Analysis of Decision Making and Incentives in Danish Green Web Applications

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Abstract: *Traditional information campaigns aimed at incentivising the kind of behaviour change that will lead to more sustainable levels of energy consumption have been proven inefficient. Politicians and government bodies could consider using green web applications as an alternative. However, there is little research documenting how such applications actually motivate behaviour change. There is a need for a better understanding of how such applications work and whether they are effective. This paper addresses the first question by demonstrating how three Danish green web applications employ different types of incentives.*
Three key parameters are used to compare and analyse the different applications and the ways in which incentives are used. Three primary types of disciplinary approach are identified. The first approach uses incentives based on conventional economic gains. The second revolves around normative or behavioural gains. The third approach is based on a socio-psychological decision model in which values, attitudes and norms affect the choices we make. All three theoretical approaches aim at explaining decision-making in the context of energy consumption.

Key words: *Climate, Green Web Applications, decision making, incentives*

1. Introduction

Climate change caused by increasing carbon emissions constitutes a global problem of epic proportions. (Helm & Cameron 2009; Baranzini *et al*. 2003) There is a broad political consensus in Denmark on the need to address this problem. It has been decided that, by 2050, Denmark should satisfy all its domestic energy needs without the use of fossil fuels (www.goenergi.dk 2011a).

Traditional 'one size fits all' information campaigns aimed at motivating more sustainable behaviour with regard to energy consumption have been proven not to be efficient (Benders *et al*. 2006). One reason for this is that households are too diverse for standardised information to work. Information has to be personalised to be effective (Dulleck & Kaufmann 2004). It has been shown in a Dutch experiment that web applications such as the ones analysed in this paper – i.e. personalised large-scale approaches with automatically generated energy reduction options and feedback – are potentially successful and can reduce energy consumption by more than 8% (Benders *et al*. 2006). However, the incentives used in such applications have not been examined academically.

Applications like these may also have potential in a Danish context because levels of Internet access are similar to those in the Netherlands. At a more general level, interactive websites make it possible to create a more personalised user experience and to gather information about the user for future development and communication. Developers can modify the site as they gain more knowledge about user behaviour. These are some of the reasons that green web applications have potential for policy makers.

The present Danish Government, which is led by a Social Democratic prime minister, has developed a number of initiatives aimed specifically at reducing carbon emissions (Danish Ministry of Climate 2012) and the Danish Electricity Saving Trust has developed a green web application aimed at promoting initiatives to heat buildings more efficiently (www.goenergi.dk 2011b). The reason for developing the application is that heating accounts for half of Denmark's energy consumption (www.goenergi.dk 2011a). Thus, from a policy point of view, it is important to understand whether and how these applications work.

When trying to understand how web applications function, a distinction that can be made between understanding how green web applications work and whether they are effective. This paper will address the first. Examining their effectiveness is a separate research project beyond the scope of this paper. It is, however, an important question and research is being conducted that is designed to answer it.

The concept of a 'green web application' is new in the social sciences. Research has been conducted on climate issues in many branches of political science, for example, international politics, public administration and comparative politics (Nedergaard & Fristrup 2009; Helm & Cameron 2009). There has also been a considerable amount of research on web applications, or ICT, in a broader political science context (Dunleavy *et al.* 2006; Henman 2010). The final issue covered in this paper is that of incentives, motivation and decision-making in relation to energy consumption vis-à-vis unwanted climate change (Wilson & Dowlatabadi 2007; Jackson 2005). The paper combines these three issues – climate change, web applications, and incentives for decision-making – in its analysis of green web applications.

2. Problem and Methodology

The problem addressed in this paper concerns how green web applications can motivate behavioural change in an environmentally sustainable direction. Success depends on a majority of people being aware of which changes need to be made, and subsequently making the necessary decisions and behaviour changes.

Denmark is an e-democracy: The Danish government uses the Internet as a primary means of communication with citizens (Hoff *et al.* 2003). Denmark was in 2004 ranked as the second most e-ready state among all UN members (Lee *et al.* 2005). The vast majority of Danes (88%) have access to the Internet from home (DST 2010). The Internet is increasingly used by the state as a means of communicating with citizens and enterprises (Heilesen 2004). The Internet and its applications makes it possible for governments to reach out to almost everybody - e.g. the vast majority of Danes use social networks (97% in some age groups) and 50% have the Internet 'in their pocket' via a smartphone (DST 2011; DST 2012).

