larger or more developed at introduction (Advisory Committee on Pesticides, 2013; Environmental Audit Committee, 2013; EFSA 2013). Dr Lynn Dicks noted before the study was concluded that the ability to draw conclusions would be confounded by non knowledge about bee behaviour (Environmental Audit Committee, 2013), and the Advisory Committee on Pesticides noted the same after completion (Advisory Committee on Pesticides, 2013). All in all, given the subject matter and time-frame, many of the critical actors appear to claim that role of FERA as science arbiter is to answer, in the words of Weinberg (1972), "questions which can be asked of science and yet which cannot be answered of science". While this may still mean we consider the FERA scientists as science arbiters, it also raises the possibility that they are acting, either knowingly or unknowingly, as issue advocates. The implication of this would be that they either knowingly over-inferred from their data, or that the inconclusive results arising from DEFRA's 'grey area' hasty questioning were intended to be used strategically, rendering them unintentional stealth issue advocates, in Pielke Jr's words. The Guardian newspaper also argued that the report would be unlikely to be accepted into a peer-reviewed journal (Carrington, 2013a). The use of this research is widely used within Coalition B. B member Syngenta cites the report prominently on the front page of the website, The Plight of the Bees, as a report that "confirms that there is no significant link between neonics and bumble bees" (Syngenta AG, n.d.a).

Secondly, they question the legitimacy of their findings. An article in the Guardian, a debate in the House of Lords and public relations material from the European Beekeeping Coordination all question the appropriateness of the announcement of the move of the lead author from her career as a UK civil servant to scientist for the neonicotinoid manufacturer Syngenta three months after the publication of the FERA report (Carrington, 2013b; European Beekeeping Coordination, 2013a; Hansard, 30 July 2013 col 1636).

III.III.II. Noleppa and Hahn (2013)

This study by the Humboldt Foundation for Food and Agriculture e.V. (HFFA) examines the economic effect of ceasing neonicotinoid use on crops within the European Union. It concludes that there are high costs to abandoning the use of neonicotinoids, and it may have an upward effect on food prices.

Criticism once again targeted both credibility and legitimacy. In terms of credibility, Coalition A members Pesticide Action Network Europe claimed that the valuation method was questionable, while the Soil Association noted that the report did not place a value on pollinators, which it claims are worth three times as much as the estimates of the costs of neonicotinoid abatement (Environmental Audit Committee, 2013, para. 68).

In terms of legitimacy, much criticism was focused in this area. The publisher, HFFA was established only in 2009 with direct funding from Bayer AG (von Witzke, Noleppa & Schwartz, 2009), and now acknowledges additional support from Syngenta AG, the European Crop Protection Association, KWF Seed and BASF SE (HFFA, n.d.), all of whom fall strongly in Coalition B. The report has a separate website, neonicreport.com, containing videos about neonicotinoid use and links to several Coalition B members. Consequently, David Goulson, a professor at the University of Sussex (then at University of Stirling) described it as "laughable propaganda" with "no basis in fact" (Stafford, 2013). Corporate Europe Observatory, a research and campaign group examining corporate lobbying in the EU, attempted to show Bayer and Syngenta both attempting to portray the HFFA as a pure science

organisation, whereas they believed it to be a stealth issue advocate, basing their claim on a lack of acknowledgement of funding sources in some letters from Syngenta and Bayer citing the Noleppa and Hahn report (Corporate Europe Observatory, 2013). The House of Commons Environmental Audit Committee (2013) also noted that the HFFA was asked to consider the economic effects of a ban on all neonicotinoids, rather than just those in the proposed EU legislation, for the proposed banned purposes. They fundamentally claim that the HFFA, in its role as science arbiter, is acting as a stealth issue advocate by feigning the production of policy relevant research to its client's own ends. Syngenta however argue that funding does not cause bias and undermine cognitive authority, writing on their website that "research directly or indirectly paid for" by any stakeholders is not "discredited just because of the source of its funding. Some of this research is important and useful".

Potentially in response to these credibility and legitimacy concerns, DEFRA revealed in a Freedom of Information Request that they are currently working on their own economic valuation of neonicotinoid abatement as part of an impact assessment to be published in April 2014 (DEFRA, personal communication, December 2, 2013).

III.III.III. European Food Safety Authority (EFSA) (2013a, 2013b, 2013a)

The European Food Safety Authority (EFSA), an EC agency, aims to be an "independent source of scientific advice and communication on risks associated with the food chain". In 2012 the EC asked the EFSA to perform an assessment of the risks the three main neonicotinoid pesticides pose to bees and their colonies. The report, delivered in three parts representing the three substances on January 16 2013, synthesised submitted studies, concluding in a press release that "only uses on crops not attractive to honey bees were considered acceptable" (EFSA, 2013d). Despite identifying significant data gaps and uncertainties, the EC used this report as the main justification for the two-year ban that started in December 2013.

In regard to legitimacy, Coalition B members Syngenta and the European Crop Protection Association (ECPA, 2013) argued that the EFSA was not representative in its choice of reports. Syngenta claimed the EFSA ignored all field studies they submitted, since they exhibited "non-compliance" with the review criteria due to not representing the worst case scenarios (Ashurst LLP, 2013). In addition, they claim that the EFSA allowed only ten days instead of the usual thirty for submitting a response to the risk assessment, which Syngenta adhered to, and yet a call for "swift and decisive action" was made by the Commision eleven days later, leading Syngenta to believe their response was "disregarded" (Syngenta, February 8 2013). Furthermore, Coalition B members DEFRA (Environmental Audit Committee, 2013, Q596), the National Farmers Union (National Farmers Union, February 20 2013) and Syngenta argue that the EFSA misrepresented its report in its press release, going beyond its mandate in deciding what is "acceptable" or not. Syngenta was particularly concerned about misrepresentation of the extent of risk from its thiamethoxam product, noting that the widespread use of this press release was damaging (Syngenta, January 15 2013). In legitimacy terms, the EFSA has been accused of acting as a stealth issue advocate deliberately 'doing bad science' and misrepresenting its results.

Credibility is an area that is more broadly targeted. Coalition B members claim the report is overly conservative (Campbell, 2013), overly theoretical (European Seed Association, 2013; Syngenta, 2013) and rushed (Environmental Audit Committee, 2013, para. 71). The result coming down in favour of banning neonicotinoids has been claimed to be biased, as evidence indicating harm is "easily accepted", while evidence indicating safety is "subject to deep scrutiny" (Campbell, 2013 p. 55).

The EFSA identified many 'data gaps' and

uncertainties in each risk assessment, and were required to compile a lot of evidence that may be contradictory. The controversy around their centres worries that they have attempted to "banish" uncertainty rather than communicate it, which is unsuited to areas where the political stakes are high and the uncertainties large and varied (Funtowicz & Ravetz, 1993). Assuming the role of a science arbiter for the European Commission in a situation like this may be inappropriate, as complex questions of risk are inherently questions of societal values (Giddens, 1999). Instead, a role of an honest broker may be more appropriate, widening the scope of choice and communicating uncertainty along with possible paths of action to both reduce it and make relevant policy. However, this is easier said than done, as has been shown with the difficulties and criticism the Intergovernmental Panel on Climate Change has faced in spite of the efforts it has made to communicate uncertainty in innovative ways (Patt & Dessai, 2005).

III.III.IV. Henry et al. (2012)

The Henry et al. (2012) paper is an example of a number of papers published in high-impact scientific journals in 2012 regarding bees and neonicotinoids (see also Gill et al., 2012; Whitehorn et al., 2012). This paper was one of the main reasons for the European Commission to request the EFSA to produce the risk assessment report discussed above (EFSA, 2012). This paper can be considered to have been produced on a largely pure science basis, by university researchers seeking to publish studies. However, it can also be considered as use-inspired. The word "common" in the title, "A common pesticide decreases foraging success and survival in honey bees" is one sign that this research was done with the situation on the ground strongly in mind.

Legitimacy of the research itself has not been very highly criticised in this case. Most of the legitimacy criticisms have been levelled at those using the research. Syngenta, for example, claims that the paper is a "good example of research being misused" by the French government (Syngenta, n.d.b). Other actors, such as David Goulson at the University of Sussex, have defended its legitimacy against perceived attacks, stating that they "are published in the best journals in the world ... have been through an excruciatingly tough peer review process ... Which group of studies would you trust?" (Goulson, 2013).

Credibility on the other hand was much more hotly disputed. A report produced by Bayer that was unpublished but was delivered to boundary institutions such as the Congressional Research Service in the US (Scierow, Johnson & Corn, 2012, p.27) claimed that Henry et al. tested bees at dosages "over twenty times greater than a worst-case estimate of the acute oral dose that is field relevant" (Heintzelman, Kelly, Fischer & Maus, 2012, p.1). Syngenta on their website put this objection more informally, claiming that "dose rate was so high and the period of exposure so short that it would have been equivalent to a person consuming 5 bottles of wine in a day instead of just a glass" (Syngenta, n.d.b). Other researchers however are critical of the objection of Heintzelman et al., claiming that their concern "is based on an unnamed estimated level derived from an unnamed acute dose for reduction in foraging flights. This violates the standard practice of giving the authors or any other reader the option to refute any calculated dose raised as an objection by checking the calculation for themselves" (Frazier, 2012, p.3). Coalition B member DEFRA raise related concerns to fellow members Bayer and Sygenta, claiming that the credibility of the report is limited to an "unusually extreme case", not one that is "average or normal" (DEFRA, 2013, p.3). As it can be seen here, coalitions do not attempt to hijack or discredit these papers based on the role of the scientist, since that remains relatively agreed upon between coalitions as a pure, use-inspired position. Instead, the debate largely falls to the previously discussed divides between the coalitions on stated core beliefs.

III.IV. Science–policy interfaces

There are many science-policy interfaces active in this case, which connect research and scientific thought to policy options and approaches. A key issue is both how far they are accepted by all actors, and how far they are perceived as falling into a particular coalition. We focus on boundary texts, which are one type of boundary work, and argue that two of the main interfaces – the DEFRA policy text "An assessment of key evidence about Neonicotinoids and bees" and the EFSA policy report discussed in 3.3.3 – are considered too partial to be at the boundary of the whole issue, and instead are considered communication from coalitions B and A respectively. A third report, the report from the UK Parliament Environmental Audit Committee, has not been attacked or accused of bias despite coming down in favour of the ban, yet has also not managed to extensively influence views. We argue that this is because it better approximates Hoppe's (2010) conditions (see Table 4) for successful boundary arrangements.

DEFRA (2013) summarises and weighs the three laboratory studies in laboratory against five field studies, which are represented by Thompson et al. (2013), in an attempt to communicate the state of the knowledge in a five-page policy-relevant document. However, it is not only the report's strong preference for the results and methodology of the criticised DEFRA-commissioned study that cause concern about its acceptability. The text's construction occurred within the department, behind closed doors, and in an unclear ad-hoc arrangement. Co-production and double participation were minimal, perhaps why the report cites Thompson et al. (2013) as "representative" of four other field experiments. Goulson (2013) notes this is incorrect as two contain only field observations and no experiments at all and one contains no new data whatsoever. In general, the report, while claiming to work on the boundary of science and policy, both falls firmly and is perceived to be within the belief structures of Coalition B, and therefore cannot straddle the entire issue. EFSA (2013a, 2013b, 2013c), as mentioned in 3.3.3, serves as a research synthesis of studies. As shown in Table 4, it performs better than DEFRA due to a more inclusive process with a larger variety of experts, peer review and comment structures, as well as direct links to flexible EC research funding. However, the exercise is not fully open, the actual analysis is not co-produced, and there were worries, especially from Coalition B, about the clout of research being linked to the results. Subsequently, despite its central, pan-European position, the EFSA has been widely perceived as a Coalition A actor, and an illegitimate forum for broadly accepted knowledge production and communication.

The final report, from the Environmental Audit Committee (2013), took written and oral evidence from a wide variety of actors. This evidence was assembled by members of Parliament, who themselves have legitimacy through a political mandate. Consequently, despite the recommendations of the committee's report resembling the EFSA's to a certain degree, and the report being publicised and salient, we could find no examples of it being framed as illegitimate. However, similarly, there is little evidence that it changed the views of any key coalition actors. Jasanoff (2005) uses the example of biotechnology to argue that negotiated, state-led committee systems such as this committee may generate knowledge that is accepted more readily by the public. However, public knowledge creation in the US is more pluralistic and less service-based. Those structures can create legitimacy in the eyes of private actors who hold relatively large stakes, but may fail to convince the public. While the Environmental Audit Committees report may be legitimate in the eyes of the public and therefore difficult for any coalition to delegitimise, it is important to consider too the set of actors that a report must be legitimate to, in order to reach agreement. In the case of neonicotinoids, compromise between the coalitions has to be reached, rather than simply public consensus. Fundamentally, while the Environmental Audit

Committee is a step in the right direction, there are currently no boundary actors that truly are perceived as existing between the coalitions, able to create a focal point for co-operation, contestation and consensus-building.

IV. Conclusion

As this issue is still ongoing, it is difficult to reach strong conclusions about any future direction now. As one columnist in Nature wrote, the current ban will, more than anything else "buy some time" for more research on the subject (Dicks, 2013, p. 283). Yet we can draw a few points out of our analysis which both help understand the situation and may be useful recommendations for the future.

Firstly, the shared negative knowledge possessed by both coalitions strongly hinders understanding of the subject. These topics, which both sides have incentives to keep off the table lest they discover something which undermines their carefully constructed argumentation and beliefs, are under-researched, underfunded and generally lack salience. There is a strong role for a central actor outside of coalition to promote and fund research in areas of scaling bee effects to colony effects, and developing understanding that help us better control in the field – for example, developing methodologies to mapping pesticide use on nearby fields to identify potential test sites. However, there are of course caveats here. Both endeavours are complex: negative knowledge is not just something you might not wish to know, but also something you think you cannot know. To that extent, resolving conflict through better understanding the evidence may be limited by our current ability to understand these topics.

Secondly, there is no easily identifiable actor which has a central, international and cross-sectoral role, yet has not arguably placed themselves in a coalition. The European Commission would be a prime candidate, yet its perception of being one-and-the-same as the EFSA, and adding a political spin to research, means it is no longer able to act as a facilitator both on the boundary of science and policy, and between coalitions with divergent views. The UK Parliament had a strong and admirable attempt to produce a report, yet that report may, for the reasons discussed above, be more convincing for the public than for stakeholders. Progress on understanding and interpreting the evidence may be made if such a facilitator could be found, or if the European Commission is able to create a forum for debate where it is not perceived as a partisan actor.

Thirdly, the divide in knowledge is quite a neat one, given the divisions between 'laboratory' and 'field' studies coinciding with the results. While this divide arises somewhat from methodological differences, it is not so clear that it is a particularly robust relationship. The coalitions are likely to be shaken up, were reputable field studies to show positive effects, or laboratory studies negative ones.

To conclude – unlike many complex problems, everyone agrees that bees are important. The real debate here is about the knowledge, and policy's responses to and interpretations of 'the science'. We have illustrated the key divides in thought, and shown how until certain under-researched topics are examined, there is little hope for the debate to be resolved with 'brute force' of evidence. Instead, an arena is required where this problem can be thought of as a puzzle rather than a political debate. Frustratingly, there is no key actor that is currently well positioned to facilitate such a collaborative zone. Time will tell how the tensions and adversarial positions will resolve themselves or develop further. However, it is clear that agreement on the validity of this issue, and the consequent approach to be taken, will require techniques of discussion and engagement that have so far been conspicuous by their absence.

Figures and tables

Figure .1: *The two advocacy coalitions identified in the Apian-Decline-Neonicotinoid policy subsystem*

Core policy belief	Coalition A: *In favour of the ban*	Coalition B: *Against the ban*
Shared problem statement	Pollinator decline is threatening global agriculture	Pollinator decline is threatening global agriculture
Specific problem statement	Negative long term agricultural and environmental effects arise due to neonicotinoids' effects on bee colonies	Agricultural competitiveness is threatened by a ban on neonicotinoid pesticides
View on uncertainty	Uncertainty means precaution should be taken	Agricultural competitiveness is threatened by a ban on neonicotinoid pesticides
Focus of arguments	Environmental arguments, pollinator decline	Economic arguments, food insecurity and price increases
Causes of apian decline	Neonicotinoids both as direct cause and/or indirectly facilitating other factors	A myriad of factors
View on pesticides in general	1.minimal, best avoided	1. newer pesticides crucial for food safety and security
	2. potentially dangerous for human health	2. must be correctly applied 3. potential danger from replacing [neonicotinoids] with older products
View on body of research	Adequate to demonstrate direct/indirect effects on bees	Inadequate logical upscaling from individual bee effects in the laboratory to colony effects in the field
Choice of policy instrument	European ban as a minimum standard	More focussed (EU) efforts on apian nutrition, viruses and habitat loss
More focussed (EU) efforts on apian nutrition, viruses and habitat loss	High, as many related issues solvable with command and control style ban	Low, due to no core problem causing apian decline

Table .1: *Core policy beliefs of the two identified coalitions*

Reference for knowledge product(s)	Description of report
Thompson et al. (2013)	Field study conducted by the UK Food and Agriculture Research Agency, commissioned by the UK Department for Food, Environment and Rural Affairs. Designed to examine if there were any major effects on bumble bees from exposure to neonicotinoids in the field.
European Food Safety Authority (EFSA) (2013)	The Authority, an agency of the European Commission, was asked by the Commission to assess risks linked to the use of the neonicotinoids clothianidin, imidacloprid and thiamethoxam as seed treatment or granules.
Noleppa and Hahn (2013)	A "socio-economic, technological and environmental review" of the value of seed treatment by all types of neonicotinoids in the European Union. Published by the Humboldt Forum for Food and Agriculture.
Three 'laboratory' studies: i) i) *Henry et al. (2012)* ii) *(the focus as it captures much of the debate)* iii) ii) Whitehorn, O'Connor, Wackers, and Goulson (2012) iv) iii) Gill, Ramos-Rodriguez, and Raine (2012).	*i) A laboratory study published by French researchers in Science indicating that the neonicotinoid thiamethoxam decreases foraging success in honey bees.* ii) A laboratory study published by UK researchers in Science exposing bumble bees to field-realistic levels of the neonicotinoids imidacloprid and noting a significant decrease in growth rate and the production of new queens. iii) A laboratory study published by UK researchers in Nature indicating that combined exposure to both neonicotinoid and pyrethroid pesticides impairs foraging performance and worker recruitment, and increases both workers losses and the propensity for an entire colony to fail.

Table .2: *Four knowledge product case studies*

	A: In favour of the ban	B: Against the ban
Knowledge	'Worst case' field doses identifiable (EFSA, 2012; Environmental Audit Committee, 2013, p. Ev 18)	Range of realistic field doses. (Heintzelman et al., 2012; Syngenta, n.d.b.)
What is known	Neonicotinoids have the potential to be harmful to individual bees at field levels (European Parliament, 2012; Tirado, 2013, p24) Farming without neonicotinoids has no necessary significant yield effects (European Beekeeping Coordination, 2013b, Environmental Audit Committee, 2013).	Neonicotinoids at normal levels, applied correctly are not harmful to colonies (Syngenta, n.d.b; Heintzelman et al., 2012; DEFRA, 2013; European Crop Protection Association, 2013) Farming without neonicotinoids would be dangerous and have significant downward yield effects (Noleppa & Hahn, 2013; UK Government, 2013, para. 41; National Farmers Union, February 20 2013)
Nonknowledge	Interaction effects, going beyond current toxicology paradigm (Frazier, 2012; Reynard, 2012; Tirado, 2013, p.33; Environmental Audit Committee, 2013, pp. Ev 6, Ev 115, Ev 125)	Increased body of field data (DEFRA, 2012)
'Known unknowns' with intention to know	Bee behaviour (Advisory Committee on Pesticides, 2013) Alternative pathways of transmission (Tapparo et al., 2012) Extent of indirect effects (European Parliament, 2012; Frazier, 2012) Duration/extent of neonicotinoids in the wider environments (van Vliet, Vlaar & Leendertse, 2013) Effects of neonicotinoids on other species (van Vliet et al., 2013) Field data on implications of growing crops without neonicotinoids. (European Beekeeping Coordination, 2013b)	Importance of other causes of bee decline (Thompson et al., 2013; Syngenta, n.d.b) Other forage sources (DEFRA, 2013)
Negative Knowledge	Relative importance of other causes of bee decline	Exact field doses
'Known unknowns' with no intention to know	How individual bee effects affect colonies Significantly improved methods of controlling	Interaction effects, going beyond current toxicology paradigm Significantly improved methods of controlling How individual bee effects affect colonies

Table .3: *Knowledge, non-knowledge and negative knowledge as perceived/framed by both coalitions.*

	DEFRA (2013)	EFSA (2013a, 2013b, 2013c)	Environmental Audit Committee (2013)
1. Double participation from both science and policy	**Limited**: assembled in a government department.	**Medium**: assembled in a supranational agency with the role of impartial policy-relevant science advisor.	**High**: parliamentary committee taking oral and written evidence from scientific, policy and civil actors.
2. Dual accountability: leadership is accountable to both science and politics	**Limited**: no consultation on report, authors are anonymous, no peer review.	**Medium**: peer review process from select member state government scientists.	**Medium**: accountable insofar as assembled by elected politicians, but no other means.
3. Boundary objects: well-developed, inclusive processes and arrangements	**Limited**: opaque and impermeable drafting process.	**Medium**: reviews based on submitted literature, yet no collective analysis arrangements.	**High**: committee rules and processes are generalised and formalised.
4. Co-production: including negotiation and confrontation	**Limited**: negotiation and confrontation, if it occurs, happens only within the department.	**Limited**: no co-production of analysis, unclear that comments or reviews after publication have a high change of changing the report.	**Medium**: evidence taken, cross-party discussions about and with witnesses. Yet negotiation relatively hierarchical with politicians at the centre. Stakeholder base consulted rather than consulting.
5. Metagovernance & capacity building	**Limited**: traditional structures of weighing up knowledge, no attempt to engage in reflexive learning.	**Medium**: notes data gaps and areas to research into, points to other frameworks networking for knowledge production within the EC.	**Limited**: no real capacity building, only recommendations for action of actors such as DEFRA.

Table .4: *Characteristics of three science-policy interfaces. Based on Hoppe (2010).*

References

Advisory Committee on Pesticides (2013), Agenda item 1: Pesticides and Bees: 29 January 2013 Detailed Record of Discussion [online] ACP 7 359/2013. Retrieved from: http://www.pesticides.gov.uk/guidance/industries/pesticides/advisory-groups/acp/ACP-News/ACP-359-29-January-2013-Detailed-Record-of-Discussion

Ashurst LLP (2013, April 3). [Letter to Ladislav Miko]. Retrieved from: http://www.syngenta.com/eame/plightofthebees/SiteCollectionDocuments/correspondence/ares-2013-544997-letter-miko.pdf [Accessed: 10 December].

Benjamin, A. (2008). Pesticides: Germany bans chemicals linked to honeybee devastation. The Guardian [online] 23 May. Retrieved from: http://gu.com/p/xc984 [Accessed: 10 December 2013].

Campbell, P. J. (2013). Declining European bee health: Banning the neonicotinoids is not the answer. Outlooks on Pest Management, April. doi:10.1564/v24_apr_02

Carrington, D. (2013a). UK bee insecticide study flawed, says EU food agency. The Guardian, [online] 26 July. Retrieved from: http://gu.com/p/3gb2n [Accessed: 9 December 2013].

Carrington, D. (2013b). Government bee scientist behind controversial study joins pesticide firm. The Guardian, [online] 5 June. Retrieved from: http://gu.com/p/3hfd7 [Accessed: 9 December 2013].

Cash, D. W., Clark, W. C., Alcock, F., Dickson, N. M., Eckley, N., Guston, D. H., ... & Mitchell, R. B. (2003). Knowledge systems for sustainable development. Proceedings of the National Academy of Sciences, 100(14), 8086-8091.

Corporate Europe Observatory (2013). Pesticides against pollinators [Website]. Retrieved from: http://corporateeurope.org/agribusiness/2013/04/pesticides-against-pollinators [Accessed: 9 December 2013].

Cresswell, J. E., & Thompson, H. M. (2012). Comment on "A Common Pesticide Decreases Foraging Success and Survival in Honey Bees." Science, 337(6101), 1453–1453.

Department for Environment, Food and Rural Affairs (DEFRA) (2012). Neonicotinoid insecticides and bees: The state of the science and the regulatory response. Retrieved from: http://webarchive.nationalarchives.gov.uk/20130123162956 http://www.defra.gov.uk/publications/files/pb13818-neonicotinoid-bees-20120918.pdf [Accessed 10 December 2013].

Department for Environment, Food and Rural Affairs (DEFRA) (2013). An assessment of key evidence about neonicotinoids and bees [online]. Retrieved from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/221052/ pb13937-neonicotinoidbees20130326.pdf [Accessed: 10 December 2013].

Dicks, L. (2013). Bees, lies and evidence-based policy. Nature, 494, 283. doi:10.1038/494283a

Dutch Delegation to the Council of the European Union (2013), EFSA conclusions on the risk assessment for bees for three neonicotinoids January 24 5667/13 AGRI 37 PHYTOSAN 1.

Environmental Audit Committee (2013), Pollinators and pesticides: Seventh report of session 2012-13 vol I HC 668 [Electronic version]. Retrieved from: http://www.publications.

parliament.uk/pa/cm201213/cmselect/cmenvaud/668/668.pdf [Accessed: 9 December 2013].

EurActiv. (2013, April 30). Green NGOs hail "historic" victory in pesticides vote. Retrieved from:
http://www.euractiv.com/sustainability/environment-ngos-hail-historic-v-news-519428
[Accessed December 10 2013]

European Beekeeping Coordination. (2013a). Doors keep revolving [Press release]. Retrieved from: http://bee-life.eu/en/article/47/ [Accessed: 9 December 2013].

European Beekeeping Coordination (2013b). Farming without neonicotinoids. Proceedings of the "Pollinator friendly farming is possible" Conference, March 22 2013. Retrieved from: http://bee-life.eu/medias/temp/4112013_report_farming-without-neonicotinoids.pdf [Accessed 10 December 2013].

European Crop Protection Association (ECPA) (2013). EFSA acknowledges high level of uncertainty in its negative evaluation of the risk of neonicotinoids to bees [Press release]. Retrieved from: http://www.ecpa.eu/news-item/environmental-protection/01-16-2013/705/efsa-acknowledges-high-level-uncertainty-its-negat [Accessed: 10 December 2013].