The Danish Ministry of Climate has prioritised information campaigns and web applications as environmental policy instruments with an approximately €12 million policy initiative called 'Centre for Energy Savings'. At the heart of this initiative are media campaigns and knowledge dissemination via the Internet[1] – designed to reduce energy consumption in Denmark[2]. Web applications are used as a tool for recommending reductions in energy use because they make it possible to personalize communication to the individual, e.g. depending on the user's 'energy consumption segment' (Hansen 2002; Danish Ministry of Climate 2012; Benders *et al.* 2006).

There is an inherent challenge for policy makers when using the Internet as an information tool because it requires an active effort by the user (Norris 2003). Nevertheless web-based tools have been shown to reduce a household's energy consumption (Benders *et al.* 2006). This is particularly important because it has been shown that traditional, government funded, mass media information campaigns are ineffective as a tool for persuading households on a large scale to reduce energy consumption (Dulleck & Kaufmann 2004). Given the magnitude of the climate problem, it is important to research green web applications and assess their potential. Even though these applications tend to preach to the converted, there might also be a secondary effect if they also preach *through* the converted.

Research question:

'*What decision-making models and incentive structures are embodied in different green web applications?*'

The answer to the research question has value for software developers, policy makers, and public administrators if they want to use green web applications as tools to motivate sustainable behaviour. There can be a political dimension in the choice of which decision-making model to use, and which incentives to put in play. It is important for politicians and public administrators to be aware of whether the green web application is based on a view of people primarily as rational actors in constant pursuit of the best possible economic output or on a view of people primarily as members of social communities who are looking for approval from others as they construct their identity in a postmodern society.

The research question examines disciplinary approaches to decision-making in the context of energy use and incentives employed in different Danish green web applications. The suggestion is that these applications may try to appeal to different types of human motivation, e.g. conventional economic gain, behavioural economic gain or socio-psychological motivation.

The following criteria were used to select the applications discussed in this article:

1. Their primary aim must be the reduction of direct household energy consumption: thus applications that aim at indirect energy consumption e.g. food and groceries (choosing products with the 'smallest energy footprint' and avoiding waste) do not form part of the analysis. This is because the same types of incentive are used in applications with different topics, thus making them partly redundant (Petersen & Ryberg 2011: 90)

2. They must have been developed for use in Denmark: countries have different legislation affecting incentives. There is also a marked difference between Danish household energy requirements and those in other countries (Lenzen *et al.* 2006)

3. They must be free of charge to the user: applications that the user has to pay for (e.g. BE10[3]) are excluded because they distort the foundation for the comparative analysis. There is no need to incentivise applications that the user has paid to use. If the user is willing to pay for the application it is likely that the incentive for behaviour change is present from the outset.

4. There must be no direct commercial interests - applications developed by companies that sell related products are excluded because it can be difficult to separate out the effects of product marketing from other incentives for behaviour change that benefits the climate.

At the time of data collection there were four web applications that met the selection criteria. These were:

1. Husetsweb (translates into 'Web of the House'): https://www.husetsweb.dk

2. Goenergi (translates into 'GoodEnergy'): https://www.goenergi.dk/forbruger/boligtjek (the application has been decommissioned in 2012 and is no longer active)

3. Klimabevidst (translates into 'ClimateAwareness'): https://klimabevidst.dk

4. Mapmyclimate: http://mapmyclimate.dk/

Husetsweb was excluded from further analysis as its disciplinary approach to decision-making in the context of energy use is identical to that of Goenergi, and would thus not increase understanding of the range of incentives.[4]

The remaining three green web applications are described according to three key parameters:

1. Target Group – who is the target audience?

2. Key Concept – what are the core functionalities of the application?

3. Data Output – what data is generated and what does it include?

The first parameter is designed to ensure that the applications all aim at adult individuals or household groups who are able to modify their behavioural approach to energy consumption. The second parameter concerns the core of the application. The third is relevant because the output of the application is material that is intended to incentivise behaviour change.

3. Incentives

This section describes the kinds of incentive used in each application. First, the incentives will be classified. There is substantial research on how incentives can be classified (Jackson 2005).

Here, the focus will be on three types of disciplinary approach to decision-making and incentives in the context of energy use – a conventional economic incentive, a behavioural economic incentive and a socio-psychological incentive (Wilson & Dowlatabadi 2007). The reason for selecting these three disciplinary approaches is that, together, they appear to cover all the incentives used in these web applications.