European Food Safety Authority (EFSA) (2012). Statement on the findings in recent studies investigating sub-lethal effects in bees of some neonicotinoids in consideration of the uses currently authorised in Europe. EFSA Journal 10(6). Retrieved from: http://www.efsa.europa.eu/en/efsajournal/doc/2752.pdf [Accessed: 10 December 2013].

European Food Safety Authority (EFSA) (2013a). Conclusion on the peer review of the pesticide risk assessment for bees for the active substance clothianidin. EFSA Journal, 11(1), 3066. doi:10.2903/j.efsa.2013.3066

European Food Safety Authority (EFSA) (2013b). Conclusion on the peer review of the pesticide risk assessment for bees for the active substance thiamethoxam. EFSA Journal, 11(1), 3067. doi:10.2903/j.efsa.2013.3067

European Food Safety Authority (EFSA) (2013a). Conclusion on the peer review of the pesticide risk assessment for bees for the active substance imidacloprid. EFSA Journal, 11(1), 3068. doi:10.2903/j.efsa.2013.3068

European Food Safety Authority (EFSA) (2013d). EFSA identifies risks to bees from neonicotinoids [Press release]. Retrieved from: http://www.efsa.europa.eu/en/press/news/130116.htm

European Food Safety Authority (EFSA) (2013e). Evaluation of the FERA study on bumble bees and consideration of its potential impact on the EFSA conclusions on neonicotinoids. EFSA Journal, 11(6), 3242. doi:10.2903/j.efsa.2013.3242

European Parliament. (2012). Existing scientific evidence of the effects of neonicotinoid pesticides on bees (No. IP/A/ENVI/NT/2012-09 PE 492.465).

European Seed Association (2013). EFSA states high level of uncertainty in its evaluations of neonicotinoids and their impact on bee health [Press release], January 16. Retrieved from: http://www.euroseeds.org/news-room/news-archive/2013/esa_13.0030.2 [Accessed 10 December 2013].

Frazier, J. L. (2012). A critique of Dr. Richard Heintzelman, Dr. Iain D. Kelly, Dr. David L. Fischer, Dr. Christian Maus; 23 May 2012; Overview of recent publications on neonicotinoids and pollinators. Unpublished manuscript prepared for Mr. Peter T. Jenkins, Attorney/Consultant,

Center for Food Safety. Retrieved from: http://www.entomology.umn.edu/cues/pollinators/pdf-HBcolony/2012FrazierCritique.pdf [Accessed: 10 December 2013].

Funtowicz, S. O., & Ravetz, J. R. (1993). Science for the post-normal age. Futures, 25(7), 739-755.

Gallai, N., Salles, J. M., Settele, J., & Vaissière, B. E. (2009). Economic valuation of the vulnerability of world agriculture confronted with pollinator decline. Ecological Economics, 68(3), 810-821.

Garwood, J. (2010). Honey bee mortality crisis: One big sticky mess? Lab Times [online] June. Retrieved from: http://www.labtimes.org/labtimes/issues/lt2010/lt06/lt_2010_06_30_35.pdf [Accessed: 10 December 2013].

Giddens, A. (1999). Risk and responsibility. The Modern Law Review, 62(1), 1-10. doi: 10.1111/1468-2230.00188

Gill, R. J., Ramos-Rodriguez, O., & Raine, N. E. (2012). Combined pesticide exposure severely affects individual-and colony-level traits in bees. Nature,491(7422), 105-108.

Goulson, D. (2013). One more unto the breach; a look at Defra's stance on neonicotinoids. University of Sussex SPLASH [online]. Retrieved from: http://splash.sussex.ac.uk/blog/for/dg229/2013/09/13/one-more-unto-the-breach-a-look-at-defras-stance-on-neonicotinoids [Accessed: 10 December 2013].

Gross, M. (2010). Ignorance and Surprise. Cambridge, MA: MIT Press.

Hansard HL Deb vol 748 col 1636 (30 July 2013).

Heintzelman, R., Kelly, I.D., Fischer, D.L., & Maus, C. (2012). Overview of recent publications on neonicotinoids and pollinators. Unpublished manuscript. Leverkusen, Germany: Bayer AG. Retrieved from: http://www.entomology.umn.edu/cues/pollinators/pdf-HBfor/2012Heintzelman.pdf [Accessed: 10 December 2013].

Henry, M., Béguin, M., Requier, F., Rollin, O., Odoux, J.-F., Aupinel, P., et al. (2012). A common pesticide decreases foraging success and survival in honey bees. Science, 336(6079), 348–350. doi:10.1126/science.1215039

Hoppe, R. (2010). From "knowledge use" towards "boundary work". In R. J. in't Veld (ed.) Knowledge Democracy (pp. 25-36). Berlin: Springer.

Humboldt Forum for Food and Agriculture e.V. (HFFA) (n.d.). Supporters/partners [Website]. Retrieved from: http://www.hffa.info/index.php/about-us/supporterspartners.html [Accessed: 9 December 2013].

Knorr-Cetina, K. (1999). Epistemic cultures. Cambridge, MA: Harvard University Press.

Jasanoff, S. (1987). Contested boundaries in policy-relevant science. Social Studies of Science, 17(2), 195–230. doi:10.1177/030631287017002001

Jasanoff, S. (2005). Designs on nature. Princeton: Princeton University Press.

Losey, J. E., & Vaughan, M. (2006). The economic value of ecological services provided by insects. Bioscience, 56(4), 311-323.

National Farmers Union (2013, February 20). [Letter to Owen Paterson M.P.]. Retrieved from https://www.gov.uk/government/publications/communications-on-neonicotinoids-1-june-2012-to-13-august-2013 [Accessed: 10 December 2013].

Noleppa, S. & Hahn, T. (2013). The value of neonicotinoid seed treatment in the European Union. HFFA Working Paper 01/2013. Retrieved from: http://www.neonicreport.com/wp-content/uploads/2013/01/HFFA%20Report.pdf [Accessed: 9 December 2013].

Patt, A., & Dessai, S. (2005). Communicating uncertainty: lessons learned and suggestions for climate change assessment. Comptes Rendus Geoscience, 337(4), 425-441. doi: 10.1016/j.crte.2004.10.004

Pielke, R. A., Jr. (2007). The Honest Broker. Cambridge, UK: Cambridge University Press.

Pilling, E., Campbell, P., Coulson, M., Ruddle, N., & Tornier, I. (2013). A four-year field program investigating long-term effects of repeated exposure of honey bee colonies to flowering crops treated with thiamethoxam. PLoS ONE, 8(10), e77193. doi:10.1371/journal.pone.0077193

Reynard, B. (2012). The producer-pollinator dilemma: Neonicotinoids and honey bee colony collapse. Unpublished manuscript. Retrieved from http://repository.upenn.edu/mes_capstones/50/ [Accessed: 10 December 2013].

Sabatier, P. A. (1998). The advocacy coalition framework: revisions and relevance for Europe. Journal of European Public Policy, 5(1), 98–130. doi:10.1080/13501768880000051

Scierow, L. J. , Johnson, R., & Corn, M.L. (2012). Bee health: The role of pesticides. Congressional Research Service Report for Congress, [online] R42855. Retrieved from: https://www.fas.org/sgp/crs/misc/R42855.pdf [Accessed: 10 December 2013].

Stafford, N. (2013). EU food agency links pesticides to bee decline. Chemistry World [online] 18 January. Retrieved from: www.rsc.org/chemistryworld/2013/01/efsa-europe-honey-bee-decline-neonicotinoid-pesticides [Accessed: 9 December 2013].

Stokes, D. E. (1997). Pasteur's quadrant. Washington, DC: Brookings Institution Press.

Syngenta AG (n.d.a). The plight of the bees [Website]. Retrieved from: http://www.syngenta.com/eame/plightofthebees/en/Pages/home.aspx [Accessed: 9 December 2013].

Syngenta AG (n.d.b). Research FAQs [Website]. Retrieved from: http://www.syngenta.com/eame/plightofthebees/en/bee-research/Pages/research-faqs.aspx [Accessed: 9 December 2013].

Syngenta AG (2013, February 8). [Letter to José Manuel Barroso]. Retrieved from: http://www.syngenta.com/eame/plightofthebees/SiteCollectionDocuments/correspondence/flawed-process-9-fpd.pdf [Accessed: 10 December 2013]

Syngenta AG (2013, January 15). [Letter to Kirsten Haupt]. Retrieved from: http://www.syngenta.com/eame/plightofthebees/SiteCollectionDocuments/correspondence/efsa-misrepresentation-12-4-letterhaupt.pdf [Accessed: 10 December 2013].

Syngenta AG (2013). EFSA review of the risk to bees from thiamethoxam: Response by Syngenta to the European Commission. Retrieved from: http://www.syngenta.com/eame/plightofthebees/SiteCollectionDocuments/correspondence/compelling-evidence-2-2fluh.pdf [Accessed: 10 December 2013].

Thompson, H., Harrington, P., Wilkins, S., Pietravalle, S., Sweet, D., & Jones, A. (2013). Effects of neonicotinoid seed treatments on bumble bee colonies under field conditions. FERA (UK Food and Environment Research Agency). Retrieved from: http://fera.co.uk/ccss/documents/defraBumbleBeeReportPS2371V4a.pdf

Tirado, R., Simon, G., & Johnston, P. (2013). Bees in decline: A review of factors that put pollinators and agriculture in Europe at risk (No. 01/2013). Greenpeace Research Laboratories. Retrieved from: http://www.greenpeace.org/eu-unit/Global/eu-unit/reports-briefings/2013/130409_GPI-Report_BeesInDecline.pdf [Accessed: 10 December 2013].

UK Government (2013). Appendix–Government response. In: Environmental Audit Committee (ed.) Pollinators and pesticides: government response to the committee's seventh report of session 2012–13 HC 631. Retrieved from: http://www.publications.parliament.uk/pa/cm201213/cmselect/cmenvaud/631/631.pdf [Accessed: 10 December 2013].

vanEngelsdorp, D., Caron, D., Hayes, J., Underwood, R., Henson, M., Rennich, K., et al. (2012). A national survey of managed honey bee 2010-11 winter colony losses in the USA: results from the Bee Informed Partnership. Journal of Apicultural Research, 51(1), 115–124. doi:10.3896/IBRA.1.51.1.14

van der Zee, R., Pisa, L., Andonov, S., Brodschneider, R., Charrière, J.-D., Chlebo, R., ... & Wilkins, S. (2012). Managed honey bee colony losses in Canada, China, Europe, Israel and Turkey, for the winters of 2008-9 and 2009-10. Journal of Apicultural Research, 51(1), 100–114. doi:10.3896/IBRA.1.51.1.12

van Vliet, J., Vlaar, L. N. C., & Leendertse, P. C. (2013). Toepassingen, gebruik en verbod van drie neonicotinoïden in de Nederlandse land- en tuinbouw (No. 825-2013). CLM Onderzoek en Advies. Retrieved from http://www.clm.nl/uploads/pdf/825-Gebruik_toepassing_verbod_neonicotinoiden.pdf

von Witzke H., Noleppa S., & Schwartz G. (2009) Global agricultural market trends revisited: The roles of energy prices and biofuel production. Humboldt-Universität Working Paper 89/2009. Retrieved from: http://ageconsearch.umn.edu/bitstream/48596/2/wp89.pdf [Accessed: 9 December 2013].

Weinberg, A. M. (1972). Science and trans-science. Minerva, 10(2), 209–222. doi:10.1007/BF01682418

Whitehorn, P. R., O'Connor, S., Wackers, F. L., & Goulson, D. (2012). Neonicotinoid pesticide reduces bumble bee colony growth and queen production. Science, 336(6079), 351–352. doi:10.1126/science.1215025

Mo' meat, mo' problems: An assessment of cultured meat and food system transitions

Liza Wood

International Centre for Integrated assessment and Sustainable development (ICIS), Maastricht University
beverleylizawood@gmail.com

Abstract

Global food security is a pressing concern in our world, where population is growing and demand for meat is rising alongside development. As such, our current food system needs to be seriously reconsidered. But what a new food system looks like and how to achieve it is widely disputed. Recently, technologies of lab-cultured meat have been proposed as a sustainable alternative to the current meat production system – a prime culprit of unsustainability. This paper discusses lab-cultured meat and its potential benefits and drawbacks for sustainability. Moreover, it analyzes the paradigmatic underpinnings of this technology, based on which I contend that lab-cultured meat is not an effective means of addressing global food insecurity. The paper concludes by discussing the paradigm shifts needed for a truly sustainable food regime and the process by which this transition can occur.

Introduction

Envision the Anthropocene – a layer of the earth demarcated by non-degradable plastics, depleted soils, and excessive carbon sequestration. This will be the geological proof found by future scientists (if there are any) of our society's rapid environmental degradation (Steffen et al., 2004). As social awareness of such degradation increases, various movements aim to reduce human impact and transition to a more sustainable system, environmentally and socially. One major aspect of these hopeful transitions is the food system, as our current food regime is linked to environmental degradation, energy consumption, and inequitable distribution. But what a new food system looks like and how to achieve it is widely disputed. Recently, technologies of lab-cultured meat have been proposed as a sustainable alternative to the current meat production system – a prime culprit of unsustainability. Section one of this paper discusses lab-cultured meat and its potential benefits for sustainability, followed by uncertainties of this technology in section two. In section three, the paradigmatic underpinnings of a cultured meat regime are explored, based on which I contend that lab-cultured meat is not an effective means of addressing global food insecurity. As such, section four proposes the necessary paradigm shifts needed for a truly sustainable food regime and discusses the process by which this transition can occur.

I. Cultured meat and its benefits

Cultured meat, also referred to as in vitro meat, lab meat, and schmeat, is meat grown from animal cells in a laboratory. This innovation's inception is traced to the scientist Willem van Eelen, who patented one technique in 1999, but has since been advanced by research funded by NASA, the Dutch government, and Sergey Brin of Google (Chiles, 2013; Steffen et al., 2004). Most recently, Professor Mark Post of Maastricht University has been making advances in the field, and in August 2013 his lab burger was cultured and taste-tested (Barclay, 2013; Post, 2012).[1] Post used skeletal muscle stem cells, also called satellite cells, from a cow and cultured them in fetal bovine serum (calf's blood). The cells were then anchored to a scaffold and stationed in a bioreactor to exercise the muscles for growth (Post, 2012). After years of experimentation and three months of culturing muscle strands, Post and his team were able to produce a five ounce burger consisting of 20,000 layered meat strips, totaling in at $325,000 (Duhaime-Ross, 2013). Media, academics, and animals rights groups alike have championed this technology as the sustainable future of meat production. As the economies of newly industrialized countries grow, the demand for meat is projected to increase by at least two thirds by 2050 (Alexandratos & Bruinsma, 2012). Proponents claim that cultured meat can contribute to feeding the growing population by meeting their protein demands (NPR, 2011). Moreover, environmental improvements to meat production include reduced use of land, energy, and water, as well as reduced greenhouse gas emissions (Tuomisto & de Mattos, 2011). Animal welfare activists, particularly People for the Ethical Treatment of Animals, also consider this a huge step forward, as cultured meat reduces, if not eliminates, animal suffering (PETA, n.d.). Proponents also claim improved safety, as close monitoring can be done in ways that aren't possible on a farm (Langelaan et al., 2010). Lastly, scientists working on cell culturing maintain that they may be able to reduce unhealthy dietary aspects, such as the polyunsaturated fatty acid content of red meat (Post, 2012). All in all, the benefits put forth by cultured meat proponents are grand in scope and impact, and have helped garner support for the 'meat of the future.'

II. Uncertainties of cultured meat

While the benefits of lab-cultured meat sound promising, they come with a lot of conditional statements and potential drawbacks. Not only are there the technical hurdles of scaling up, such as finding a quickly proliferating cell source and non-animal growth medium (Langelaan et al., 2010; Post, 2012), but there are also uncertainties regarding the benefits previously mentioned: environment, food safety, and consumer health. Even beyond that, broader sociopolitical uncertainties regarding meat production, which have been rather absent from the current literature, must be considered to ensure a fully rounded assessment of this technological alternative and its impacts on food security.

Environmental uncertainties

Almost every environmental benefit claimed by proponents of cultured meat carries with it conditionalities. The environmental impact projection of the cultured meat industry by Tuomisto and de Mattos (2011) stands alone as a reference, and I argue that its measures make gratuitous assumptions that merit further research. Its first assumption is that scientists will be able to overcome their aforementioned cell and culture limitations, and be able to grow cells on cyanobacteria medium (as opposed to the bovine serum currently used) on a large scale. Cyanobacteria cultivation on such a large scale has never been done before, so it is hard to use a simple scaling up of resource and

[1] Artists Catts and Zurr actually fed lab-grown meat (frog and sheep) at an art exhibit in 2002 (Catts & Zurr, 2013), but in vitro meat as a post-modern philosophical art form that's questions 'what is human?' is beyond the scope of this paper.

land use to estimate the needs of the operation. Moreover, the study's estimate that lab meat will require 99% less land excludes indirect land use such as laboratories and space to raise cattle for stem cells. Secondly, its estimate of 7-45% energy reduction assumes that transport of cyanobacteria to culturing lab would be under 50 kilometers. However, I regard this as an underestimate when practically considering the spatial needs of cyanobacteria production (which requires large areas and a seawater source) and the technological infrastructure for meat culturing. Third, the reduction in water use also seems optimistic and even somewhat ignorant of environmental limitations, as the report excludes seawater – a key ingredient in cyanobacteria cultivation. Seawater is excluded from calculations because "seawater resources are abundant" (Tuomisto & de Mattos, 2011, p. 6120), but I contend that ignoring potential drawbacks of excessive seawater use due to its current abundance is irresponsible. These skepticisms of cultured meat production's environmental impact, just to name of a few, demand continued assessment and urge technological and political investments not to rest on the positive claims of this single report.

Health and safety uncertainties

Much like the environmental assessment, the promises of cultured meat's improved food safety and consumer health are quite attractive, but also need to be considered more critically. Proponents argue that lab settings allow for increased monitoring, and thus a lower threat of food-related disease outbreaks. However, as Metcalf (2013) points out, disease outbreaks are not inherent in the current food system, but rather, they are a consequence of large scale production. Lab meat may fall victim to this same issue, because the fact that scientists can monitor production makes them no different from conventional meat, and nothing about a lab setting means they will. I would further argue that any scaling up of a monoculture, in or out of a lab, increases vulnerability to contamination and disease (Oupkaew et al., 2010). In terms of consumer health, proponents claim that they can alter cellular composition to reduce meat-related health problems such as heart disease and colorectal cancer. However, scientists are not able to identify what it is about meat that causes the cancer (Post, 2012), and therefore their ability to manufacture such benefits into the meat is not feasible. Additionally, scientists have made it clear that their top priority is mimicry of the taste of real meat and texture (Bhat & Fayaz, 2011), and if that requires adding the same type and amount of fats, the value of taste will trump the engineering of health.

Sociopolitical uncertainties

In addition to the more publicized promises and uncertainties of cultured meat, its sociopolitical uncertainties and impacts for food security go largely unmentioned. Scientists point generally to statistics about rising demand for meat and unequal distribution of food (Bhat & Fayaz, 2011; Post, 2012) and media have referred to this as a way of feeding the world's growing population (NPR, 2011). However, none of these claims have been elaborated on, nor have they been contested in scholarly literature. Instead, discussion of in vitro meat technology has taken place largely between scientists and animal welfare activists, with farmers conspicuously absent (Driessen & Korthals, 2012). The absence of these grassroots stakeholders generates a high degree of uncertainty regarding the meat's sociopolitical impacts on production. Thus far, the power of in vitro meat resides in the hand of few, and diffusion of such methods is uncertain. The technologies for production are expensive and certain methods of production have already been patented (Steffen et al., 2004), implying that this method of meat cultivation is not for the masses – at least not without extra costs. As such, there is the threat of technological exclusion (Hall, Matos, & Langford, 2008) as well as drawbacks similar to those of patenting seeds, with disproportionate gains seen for those who hold the power of technology (Stiglitz, 2006). Additionally, though the criticism of industrial factory farms in the United

States is merited, small-scale pastoralism is still the basis of livelihoods for one billion of the world's poor (FAO, 2006). The role of cultured meat in the market is still unknown, but if it were to become competitive, traditional livestock raising may be pressured out of practice – in fact, this is already beginning to happen from factory farm pressure (FAO, 2006) – and the world's poor will be further marginalized. Therefore, while cultured meat may remove the unfavorable practices of factory farming, it may also impact traditional livestock industries, potentially disempowering these producers and forcing reliance on an industry controlled by technocrats. Ultimately, there are a number of technical hurdles, assumptions, and conditionalities upon which the cultured meat proponent's promises rest; and public, scientific, and political spheres should critically assess each issue before joining the cultured meat fan club.

III. New cultured meat regime, same old paradigm

As global sustainability concerns increase, pushes for alternatives to the current regime become stronger, providing an opportunity for a food system transition. For some, an incremental shift from factory farms to in vitro meat may seem like a positive step forward, and perhaps even a moral obligation (Driessen & Korthals, 2012; Hopkins & Dacey, 2008). However, despite the potential benefits of an environmentally sound and animal-friendly meat product, the transition to lab-cultured meat is not the appropriate response to global food insecurity. While it serves as a popular attractor to the sustainability-conscious scientists and western consumers, this option fails to divorce us from our current paradigm of neoliberal development solutions, productivity as progress, limitless consumption, and mechanistic thinking. These elements of our paradigm are root causes of global unsustainability, and if unchanged, food security is unlikely to be solved. The current food system regime relies on a paradigm of linear progress, in which neoliberal development pushes for a global model of economic growth. However, this model advances the power of corporations and nation-states without consideration of power imbalances (Stiglitz, 2006). If the global food system were to transition from industrial farming to in vitro meat, the concentration of power is likely to change hands, without the paradigmatic change that needs to accompany it. Institutions, policies, and subsidies built up around feedlots, corn, and fossil fuels would transition a regime built up around cyanobacteria, bioreactors, and stem cell lobbies, but the power imbalance would remain. Cultured meat will be just another product embedded in the market system, and as such will provide an opportunity for corporate control and exploitation of the cheapest production. In addition to imbalanced production power, our current paradigm tends to assume that more efficient production will result in feeding the world's population (Beckerman, 2010; Bhat & Fayaz, 2011) However, as seen in agriculture, inefficient production is not what leads to regional food insecurity and hunger, but rather, it is the distribution of food (Chappell & LaValle, 2011). Thus far, equitable distribution of cultured meat to those that need it most seems unlikely. The first lab burger cost $325,000, and its current market value averaged about $30 per pound (Barclay, 2013). Furthermore, though future costs are estimated to be 'accessible,' it is still more likely for it to be a "boutique item marketed toward the ethical desires of vegetarians and vegans, not a cheap protein source for the global South" (Metcalf, 2013, p. 81). A third way in which cultured meat remains in our current, unsustainable paradigm is its perpetuation of consumerism. In such a globalized society, much of the developed world believes that we have the right to eat whatever we want, whenever we want. In vitro meat further accommodates this mentality, and can even add a "guilt-free" label to the environmentally aware and animal-friendly consumers. And what's more is that cultured meat scientists want to appeal to our extreme consumptive desires by potentially creating hybrid "unimaginable meats" (Post, 2012,

p. 298) and even endangered or extinct species (Bhat & Fayaz, 2011). Instead of pointing to our unsustainable and environmentally unrealistic consumer demands, in vitro meat proponents emphasize the faults of current production and insist we can improve technology for the sake of even more consumption. Lastly, not only would this new regime maintain the current power imbalances and exacerbate consumerism, but it would also perpetuate a mechanistic worldview by furthering the separation between humans and the environment (Capra, 1996). As Metcalf (2013) puts it, cultured meat "is fast becoming a key example of the molecularization and decontextualization of sustainability – it is molecularly tuned flesh with no body and thus no apparent ecology" (p. 75). By removing meat from the context of the animal, scientists are taking control to a new class of exploitation (Catts & Zurr, 2013). As such, in vitro meat would only intensify our disconnect from the natural world and contribute to our illusion of control. Ultimately, it is unlikely that cultured meat will make any strides in addressing world hunger, because it fails to challenge our unsustainable paradigm of neoliberal development, inefficiency, consumerism, and isolation of nature, all of which hinder true progress towards food security.

IV. Transitioning to a food systems paradigm

It is widely agreed that the current global food system is unstable, as the climate is changing, 12% of the world suffers from chronic hunger (FAO, IFAD & WFP, 2013), and agri-businesses dominate the global economy. As such, society is nearing a bifurcation point in terms of food production, and we are looking for an attractor to lead us into a new era of food. However, as explained above, a shift from the conventional system to an in vitro regime, with no change to our ideas of development, distribution, consumption, or mechanistic thinking would be only driving us further from food security. Instead, we are in need of a new food regime that is coupled with a complete paradigm shift to systems thinking. This new paradigm includes principles of local production, biodiversity, tempered consumption, and equitable distribution, and I propose such a transition by means of micro and macro-level forcings on the meso-level regime. Integrating food production into systems thinking is no easy task, as there is no miracle crop, nor single stem cell, that can provide food for everyone. Instead, a new food system requires playing to a variety of strengths based on local diversity. These localized systems will have increased resilience by scaling down from monoculture to permaculture, focusing on regional diversity, and utilizing ecosystem services for increased output (Badgley et al., 2007; Hosking & Green, 2009). Such systems would reduce reliance on foreign inputs and technologies, which is particularly important as the looming era of peak-oil threatens the foundations upon which conventional agriculture depends. In terms of meat, a systems paradigm calls for similar solutions. Production will have to shift from factory farms to smaller-scale systems, such as silvopastoralism – the practice of integrating livestock grazing into forested areas (Sharrow, 1997). Meat will not disappear altogether, as pastured animals play an important role in a balanced ecosystem and can provide additional services such a power, manure, and dairy products (Barber in Specter, 2011; FAO 2006). However, livestock will have to be less densely distributed and properly managed, decreasing the availability of meat. These changes to production will be coupled with patterns of consumption and distribution. Dietary preferences must be tempered and adaptable to the capacities and seasonal availabilities of local food systems. Similarly, the nutrients and proteins we seek from meat will have to be largely replaced with plant-based sources such as legumes, nuts, and whole grains (American Dietetic Association, 2003). Consumers will have to redefine their relationship to food, particularly meat, as a reduction in consumption of non-local foods and meat will be a necessity for maintaining a good balance in the ecolog-

ical system. Socially, this process of scaling down and diversifying will come with a weakening of corporate food power and imbalanced global trade, and as such, will empower local producers. Ultimately, a social and political focus will be placed on ensuring that more food is distributed regionally, facilitating a more equitable system. A transition to such a different paradigm would be dramatic, and therefore needs to come from a coordinated push at the macro-, meso-, and micro-levels of a sociopolitical system (van der Brugge, 2004). On the macro-level, forces of climate change, environmental degradation, and declining availability of inputs such as oil will destabilize the current regime of conventional farming and factory farming. From the micro-level, the food movements that have emerged due through the discontent and deterritorialization of our current era (Scholte, 2002) will have to make their presence as a noticeable alternative.[2] Farmers' rights movements and localist consumers alike will have to unify as one grassroots voice – a globally democratic food empire (Martens, Dreher, & Gaston, 2010) – to pressure institutional and political reform on the meso-level. Generally, such institutional changes would include internalizing environmental costs, altering imbalanced trade agreements, and shifting subsidies away from corporate interests to diverse, small-scale, agro-ecological production. While no transition is perfect, I contend that this new regime would allow for a paradigm in which human society can co-evolve with its food system, balancing consumption patterns with environmental fluctuations and policies of distribution. In this new paradigm we would find a dynamic equilibrium that aims to balance the social and ecological concerns, ultimately addressing the food security needs of the world without reliance on engineered control.