The first two models (conventional economic incentive and behavioural economic incentive) are related to one another. The *conventional economic* model is based on the assumption that individuals are perfectly rational and seek to maximise utility within their budget constraints. The *behavioural economic* model acknowledges the empirical fact that individuals are not always rational and that framing and bounded rationality, amongst other things, affect individuals' decision-making in such a way that they do not maximise utility according to the principles of the conventional model, thereby making them normatively irrational (Camerer & Loewenstein 2004). They have preferences between outcomes as their main dependent variable. That is relevant because incentives can influence preferences.

The dependent variables in the two models are methodologically linked to the study object of this paper, which are incentives in green web applications. Even though incentives can aim to motivate behaviour changes that are at odds with the preferences of the individual user, the theory still contains a methodological link between the key concepts. It is this link that justifies the use of the two theoretical approaches to explain decision-making in the context of energy use.

The main independent variables in the conventional economic model are the weighted costs and benefits of the outcomes. In the behavioural economic model, the independent variables are aspects of the decision frame, context and elicitation method, as well as outcomes. These two approaches to decision-making share the same decision scale, which is individual – rather than social. They have a short-term time scale for intervention – as opposed to sociological models that operate over the long term. Lastly, they have been shown to be theoretically robust when seeking to explain decision-making in the context of (residential) energy use (Wilson & Dowlatabadi 2007).

One of the aims of this paper is to understand and explain how web applications can motivate behaviour changes – the main dependent variables

	Decision model	**Decision & Time Scale**	**Dependent variables**	**Independent variables**
Conventional economic incentive model	Rational choice: Utility maximisation based on fixed and consistent preferences	Individual & Short Term	Preferences between decision outcomes	Weighted costs and benefits of outcomes
Behavioural economic incentivemodel	Normative: Context dependent preferences	Individual & Short Term	Preferences between decision outcomes	Context, aspects of the decision frame and outcomes
Socio-psychology incentive model	Interacting psychological and contextual variables	Individual/social & Short to medium term	Self-reports of behaviour and energy use	Values, attitudes, norms, socio-demographics

Figure 1: *Theoretical frame for explaining incentives in decision-making in the context of energy use (Wilson & Dowlatabadi 2007; Campbell 2004).*

are preferences between decision outcomes and the amount of energy that people report using. The web applications focus on individuals (or small groups of individuals, such as the family). They operate on a short (to medium) term time scale for intervention, i.e. behaviour changes are supposed to occur within a short time of using the web application.

The challenge with these two models is that they have a narrow scope when trying to explain decision-making in the context of energy use. There are other independent variables that are important when trying to understand human decision-making processes in the context of energy use, e.g. values, attitudes, norms, etc. A decision model that contains this focus can be labelled 'socio-psychological' (Wilson & Dowlatabadi 2007). It is based on interacting psychological and contextual variables. The main dependent variable is self-reports of energy use. The decision scale is not only at the individual level but also at the social level and it operates in the short to medium term. The reason for including this model is that users are not always (bounded) rational actors whose behaviour is determined by preferences between decision outcomes. Energy users are also members of social groups; they want to be accepted by other people, and avoid problems (Stern 1985).

Adapting this focus, with three disciplinary approaches to decision-making, in the context of energy use, results in other approaches being left out. In this context at least two of them are worth mentioning - 'technology diffusion' and 'sociology'. 'Technology diffusion' revolves around an attitude-based evaluation of technologies and the consequences of adaptation with rate of diffusion as its main dependent variable and communication channels, technology attributes and leadership of the adopter as its main independent variables.

The 'sociological' model focuses on the socio-technical construction of demand. In this approach, interventions only function in the long term as it takes time to change the systemic configuration of society, lifestyle habits and infrastructure. According to this approach individuals do not make decisions about energy consumption. Instead, the idea is that energy provides a service that makes it possible for us to live a normal life with the routines that it involves (Wilhite *et al*. 2000; Wilson & Dowlatabadi 2007).

The reason for not including these two disciplinary approaches is that their main methodological features make them unsuitable for an analysis aimed at understanding how web applications use incentives that are designed to influence preferences. Specifically, as a consequence of their dependent and independent variables, decision models and time scales for intervention, the two disciplinary approaches do not have heuristic value when trying to explain incentives in green web applications.