V. Conclusion

In conclusion, lab-cultured meat is marketing its technologies as a sustainable way forward for our food system, as it will decrease land, energy, and water use, reduce animal suffering, and improve human health and safety. However, there are significant uncertainties of these claims, and each aspect of this technology requires much greater scrutiny than the existing literature provides, particularly in the sociopolitical realm. All things considered, I ultimately argue that a transition lab-cultured meat would be undesirable for food security, as such a regime change would only shift power and potentially ease resources without addressing the paradigmatic foundations that drive global unsustainable development. Instead, I envision a more holistic paradigm change, from power imbalances, consumption, and mechanistic thinking, to a dynamic system of local, diverse, and balanced socio-ecological relationships.

References

Alexandratos, N., & Bruinsma, J. (2012). World agriculture towards 2030/2050: the 2012 revision. (Vol. ESA Working paper No. 12-03). Rome: FAO.

American Dietetic Association. (2003). Position of the American Dietetic Association and Dietitians of Canada: Vegetarian diets. J Am Diet Assoc, 103, 748-765. doi: 10.1053/jada.2003.50142

Badgley, C., Moghtadera, J., Quinteroa, E., Zakema, E., Chappell, M. J., Avilés-Vázqueza, K., . . . Perfectoa, I. (2007). Organic agriculture and the global food supply. Renewable Agriculture and Food Systems, 22(2), 86-108.

[2]For instance, La Via Campesina is a peasant's movement that rallies around issues of food sovereignty and have established a significant following (Edelman, 2005).

Barclay, E. (2013, August 5). Long awaited lab-grown burger Is unveiled In London. National Public Radio. Retrieved from http://www.npr.org/blogs/thesalt/2013/08/05/209163204/long-awaited-lab-grown-burger-is-unveiled-in-london

Beckerman, M. (2010, August 6). How lab-grown steak could save the world. Esquire. Retrieved from http://www.esquire.com/blogs/food-for-men/cloned-meat-environment-080610

Bhat, Z. F., & Fayaz, H. (2011). Prospectus of cultured meat—advancing meat alternatives. Journal of Food Science and Technology, 48(2), 125-140. doi: 10.1007/s13197-010-0198-7

Capra, F. (1996). The web of life. New York, NY: Doubleday.

Catts, O., & Zurr, I. (2013). Disembodied livestock: The promise of a semi-Living utopia. Parallax, 19, 101-113. doi: 10.1080/13534645.2013.752062

Chappell, M. J., & LaValle, L. A. (2011). Food security and biodiversity: can we have both? An agroecological analysis. Agriculture and Human Values, 28, 3-26. doi: 10.1007/s10460-009-9251-4

Chiles, R. M. (2013). If they come, we will build it: in vitro meat and the discursive struggle over future agrofood expectations. Agriculture and Human Values, 1-13. doi: 10.1007/s10460-013-9427-9

Driessen, C., & Korthals, M. (2012). Pig towers and in vitro meat: Disclosing moral worlds by design. Social Studies of Science, 42(6), 797–820. doi: 10.1177/0306312712457110

Duhaime-Ross, A. (2013, August 5). Test-tube burger: lab-cultured meat passes taste test (sort of). Scientific American. Retrieved from http://www.scientificamerican.com/article.cfm?id=test-tube-burger-lab-culture

Edelman, M. (2005). Bringing the Moral Economy back in... to the Study of 21st-Century Transnational Peasant Movements. American Anthropologist, 107(3), 331–345.

FAO. (2006). Livestock's long shadow. Rome: FAO.

FAO, IFAD & WFP. (2013). The state of food insecurity in the world 2013. The multiple dimensions of food security. Rome, FAO.

Hall, J., Matos, S., & Langford, C. H. (2008). Social exclusion and transgenic technology: The case of brazilian agriculture. Journal of Business Ethics, 77(1), 45-63. doi: 10.1007A10551-006-9293-0

Hopkins, P. D., & Dacey, A. (2008). Vegetarian meat: Could technology save animals and satisfy meat eaters? Journal of Agricultural and Environmental Ethics, 21, 579-596. doi: 10.1007/s10806-008-9110-0

Hosking, R., & Green, T. (Writers). (2009). A farm for the future. BBC2 (Producer).

Langelaan, M. L. P., Boonen, K. J. M., Polak, R. B., Baaijens, F. P. T., Post, M. J., & van der Schaft, D. W. J. (2010). Meet the new meat: tissue engineered skeletal muscle. Trends in Food Science & Technology, 21, 59-66. doi: 10.1016/j.tifs.2009.11.001

Martens, P., Dreher, A., & Gaston, N. (2010). Globalisation, the global village and the civil society. Futures, 42(6), 574-582. doi: 10.1016/j.futures.2010.01.008

Metcalf, J. (2013). Meet shmeat: Food system ethics, biotechnology and re-worlding techno-science. Parallax, 19(1), 74-87. doi:10.1080/13534645.2013.743294

NPR. (2011, August 8). Tube burgers: The world of in vitro meat. NPR. Retrieved from

http://www.npr.org/2011/08/30/139786731/tube-burgers-the-world-of-in-vitro-meat

Oupkaew, P., Pusadee, T., Sirabanchongkran, A., Rerkasem, K., Jamjod, S., & Rerkasem, B. (2010). Complexity and adaptability of a traditional agricultural system: case study of a gall midge resistant rice landrace from northern Thailand. Genetic Resources and Crop Evolution, 58(3), 361-372. doi: 10.1007/s10722-010-9579-z

PETA. (n.d.). PETA offers $1 million reward to first person to make 'test tube' meat. Retrieved October 17, 2013 from http://www.peta.org/features/in-vitro-meat-contest.aspx

Post, M. J. (2012). Cultured meat from stem cells: challenges and prospects. Meat Science, 92(3), 297-301. doi: 10.1016/j.meatsci.2012.04.008

Scholte, J. A. (2002). What is globalization? The definitional issue – again. University of Warwick: Centre for the Study of Globalisation and Regionalisation. Working paper.

Sharrow, S. H. (1997). The biology of silvopastoralism. Agroforestry Notes (USDA-NAC). Working paper (7).

Specter, M. (2011, May 23). Test-tube burgers. The New Yorker. Retrieved from http://www.newyorker.com/reporting/2011/05/23/110523fa_fact_specter

Steffen, W., Sanderson, A., Tyson, P. D., Jäger, J., Matson, P. A., Moore III, B., . . . Wasson, R. J. (2004). Global change and the earth system: A planet under pressure. Stockhold: Royal Swedish Academy of Sciences. Executive Summary.

Stiglitz, J. E. (2006). Making globalization work. New York, NY: W.W. Norton & Company, Inc.

Tuomisto, H. L., & de Mattos, M. J. (2011). Environmental impacts of cultured meat production. Environ Sci Technol, 45(14), 6117-6123. doi: 10.1021/es200130u

van der Brugge, R. (2004). Transition dynamics: the case of Dutch water management. Dutch Research Institute for Transitions (DRIFT Erasmus University Rotterdam.

Personal carbon trading: A stepwise approach to implementation

Florian Simonsen and Lukas Warning

University College Maastricht (UCM), Maastricht University
f.simonsen@student.maastrichtuniversity.nl
l.warning@student.maastrichtuniversity.nl

Abstract

If negative effects of anthropogenic climate change are to be minimized, downstream policies play an important role. This mixed-methods study investigates to what extent the feasibility of implementation of Personal Carbon Trading (PCT) could be increased through prior introduction of Personal Carbon Accounting (PCA). The main barriers to the implementation of PCT, and the extent to which PCA, as a preparatory stage in a stepwise policy approach can contribute to overcoming these, are investigated with a focus on the Netherlands. The study finds that while PCA can help create favorable conditions for implementing PCT, important barriers remain.

I. Introduction

Achieving a transformation to a sustainable world in which environmental integrity is assured is the single biggest challenge faced by humanity in the 21st century. A substantial part of this challenge is the mitigation of anthropogenic climate change. Significant reductions in the emissions of greenhouse gases (GHG) need to be realized very soon if the worst consequences are to be avoided. Existing measures in the EU, as well as in the Netherlands, may fall short of effectively and timely reducing GHG emissions to a sufficient degree. Accordingly, new and more effective policy is called for. This study focuses on demand-side, consumer oriented energy policy in the Netherlands with its potential effects on personal behavior and individual consumption patterns. Engaging citizens with the issue of climate change, their personal emissions, and creating a feeling of individual responsibility can render the development of a much-needed social discussion and value changes possible. As one viable and potentially effective demand-side policy, which has the benefit of directly involving citizens, the introduction of a cap-and-trade scheme on the personal level, a market based mechanism usually referred to as Personal Carbon Trading (PCT), is the object of this research. In existing literature, barriers to the introduction of PCT can be identified, which mainly concern political acceptability and public perception, technical feasibility and costs, as well as the fairness of such a scheme. As an intermediate policy stage that could help overcome some of these barriers, the prior introduction of a Personal Carbon Accounting (PCA) scheme is proposed and tested. Accordingly, this study attempts to address the question to what extent the introduction of Personal Carbon Accounting can contribute to the feasibility of implementation of a Personal Carbon Trading scheme in the Netherlands by overcoming existing barriers. This study sets out with an introduction to PCT.

Consequently, the stepwise policy approach used in this study is lined out and PCA as a preparatory policy stage is described. Building on this background, the research question is formulated and the scope of the study is defined. The methods used in this study, a questionnaire and qualitative research through semi-structured interviews, as well as the methods of analysis are introduced, followed by a description of the results. Finally, the results are discussed in the context of the existing literature and conclusions on the fruitfulness of PCA in overcoming existing barriers to PCT are drawn.

II. Personal Carbon Trading

The concept of Personal Carbon Trading has been developed in the UK as an alternative to carbon taxes. PCT figures under several names and appears in different forms and models.[1] Common to the various models is that individuals are assigned free, tradable rights to carbon emissions on a yearly basis, that participation in the scheme is mandatory, and that the total amount of assigned emissions rights is reduced annually (Fawcett, 2010). The goal of these schemes is to bring about "guaranteed carbon savings in an egalitarian way" (Fawcett, 2004, p.1067). For the purpose of this study, PCT is defined, based on the literature, as a scheme in which individuals are assigned free, tradable rights to carbon emissions, in which participation is mandatory, and in which the total amount of emissions rights is reduced on a yearly basis. This scheme covers individual emissions for household energy consumption and personal transportation. Most of the research activity on PCT schemes has been in the UK. In the Netherlands, PCT has gained only limited attention (e.g. Woerdman & Wolderdijk, 2010; Roy & Woerdman, forthcoming). Yet, PCT implementation could be particularly interesting in this country, being relatively small and therefore requiring comparably little administration activities. The Netherlands furthermore possesses a rich infrastructure that includes extensive virtual banking and e-governance tools. Finally, being a democratically organized country with a relatively wealthy population, policies can be implemented that require public participation and the availability of resources. Among the barriers to PCT implementation in the UK were high costs of implementation, as well as low public acceptability (DEFRA, 2008). The implementation of such a "radical policy invention" (Parag & Eyre, 2010) requires a well-developed implementation strategy that involves the public, takes into consideration existing barriers and addresses them in the development phase.

III. A Stepwise Policy Approach

Introducing PCT on a local level, as a voluntary scheme or as a virtual model can be helpful, yet falls short of incorporating the nature of a mandatory, trade-based scheme that deals with millions of participants (Parag & Eyre, 2010). Simulations and pilot projects can add to the research (Howell, 2012; RSA, 2008; Capstick & Lewis, 2009; NICHE, December 2013), but will not yield the preparatory effects on public perception, political acceptability, and technical maturing that are necessary for successful implementation. Parag and Eyre (2010) propose an "incremental implementation", where emissions credits are allocated and surrendered with trading and penalties only introduced later. This approach is thought to deliver benefits in terms of "policy learning, better design, and error correction", as well as increasing political acceptability (Parag & Eyre, 2010, p. 364). Building on this recommendation, a stepwise policy introduction as a solution to the implementation difficulties of PCT is developed and tested here. Though it is rarely described in the literature on policy implementation, in practice, stepwise implementation is often used by policy makers. This approach can be explicit or

[1] Most prominent among these are Tradable Energy Quotas (TEQs), also known as Domestic Tradable Quotas (DTQs) (Fleming, 1997; 2007; Starkey & Anderson, 2005), and Personal Carbon Allowances (Hillmann & Fawcett, 2004).

implicit to the policy making process, as with the EU's policy on bringing forward the single market in telecommunication (European Commission, 2013). A policy step towards a desired final policy goal can be an end in itself and will likely serve one or more goals independently of the final policy. At the same time, however, the implementation of the first step or stage will encounter fewer barriers and will thus be easier to achieve. It can render the final policy more feasible by involving and preparing the public, identifying and solving technical challenges and strengthening political acceptability. However, if the preparatory stage is perceived as a premature or costly experiment, it could lead to unintended consequences and negatively affect public opinion.