4. Empirical Data

Each of the three web applications identified incentivises behaviour change that will reduce consumption of fossil fuel in distinct ways. They are described below:

4.1 Goenergi (*www.goenergi.dk/forbruger/boligtjek*)

(The application no longer exists in this format) This is an application that predominantly functions as a kind of 'virtual energy consultant'. It produces recommendations for behaviour changes and physical changes to the fabric of the house that will make it more energy efficient. The application is advanced and has a user-friendly graphic interface. Figure 2 shows the site's home page.

Target Group

Goenergi is aimed at households. The focus is on energy consumption in all areas except transport. It is relevant to home owners, people living in rented accommodation (houses and flats) and people who live permanently in a 'holiday home'.

Key Concept

The main component is a 'house check' combined with a number of sub-applications that are briefly described below as they help to understand the different approaches to decision- making and incentives employed by Goenergi.

The key concept is advice on how to reduce energy consumption. The user supplies information which is then used to gather data from a number of external, official databases. The combined information is processed in a series of algorithms and produces both online and offline output.

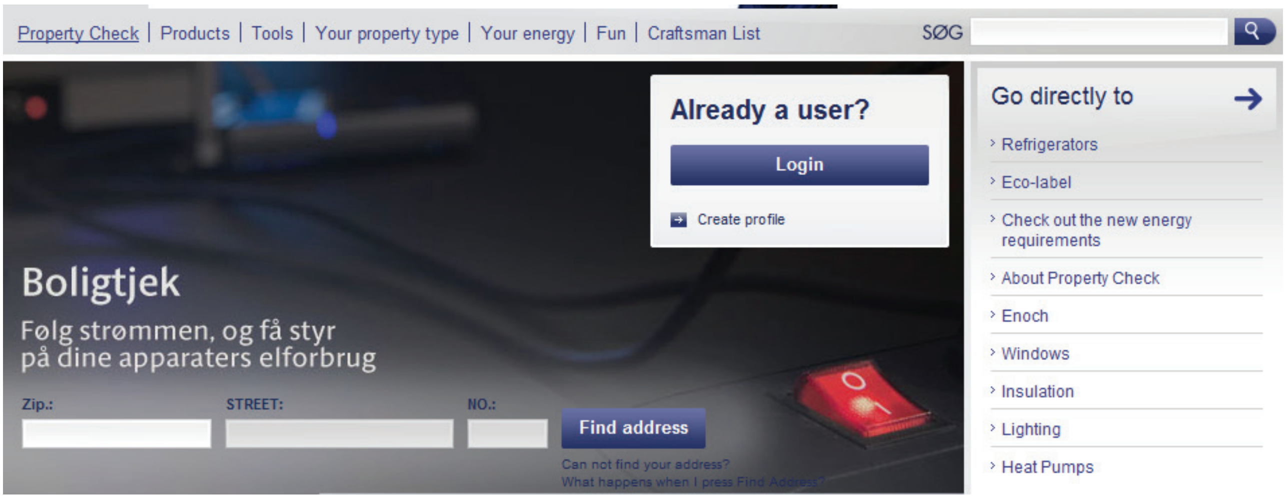

Figure 2: *Goenergi – opening screen view*

The application generates a three-dimensional interactive graphic picture of the user's home. To create this image the user has to supply information like the size of the energy bill; the number of people living in the house; and the number of windows and doors.

Goenergi also includes suggestions for behaviour changes – e.g. a reminder to turn off lights when rooms are not in use. This does not leave the user worse off than before provided that the motivation for having the light on is to be able to see what is in the room. If the motivation for having the room lit is to prevent burglary, then there could be a loss associated with turning off the light.

However, the application also suggests behaviour changes that will probably reduce comfort levels. It might, for example, suggest lowering the room temperature. When confronted with such advice, the user must – ultimately - balance long-term climate sustainability and energy costs, on one hand, against short-term personal comfort on the other. One could argue that the user might achieve a socio-psychological gain by following societal norms and thus have a 'clear conscience' as a result of lowering the room temperature – as well as an economic gain resulting from a lower utility bill.

Together with the main application there is a subset of applications designed to motivate behaviour changes. One of the sub-applications is a competition where the goal is to become the family with lowest electricity consumption over a period of six months. The user supplies information on the energy consumption of the household. On this basis, the user's household is ranked against similar residential properties, giving the family an idea of how 'green' a profile they have compared with others.

Data Output

The main data output is a report with advice described above.

The application generates two categories of advice. One is aimed at possible physical improvements to the user's home and the other is aimed at behaviour changes that will reduce energy consumption.