IV. Personal Carbon Accounting

Main barriers encountered by PCT, as can be identified in the existing literature, regard political acceptability, public perception, technical issues and cost (DEFRA, 2008). Some of these barriers could potentially be overcome through a stepwise policy implementation. Personal Carbon Accounting is proposed here as a feasible intermediate step towards the implementation of PCT, which could help overcome some of the existing barriers. For the purpose of this study, the concept of Personal Carbon Accounting is defined as a nationwide scheme in which citizens have a digital carbon account to keep track of their emissions in the areas of energy consumption and personal transport, enabling them to compare their emissions with a set threshold level that is desired for climate change mitigation. One potential effect through which PCA could help create favorable conditions for the implementation of PCT is by increasing carbon literacy. Carbon literacy describes an individual's understanding of the basic functioning of anthropogenic climate change and knowledge of the emissions that are attributable to the person's activities and their effect on global climate change. Knowledge of the emitted amount and comparing own emissions to those of the country average or a targeted 'safe' amount can enhance the individual's feeling of responsibility (Semenza et al., 2008). Other effects beyond increased carbon literacy are expected.

V. Research Question

PCT is neither the only option nor a standalone policy for downstream emissions reduction, but one that, if developed and implemented, promises to yield significant results. Downstream carbon trading schemes, such as PCT, have the benefit of engaging citizens directly and thereby enabling changes in social norms (Matthews, 2010; Sorrell, 2010). Identifying barriers to decisive action and steps that can help overcome them is a particularly interesting and fruitful field of research when focusing on a small, wealthy and democratically organized country like the Netherlands, where emissions reduction policies are not sufficient. This research investigates the role of a stepwise approach in the implementation of a radical policy. It does so by studying in how far PCA contributes to the feasibility of implementing PCT if introduced as a preparatory step. The research question addressed in this study is thus:

To what extent can the introduction of Personal Carbon Accounting contribute to the feasibility of implementation of a Personal Carbon Trading scheme in the Netherlands by overcoming existing barriers?

In order to address the research question, the main barriers to PCT in the Netherlands are identified, the potential of PCA for addressing these barriers is tested and the process, benefits and limitations of a stepwise policy approach are discussed. Barriers to PCT and the analysis of PCA's contribution in creating favorable conditions by overcoming these can be organized in five categories that help in the analysis, while the interrelatedness of the

different factors must be acknowledged[2]: economic behavior - choices of individuals under external constraints, such as PCT's economic mechanisms and the availability of low-carbon alternatives -, carbon literacy - general awareness individuals have of climate change and their individual contribution thereto -, social norms - values that people hold and the importance, framing of and support for emissions reduction policy -, technical questions - the cost and technical details of PCT implementation -, and policy design - the exact scope and functioning of PCT.

VI. Methods

Additionally to a comprehensive literature review, a mixed-methods approach was taken which included semi-structured interviews with PCT experts and policy makers and a questionnaire among Dutch citizens. Barriers to and desirability of both PCA and PCT as well as the potential role of a preparatory policy stage were assessed. Together, interviews and questionnaire offer a valuable indication of the extent to which existing barriers to PCT in the Netherlands could be overcome through the introduction of PCA as a preparatory policy stage.

Questionnaire[3]

The questionnaire was used to test background knowledge of the general population concerning individual carbon emissions and its climate change effects, their values related to this and in how far citizens act on these. One of the aims was a better understanding of the correlation between carbon literacy, values, and green behavior. Additionally, the questionnaire served as a first indication of the public perception of PCT in the Netherlands, and more importantly as an indication of how acceptability of PCT relates to Personal Carbon Accounting, carbon literacy, values and behavior. The population under study includes all Dutch citizens above sixteen years of age. As a sampling method, snowball sampling was used. The online questionnaire was distributed via friends and colleagues of the researchers, who in turn were asked to forward it to friends, colleagues and family members. The questionnaire was online for three weeks in late 2013. It contained 25 questions and took around 10-15 minutes to fill out.

Interviews

Overall, 34 people were contacted, and interviews were conducted with eight individuals that fall into the following categories: (i) researchers on PCT (4), (ii) experts of the Dutch energy policy arena (2), (iii) Dutch energy and climate policy makers (1), and (iv) civil society groups that support the introduction of PCT (1).[4] The 30 to 45 minute semi-structured interviews were conducted via telephone and Skype. The interviews shared the same basic structure and questions[5] but particular topics of interest were added for the individual interviews and flexibility was allowed for following up on unexpected and important insights and comments. The aim of the interviews was to get a deeper understanding of the current status of PCT in the policy arena, to identify barriers that are encountered and ways in which these could be overcome. The experts' perspective on PCA and the relevance of carbon literacy in making PCT more feasible as well as the impact of a stepwise approach on the feasibility of implementation in the Dutch policy arena were other important aspects studied.

[2]These categories are informed by Parag and Strickland's account of the working mechanisms of PCT as economic behavior, carbon perception and social norms (2009) and adapted here to cover the most relevant factors that influence the feasibility of implementation of PCT.

[3]The full questionnaire will be provided by the authors upon request.

[4]A list of interviewees will be provided by the authors upon request.

[5]An example will be provided by the authors upon request.

VII. Results

Questionnaire

131 responses were recorded, of which 127 were applicable.[6] The sample is not perfectly representative for all Dutch citizens above 16 years.[7] When analyzing the proxy values for green values and green behavior, a clear correlation can be identified. As Figure 1 shows, and as the correlation coefficient of r=0.49 indicates, there is a significant association between the green values variable and the green behavior variable. There are only few outliers that do not significantly affect the significance of the correlation. The correlation between carbon literacy and green behavior is less strong. Here, the correlation coefficient is r=0.20, which shows a significant, but comparatively weak association. It follows that the higher the carbon literacy, the higher the levels of green behavior. However, as the boxplot in Figure 2 indicates, green behavior is only considerably higher at high levels of carbon literacy and comparatively low at very low, low, and medium levels of carbon literacy. As Figure 3 indicates, there is a positive association between carbon literacy and green values. However, the correlation coefficient of r=0.15 indicates a significant, but rather weak association, which indicates that higher carbon literacy can be associated with a higher score on the green values scale. Green values are clearly higher for those with high carbon literacy, but other levels of carbon literacy do not affect green values strongly. Participants were briefly introduced to PCA. Of the participants, about 53% indicated that they would make use of the scheme to compare own emissions and their impact on climate change to those of others while around 31% answered that they would not do so. Moreover, about 81% indicated that knowing about the emissions related to a product or service would influence their consumption behavior for some or most product choices, while only about 12% indicated that such knowledge would not affect their consumption choices. Potential problems relating to the introduction of PCA that were voiced by respondents are that such a scheme would be ignored by a large part of the population, privacy concerns, the fear that a quota system could follow, as well as the fear of misuse and fraud through product labels. The respondents were introduced to PCT as an extension of PCA. Around 44% were in principle in favor of such a scheme. Of these, about 57% would sign a petition for the introduction, while around 12% would not do so. Of all participants, about 39% were in principle against the introduction of a PCT scheme. Reasons for their opposition varied widely. Participants indicated that other options to reduce emissions, such as a carbon tax, would be more effective, that the scheme was unfair or that it was the responsibility of the private sector or the government to address emissions reductions and that people did not want to be directly involved in reducing carbon emissions. Some participants opposed PCT because they saw no need to reduce emissions, because of a lack of trust in the government and in the working of such a scheme, a lack of flexibility to take into consideration individual situations, as well as privacy concerns. Finally, some respondents opposed PCT indicating that emissions reductions must result from awareness and responsibility and that it is everyone's personal responsibility to reduce emissions. While 76% of the respondents indicated that individuals have high or very high responsibility for reducing GHG emissions in the Netherlands, even more indicated a high responsibility of the government and the EU. This perspective is a potential barrier to the introduction of PCT. Support of PCT

[6] Four participants were of other nationalities and therefore excluded from analysis.

[7] Respondents were on average 34.7 years old, with a median age of 24, which is significantly lower than the median age of Dutch citizens of 41.8 years (CIA World Factbook, December 2013). In terms of gender distribution the sample is, with a male/female ratio of 0.61 compared to the ratio of 0.98 of the Netherlands, also not representative (Centraal Bureau voor de Statistiek, October 2013). Regarding the level of education and party affiliation, the sample is not representative either. The average level of education of the sample is significantly higher than that of the average population (Centraal Bureau voor de Statistiek, December 2013).

can clearly be associated with higher scores on carbon literacy, green behavior, and green values. More carbon literate citizens, as well as those with higher green values and greener behavior, are more likely to also support the introduction of a PCT scheme. More indirectly, participants were also asked whether they would be in favor of prices of products and services that reflect their real impact on climate change through carbon emissions, offering an indication whether a radical policy that affects prices and the burden on individuals, be it a trading scheme or a carbon tax, is supported. About 78% of the respondents indicated their approval of such pricing, while only 15% were against it. This result, which is unexpected when the feeling of individual responsibility in carbon emissions reduction is considered, can partly be due to a response bias. Of the respondents, 39% have calculated their ecological footprint before. Of these, around 59% were for the introduction of a PCT scheme, while about 31% were opposed. Of those that have not calculated their own ecological footprint, around 35% were for the introduction of PCT, while about 45% were against such a scheme. A clear correlation between having calculated the own ecological footprint, and supporting the introduction of a PCT scheme follows, although this relationship is confounded by green values and behavior. At the same time, these results do suggest that people who hold strong green values and are concerned about their environmental impact are more likely to actively seek further knowledge and to pursue increased carbon literacy. This supposition is supported when looking at the extent to which respondents affiliated with different parties support the introduction of PCT. Of those that voted for GroenLinks and PvdA in the last election, 80% and 55% respectively were in favor of the scheme with 7% and 24% opposing to it, while of those that voted for D66 and VVD, 34% and 26% respectively were in favor with 50% and 68% being against the introduction of such a scheme. These findings support the earlier identified correlation between green values and the support of PCT, while the lack of support from the neoliberal camp for the market-based tool PCT is surprising.

Interviews

All of the experts interviewed stated that PCT is currently not on the political or research agenda in their respective countries. Reasons mentioned were insufficient research funding, and the fact that other issues including energy security and the economic crisis have ousted PCT from the policy arena (personal communication: Fawcett, 6.12.2013; Parag, 19.11.2013; Dosch, 4.12.2013). Attention in the Netherlands has been limited to occasional research (personal communication: Sijm, 19.11.2013; and Holtrop, 12.12.2013). Politically, PCT has, if at all, only been considered briefly and discarded as not fitting the long-term policy (cf. personal communication: Holtrop, 12.12.2013; Swinkels, 12.12.2013). Many respondents consider PCT as necessary and, given political support, feasible. Others argue that the introduction is not possible in the current policy arena and yet others claim that PCT is not what is needed, as it is not expected to yield the needed value changes (personal communication: Brown, 26.11.2013, Dalhammar, 26.11.2013), or will not be as effective as upstream policies or a carbon tax. Within the analytical framework introduced above, the barriers mentioned by interviewees can be organized into five different categories. Of course, barriers can each relate to several categories and both barriers and categories are not static but interlinked and interacting. When asked to put forward suggestions on how the identified barriers could be overcome, respondents proposed a number of different approaches of which the most important recurring ideas included increasing carbon literacy, framing and "selling" PCT as an attractive and fair policy that needs to be regarded as an alternative to other effective emissions reduction policies such as a carbon tax, rather than as an alternative to the status quo. Creating grass-root citizen support and/or private sector demand for PCT and action on climate change in general, accompanied by a national conversation, were other approaches brought

forward. Conducting further research for developing technical solutions is considered an important prerequisite by some, while others argue that further research will only be beneficial in a changed political atmosphere (Parag, personal communication, 19.11.2013). Offering alternative choices that provide citizens with low-carbon options for energy choices and personal transportation before introducing PCT was another important way in which the barriers could be addressed and a question around which an interesting debate is evolving. At the same time, some suggested that the market would react to PCT by providing options that people seek. In the end, it seems that there is consensus that despite the market effects of PCT, enabling policies need to be developed at least parallel to PCT. When PCT is considered as an alternative to other effective downstream policies and not compared to the status quo, many respondents argue the public would prefer PCT over a carbon tax, because PCT is perceived as more empowering and granting more freedom to the individual. Others claim that a carbon tax may, on the contrary, be easier to implement as the taxing infrastructure exists and that taxation may be preferable because of lower transaction costs and higher efficiency. At the same time, it is acknowledged that PCT is advantageous in actively and effectively engaging citizens and impacting their behavior more directly than a tax. An important remark made by a Dutch policy expert was that the Netherlands is a moderate country, where radical policy is not often proposed or implemented (Sijm, personal communication, 19.11.2013). After being introduced to PCA as a preparatory step that could contribute to the feasibility of implementation of PCT, most respondents stated that PCA would be a suitable, feasible, maybe even necessary step that could serve to inform, sensitize, reduce fear, raise interest and start a national debate. While technical barriers to PCA were not expected, concerns were voiced on privacy, as much data needs to be made available, as well as the high cost with little immediate returns. The need for prolonged information and the lack of interest of people in their carbon emissions were voiced. More skeptical respondents stated that information is not that relevant for changes in behavior and values and that people require information on alternatives rather than on their current emissions. There was no consensus on PCA's effectiveness and the public's reaction to it.

VIII. Discussion

In order to adequately address the research question, barriers to the implementation of PCT in the Netherlands have been identified and the extent to which these could be overcome by the prior introduction of Personal Carbon Accounting as a preparatory policy stage was studied. While the representativeness of the samples of both the interviews and the questionnaire is limited, important conclusions can still be drawn from the findings. While most interviewees and 44% of the participants of the questionnaire support the implementation of PCT (39% were against it), many concerns have been voiced. Barriers to and perceived weaknesses of PCT can be divided into those that are specific to this scheme and those concerns that are directed against effective emission reduction policy in general. Despite a potential response bias, the questionnaire results suggest that many more people are in favor of prices that reflect carbon emissions than are for the introduction of PCT. It could be that concerns specific to PCT lead to this difference, which could include that PCT is regarded as too effective and too constraining. For an effective analysis, the barriers to PCT that have been identified, as well as the extent to which PCA can help to overcome these, are discussed within the analytical framework that has been proposed earlier on. Although the complexity and interrelatedness of barriers to PCT and the mechanisms through which PCA affects the feasibility of PCT are acknowledged, this framework can be of help in the analysis thereof.

Economic behavior: Concerns against PCT voiced in both the interviews and the questionnaire related to the unavailability or high cost of low-carbon transportation and energy alternatives as well as to the unfairness of the scheme.[8] PCA could help to identify the most problematic areas, in which compensating policies need to be taken. Another advantage of the prior introduction of PCA, which includes no negative financial incentives, is the opportunity and time that is offered for secondary policy, providing low-carbon alternatives, to be developed in a way that renders PCT attractive and empowering as well as fairer. Additionally, PCA can help addressing perceived unfairness of PCT through a discourse that prepares the policy arena for the implementation of low-carbon alternatives in the transport sector etc. The economic constraints of a cap and trade system and the cost of alternatives are not impacted by PCA.

Carbon literacy: A role that PCA plays is that of increasing individuals' knowledge of climate change, their own carbon footprint and how their emissions impact global climate change. Carbon literacy has been shown, based on the questionnaire, to have a strong correlation with green values and climate conscious behavior. Although a clear causation is difficult to establish the results of the questionnaire as well as the information provided by the interview respondents do suggest that increasing carbon literacy can help overcome one of the main barriers to PCT, namely a lack of awareness of the personal emissions. Although action does not immediately follow from knowledge nor values, knowledge enables people to make conscious choices. Another barrier to PCT, related to the availability of low-carbon alternatives mentioned before, is the awareness of these options' availability. Accompanying PCA by a provision of information on alternative choices, integrated into the accounting tool could further increase people's knowledge of carbon conscious behavior.

Social norms: Social norms or values, as used here, entail the way the urgency of solving anthropogenic climate change is framed and perceived by society. Holding strong green values does not necessarily result in green behavior, although a correlation is undeniable as this study has shown. However, socially shared norms that acknowledge the relevance of the problem and call for decisive action make the implementation of policy, which may be perceived as undesirable and burdensome, much more acceptable. Increased carbon literacy can impact positively these values and thereby create more favorable conditions for policy, including PCT. Through this effect, PCA could help pave the way for this quite radical policy. The correlations that can be seen between PCT support and preference for the *GroenLinks* party or to having calculated one's carbon footprint further illustrate how values are in close correspondence with support of downstream emissions reduction policy or at least acknowledgement of the necessity thereof. An inclusive public debate, although certainly needed, cannot be made a precondition for the introduction of effective policy. PCA can be regarded as a way to set the agenda and foster public debate and making changes in social norms possible through increasing the individuals' carbon literacy. The fact that individuals are hesitant to accept effective policy interventions and that politicians do not see them as 'election winners', is another point emphasizing the important role of starting a real debate about the urgency of emissions reduction. An important insight that was brought up repeatedly in interviews was that PCT must be compared to other emissions reduction policies, not as an alternative to the status quo. For this framing to succeed, the necessity of action would, of course, first have to be grounded deeper in the public perception and in social norms. PCA can serve as a catalyst for this

[8] Although the scheme is regarded as an overall progressive policy that redistributes wealth from rich to poor, there are cases in which poorer people are further disadvantaged, for example through higher heating energy consumption in a badly insulated house or if public transport is not available in rural areas.

debate and is expected to enable change in social norms, if developed and implemented with care and based on inclusive and credible citizen participation.

Technical questions:The most important technical barriers to implementing PCT regard the cost and the bureaucratic effort that the scheme requires. These aspects have been mentioned both in the literature and by interviewees. It is likely, but needs to be investigated further, that PCA would prepare the technical implementation of PCT, for example by creating a test environment through the installation of the infrastructure, from which important lessons for the later trading can be drawn. Questionnaire respondents, on the other hand, have rather focused on the perceived (in)capability of the government to establish and securely run such a scheme. The introduction of PCA could potentially be beneficial in this respect by building trust in the government. If the technical infrastructure for PCA can be established successfully and if problems are dealt with in a transparent and competent way, the public will be more likely to trust the government with the establishment of the more complex PCT scheme. The prior introduction of PCA would necessarily be accompanied by increased research activity and funding and would offer opportunities for addressing the remaining technical questions.

Policy design: The exact design of PCT as a policy is still very much debated. The vagueness and multitude of concepts can be seen as enriching as it leaves room for an inclusive policy development process where the most desirable solution will be chosen. At the same time, the openness can lead to misconceptions, doubts and opposition. Beyond the inherent problems of unfairness with PCT negatively affecting some low-income households, which need to be addressed by a sophisticated policy design and compensation policies, perceived unfairness goes much further. Framing PCT as a fair scheme because it is (mainly) progressive and allows for consumption choices within certain constraints to the individual, is an important task that needs to take place in a favorable policy arena. At the same time, the right framing also contributes to more favorable conditions. The challenge of beginning the dialogue and discussion about the most desirable policy design is a difficult one because of this circular dependence. PCA could, however, offer an opportunity to create such dialogue without immediately testing policy designs on the citizens. The stepwise policy approach allows for learning and adaptation in a way that can be inclusive, empowering and problem solving. Additionally to the many interrelated ways in which PCA could create more favorable conditions for the introduction of PCT, PCA is also expected to have certain direct effects and to encounter barriers of its own. While it can be argued that disclosing information about individual carbon emissions and raising awareness can yield emissions reductions without any financial incentives (Ascui & Lovell, 2011), this positive effect is confronted with certain limitations. The questionnaire results show that, although more than 80% of the respondents feel that emissions labeling would affect their consumption choices, only around half of the participants would actively make use of the scheme in the sense of comparing their emissions to others. The concern that people would not be interested in PCA or not understand it was reflected in comments made in the questionnaire and interviews alike. Additionally, PCA can be perceived as an additional hassle. A concern that regards PCA and PCT alike is the risk of manipulation of carbon emissions of fuels, energy and products. Another recurring issue that needs to be addressed in the phase of policy design of PCA is privacy. Many questionnaire respondents were concerned about the disclosure of personal information. Building the trust required to overcome these concerns requires a transparent policy process and thoughtful design of the policy. The introduction of PCA may also lead to negative consequences. Concerns regarding privacy, the credibility of labeling,

high cost and mistrust in the government may lead to a backlash against PCT. As several comments from the questionnaire and an interview suggest, people are highly suspecting of government activity being transformed into taxation and may, when confronted with PCA, decline the policy because of negative financial incentives that are expected to come. Both cost and mistrust do not allow for PCA to be introduced ahead of PCT without disclosing long-term plans. The decision to take effective emissions reduction policy that includes and engages citizens needs to be made and publicized widely and confidently to prevent premature opposition and engage opponents in a constructive debate.

IX. Conclusion

Taking radical policy decisions does not fit well into the Dutch policy framework, where moderate changes are traditionally preferred. However, as long-term Dutch and European policy on climate change mitigation focuses exclusively on upstream policies and seems to avoid public debate, PCA may be even more desirable and necessary in this context. It could help stimulate public discussion and consensus building regarding the approach to be taken in the development and implementation of effective emissions reduction policy. The precise design of PCT requires an active and credible involvement of citizens. In the process of creating more favorable conditions for effective emissions reduction policy, transparent policy development, citizen engagement and possibly higher climate pressures all play a role. When the need for decisive policy is more widely acknowledged and social norms allow for the individual to take part in the reduction efforts in a meaningful way, a fruitful and inclusive debate can be led with the aim of designating the most desirable policy mix. Other policies besides PCT, as well as secondary or enabling policies that offer low-carbon alternatives, are also more likely to be implemented successfully in such an open policy arena. It is important to note that policy does not need to wait for social norms to shift, but can create favorable conditions for behavior, value and further policy shifts. Behavior, being embedded in its social, cultural and technological environment, is of course also affected by policy. PCA could be an enabling policy, if its limitations, both internal and regarding the extent to which it paves the way for PCT, and these interrelations are acknowledged and the policy design takes place in an inclusive way that empowers people to make conscious choices. In conclusion, PCA is expected to impact social norms through increased carbon literacy and to help start a national conversation in which responsibilities, values and the question of urgency of emissions reduction are discussed. PCA allows for learning and problem solving in the areas of policy design and technical questions and it allows for low-carbon alternatives and appropriate complementary policy to be created as awareness on demand and supply side is raised. However, PCA cannot overcome all barriers to the implementation of PCT and it encounters significant barriers itself. Beyond these insights, the fundamental question whether the market-based tool PCT as such is appropriate for addressing the underlying economic drivers of climate change remains open.

Figures and tables

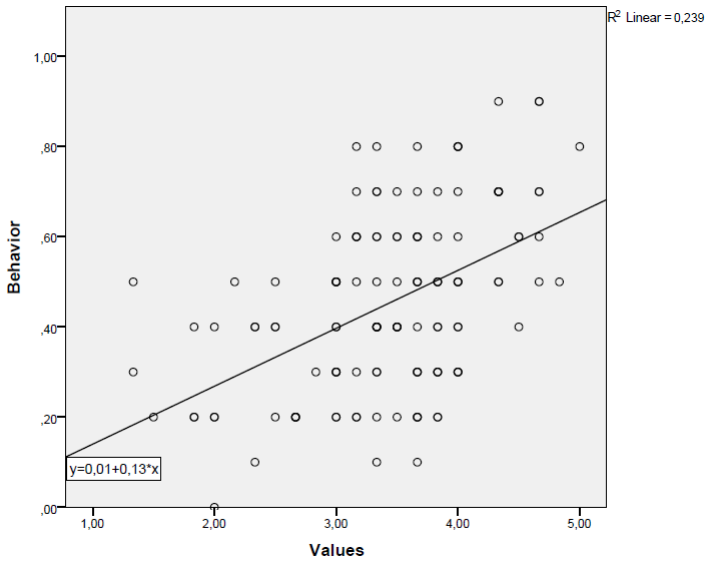

Figure .1: *Correlation green values and green behavior*

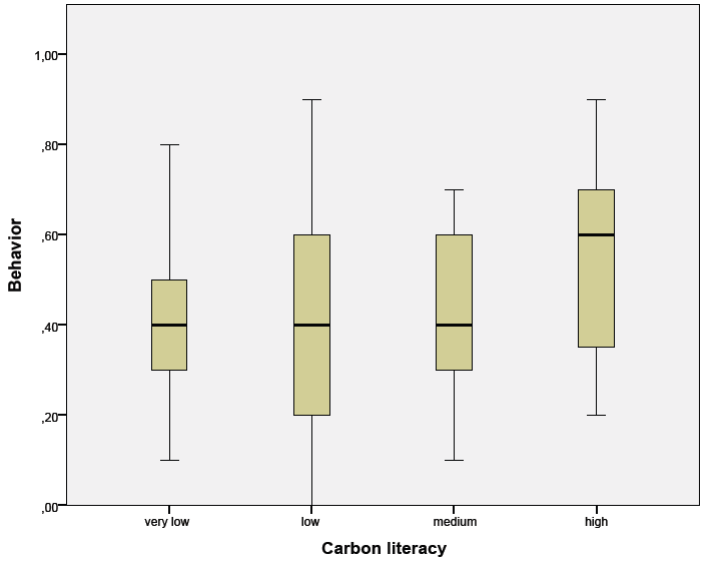

Figure .2: *Box plot carbon literacy and green behavior*

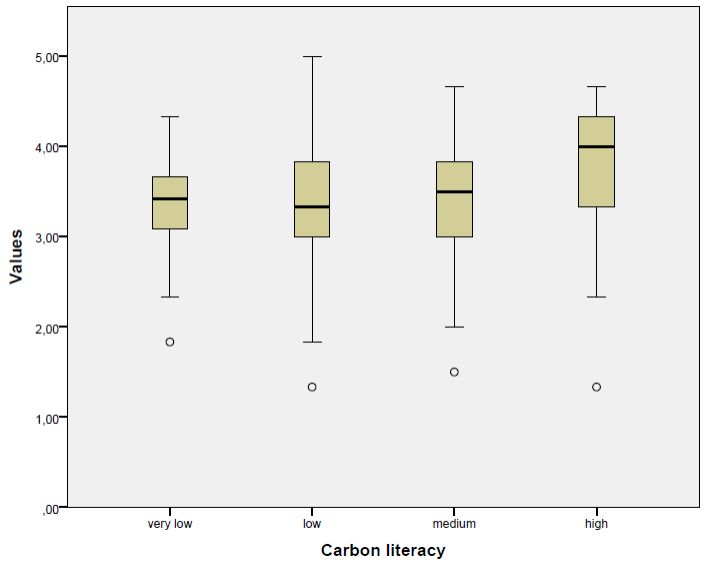

Figure .3: *Box plot carbon literacy and green values*

Category	**Barrier**
Economic behavior	
	Availability of low-carbon alternatives
	Unfairness: burden on (poor) people
Carbon Literacy	
	Lack of awareness of personal emissions
	Lack of information on low-carbon behavior
Social Norms	
	Lack of interest in effective climate change mitigation
	Perceived as additional burden: "not an election winner"
Technical issues	
	High costs
	Bureaucracy
Policy Design	
	Perceived unfairness
	Complexity

Table .1: *Barriers identified by interviewees*

References

Ascui, F., & Lovell, H. (2011). As frames collide: Making sense of carbon accounting. Accounting, Auditing & Accountability Journal, 24(8), 978-999.

Capstick, S. & Lewis, A. (2009). Personal carbon allowances: A pilot simulation and questionnaire. UK Energy Research Centre: Demand Reduction Theme, University of Oxford.

Centraal Bureau voor de Statistiek. (October 2013) Population statistics. Retrieved on 16.12.2013 from http://www.cbs.nl/nl-NL/menu/themas/bevolking/cijfers/default.htm

Centraal Bureau voor de Statistiek. (December 2013). Labor force and level of education. Retrieved on 21.12.2013 from http://statline.cbs.nl/StatWeb/publication/?DM=SLEN&PA=71822ENG&D1=0,2-4&D2=0&D3=0&D4=0&D5=a&D6=0&D7=l&LA=EN&HDR=G1,G2,G3,G5,T&STB=G4,G6&VW=T

CIA World Factbook. (December 2013). Retrieved on 20.12.2013 fromhttps://www.cia.gov/library/publications/the-world-factbook/geos/nl.html

DEFRA. (2008). Synthesis report on the findings from Defra's pre-feasibility study into Personal Carbon Trading. Retrieved on 08.09.2013 from http://www.teqs.net/Synthesis.pdf

European Commission. (2013). Digital agenda for Europe. Retrieved on 28.09.2013 from https://ec.europa.eu/digital-agenda/en/connected-continent-single-telecom-market-growth-jobs

Fawcett, T. (2004). Carbon rationing and personal energy use. Energy & Environment, 15(6), 1067-1083.

Fawcett, T. (2010). Personal Carbon Trading: A policy ahead of its time?. Energy policy, 38(11), 6868-6876.

Fleming, D. (1997). Tradable quotas: Using information technology to cap national carbon emissions. European Environment, 7(5), 139-148.

Fleming, D. (2007). Energy and the common purpose: Descending the energy staircase with Tradable Energy Quotas (TEQs). Retrieved on 08.09.2013 from http://www.teqs.net/EnergyAndTheCommonPurpose.pdf

Hillman, M. & Fawcett, T. (2004). How we can save the planet. Penguin Books, London.

Howell, R. A. (2012). Living with a carbon allowance: The experiences of Carbon Rationing Action Groups and implications for policy. Energy Policy, 41, 250-258.

NICHE. (December 2013) The Norfolk Island Carbon/Health eValuation Study. Retrieved on 16.12.2013 from http://www.norfolkislandcarbonhealthevaluation.com/

Parag, Y. & Eyre, N. (2010). Barriers to Personal Carbon Trading in the policy arena. Climate Policy, 10(4), 353-368.

Parag, Y., & Strickland, D. (2009). Personal carbon budgeting: What people need to know, learn and have in order to manage and live within a carbon budget, and the policies that could support them. UK Energy Research Centre, Working paper, UKERC/WP/DR/2009/014.

Semenza, J.C., Hall, D.E., Wilson, D.J., Bontempo, B.D.,Sailor, D.J., & George, L.A. (2008). Public perception of climate change: Voluntary mitigation and barriers to behavior change. American Journal of Preventive Medicine, 35(5), 479-487.

Starkey, R., & Anderson, K. (2005). Domestic tradable quotas: A policy instrument for reducing greenhouse gas emissions from energy use. Tyndall Center for Climate Change Research.

Interview with Dr. Jeroen Derwall, coordinator of the new "Sustainable Finance“ track

Photo by Wim Smeets

Dr. Jeroen Derwall, track coordinator of the new Sustainable Finance track of the International Business Master program at the School of Business and Economics, sat down with Judith Enders, research project coordinator, and Bram Brouwers, volunteer at Maastricht University Green Office, to talk about the track, what it offers, as well as how the idea came about and his own background and thoughts on sustainable finance.

The Sustainable Finance Master track started for the first time this September. What is this course about?

Sustainable Finance is a track within the International Business Master program at the School of Business and Economics. You graduate with a Master degree in International Business with a specialization in Sustainable Finance.

Apart from covering some courses from other IB tracks, the Sustainable Finance track covers two mandatory courses that are different from the other tracks.

Sustainable Finance, Management, and Strategy is a course in which we look into what strategic, managerial, and financial decisions companies have to consider if they want to embrace sustainability in the right way, as part of their DNA. For example, people with different backgrounds, and working in different areas of the organization, have different opinions about what sustainability constitutes. This creates a communication barrier that makes it more difficult for people within the company to introduce a business case for sustainability and further develop sustainability targets for different units or departments. With this course, we want to give students insights into the implementation process of sustainability in companies. It’s all about developing a clear strategy, implementing control mechanisms and measuring progress to report results in a way that makes sense to relevant stakeholders. We also discuss what implementation of sustainability means for the finance department. Questions we ask along the way are: Is the company still competitive? And are consumers interested, are they willing to pay more for products and services of a sustainable company, if necessary? With this course, we want students to feel comfortable facing these kind of processes and obstacles.

The other mandatory course is on sustainable investments. Here, we focus on what kind of

sustainable investment strategies are available, how do they perform on the stock market and other markets, and how can active portfolio managers integrate sustainable investments into their portfolios. Also in this area of finance, there are issues that stretch to other disciplines. For example, students will learn about issues such as investor trust and loyalty, which may affect the ways a financial institution can profitably introduce specific sustainable financial products.

How is this track different from the regular finance track?

The Sustainable Finance track really combines finance with sustainable aspects. It is for people who want to graduate in mainstream finance plus sustainability, not finance or sustainability. You learn everything you would also learn in regular finance courses plus relevant knowledge on sustainability.

How many students are following the course at the moment? Did you expect this many students, and how many students do you hope to attract for the next round in January?

Our target number for the first year is about 25 students. This semester 13 students enrolled, which is to be expected for a new course. We hope to enroll 12 more students in January 2015. To reach this goal we will continue to promote the course. We especially want to increase the awareness among applicants that the Sustainable Finance track is a hard core finance Master. So we expect Bachelor knowledge in finance.

How is the course going so far?

So far the course is going great. With the current group of students I am able to interact with everybody and detect any problems they might experience early. For example, for students that need some rehearsal on financial basics, I've put a lot of e-learning material online. We are fortunate to have a very ambitious group of students. They chose this track because they are truly interested in the combination of finance with a sustainable approach.

Was or is there notable criticism or doubt about the legitimacy of the program?

Doubts? Absolutely. Many people in finance have long seen sustainability as philanthropy in the very negative sense. Philanthropy is traditionally often associated with decreasing a company's competitive edge. There are people who say that by integrating sustainability in the world of finance, in the long run, you put yourself out of business. Also the social role companies should play in society is thought to be inefficient when it comes to profit maximization. However, we are turning these ideas around in order to fulfill a pressing need in the financial sector: to help the sector further understand the benefits that can reaped from running a sustainable business. It is indeed true that companies should focus on profit maximization, but we believe there are a lot of opportunities for those companies to fulfil the social role they have to play, and this might be even beneficial for their profit. If we simply adopt all the logics that we have learned in classic finance and we include all the new information in those classical frameworks, the importance of sustainable finance becomes clear. Especially in the long term.

What triggered your interest in sustainability and finance?

Back in 2001 when I was a student at Maastricht University and working on my master dissertation about forecasting investment strategies, I questioned myself what would be my next step. It was right after the tech-bubble had crashed and the opportunities in the labor market were not looking fantastic. I felt that the very commercial financial industry was not for me, so I searched for other opportunities. Then my Master thesis got published which was great news. My promoter at that time was Prof. Dr. Rob Bauer, part-time associate professor and part-time

head of research at ABP investments, who encouraged me to do a PhD. He had just written a paper on sustainable investment together with people from the University of Rotterdam. I was very interested in the topic and I started conducting research myself on sustainable investment while being unemployed. That research actually got published as well and in June 2003 the people from Rotterdam offered me a PhD position. In Rotterdam I continued to work on sustainable investment. The first paper I published ("The Eco-Efficiency Premium Puzzle") documented the positive return on a sustainable investment and had a big impact in the financial world.

In 2005 we received a large amount of funding from a Swedish foundation for a proposal on how institutional investors might be able to promote sustainable investment. In collaboration with Maastricht University we build the European Centre for Corporate Engagement (ECCE), a research institute on sustainable finance. We also approached companies to collaborate, and this is how it all started.

What is ECCE doing exactly?

We have seen that people in sustainable finance, for example rating agencies, usually have a more ethical background and are criticized for having a lack of financial expertise. At the other end of the spectrum you have the hardcore finance people, who are suddenly confronted with sustainability problems. At ECCE we are trying to find out how financial institutions can deal with the topic of sustainability, keeping in mind their core business and their mainstream way of doing things. We speak and communicate in the language that finance people are familiar with, and we try to fill the gap that exists in between those two parties.

How and why did this idea about a Sustainable Finance Master come up?

Nowadays ECCE is fully Maastricht based and part of the finance department. We agreed we wanted to set up a track in which we could teach the expertise we have accumulated on sustainable finance. We were already teaching courses to pension funds and asset managers, so we knew that the topic was much appreciated by these partners. Therefore we thought also students would be interested.

In how far does your involvement with ECCE have an effect on the course content?

Basically ECCE is the finance department, and the finance department is responsible for the track and I am the track coordinator. The sponsors from ECCE may be involved in guest lectures, and can be very useful for Master thesis topics and internships. For example, the first 25 students that enroll in the sustainable finance master can expect an internship offer arranged via us and the ECCE network, if they are interested.

Are there other known sustainable finance programs in the Netherlands or worldwide?

We are the only ones in the world who now have a full Master in sustainable finance, though Berkeley provides an MBA class on sustainable finance, and Harvard one on sustainable business.

I think one of the main reasons why sustainable finance curriculums are still scarce is that there was no incentive for research in this area in the past. Until very recently, most top journals in finance were unlikely to accept papers on sustainable finance. So if you wanted a nice career in academic finance, you needed to go for something more traditional. However, in Maastricht we have build up a good academic track record. We are able to publish our research in the top six most read financial journals. We build up a lot of expertise in the area. Due to our success, interest in the sustainable finance track is growing. Also students have to be convinced of this track's benefits, especially when comparing it to the mainstream finance Master. We intend to

give finance students extra baggage on the labor market by letting them know how sustainability issues affect financial problems, the mainstream tools used in financial practice today, and financial outcomes. This track has mandatory courses that focus more on investments compared to regular IB/finance, which has more mandatory courses on corporate finance.

What major trends or problems do you see with regards to sustainable finance?

The financial sector is already changing more to sustainable investment because pension funds are increasingly confronted with it. But there are still quite some obstacles that need to be overcome. One problem is the reporting of relevant information. Companies need to report their sustainable investment and profit in clearer ways. However, this is a very new field so lots of learning needs to take place first. We can currently observe a trend towards integrated reporting. For example it is already mandatory in South Africa to conduct integrated reporting and other countries are following.

A major problem is that investments on sustainability might only pay off in 20 to 40 years, if not more. So the cash flow decreases in the short run, and many shareholders do not like this very much. Moreover, a portfolio manager is judged on his performance over at most one year. Therefore it is unlikely that he will invest in companies that go sustainable if their returns will consequently not be great in the short run. Hence, incentive systems would need to change too.

In summary the financial sector should look more at the long-term profit of sustainable investment.

In your opinion, what should the financial industry ideally look like?

I think right now the financial sector is making money on things that are not good for the wellbeing of the customer. Financial service providers often try to sell things in an aggressive way in order to get rich in the short term. However, the fact is that in a well-functioning capital market you need to focus on the long run. Plus, sustainable finance is not only about investments that are good for the environment, it is more generally about making financially sound investments from which society ultimately benefits.

If you want to learn more about the one-year Master, visit
http://www.maastrichtuniversity.nl/web/faculties/sbe/targetgroup/education/mastersprogrammes/sustainablefinance.htm