There is also a focus on 'benchmarking' where the user's energy consumption is compared to that of the 'average consumer' as mentioned above. Figure 3 shows the graphics used when 'benchmarking' the user.

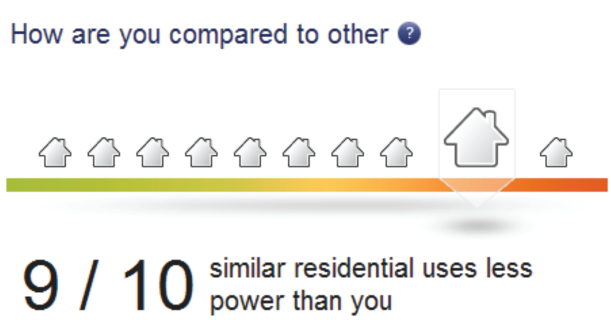

Figure 3: *Illustration from www.goenergi.dk/forbruger/boligtjek - benchmarking the user*

The illustration shows how a particular user is rated number 9 out of 10. The implicit message is: 'Nine out of ten people use less energy than you! You use too much energy!' It is worth noticing that the benchmarking display does not contain conventional economic data. There is data available in the application to place a nominal value on the energy consumption – e.g. the display could show an annual cost of DKK 18,000 and that, by reducing consumption to the average, the user could save DKK 8,000. But it seems that Goenergi wants to use social rather than economic criteria to incentivise change.

4.2 Klimabevidst (www.klimabevidst.dk)

Klimabevidst aims at reducing people's energy consumption. It provides a catalogue of 'energy reduction guides' that individuals or families can use as recipes for energy reduction in different spheres of everyday life, such as lighting, transport, shopping and lifestyle habits.

The screen shot below includes the following statement 'In 2008, Mikkel went on a climate-friendly driving course. Since then, Mikkel has reduced his petrol consumption by 10% per year.' The idea is to provide the user with easy to understand advice inspired by other users.

Target Groups

The primary target groups are individuals, families and small communities. To engage these groups, Klimabevidst contains a sub-application named 'climate battle' (klimakampen), where users can compete against friends, families, or neighbours (in the target group).

Key Concept

At the core of the application is an online catalogue which contains more than 200 'energy saving guides' that tell the user about behaviour changes that can reduce costs by implementing environmentally friendly changes. These guides are sorted into different categories, e.g. lighting, food and transport. Each category contains guides in more specific subcategories. Thus the category 'consumption and life style' has instructions on climate friendly restaurants, washing laundry at low temperatures and environmentally friendly cleaning products.

Two Different Methods are used to Promote Behaviour Change

The first method is based on providing information about the potential savings that could be achieved by making the necessary changes. The potential savings are estimates. The economic indicators are followed by instructions on how to achieve the savings.

The second method relies on a competitive element in the 'climate battle' sub-application. The aim is to score points by implementing suggestions in the

Figure 4: *Klimabevidst screen shot*

guides. The number of points that different suggestions generate is proportionately linked to the CO_2-reduction that can be derived from following each energy reduction guide. Here the incentive is to earn as many points as possible by implementing the suggestions offered, and thus win the competition. The 'climate battle' can be set to last between one and three months. Competitors can be the user's friends, family, or neighbours.

Data Output

The key output is an online energy consumption chart that shows users' progress combined with an overview of which energy guides have been implemented. The chart shows how many points a user has scored. Each energy guide is scored from 1 to 10 depending on the positive impact that implementing the suggestions promoted by the guide will have on the climate. When implementing the suggestions the application will add up the points from each guide implemented. The higher the score, the more environmentally friendly the user's behaviour is said to be.

The output of the climate battle (klimakampen) is an online chart showing the number of points earned by the individual contestant.

4.3 Mapmyclimate (www.mapmyclimate.dk)

This is an advanced climate simulator which shows the future consequences of the user's behaviour. It also contains an interactive 'CO_2 diet' for people who want to reduce their CO_2-emissions in order to mitigate climate change.

To illustrate the implications of climate change, the picture below shows how Copenhagen will be partially flooded by the year 2100 if everybody were to have the same energy consumption profile as the person using the application in this instance: The blue areas show which parts of Copenhagen will be flooded.

Figure 5: *www.mapmyclimate.dk – flooding of Copenhagen year 2100*

Target Group
The target audience are people living in the Greater Copenhagen area. Users can find their address by zooming in on the satellite image. People who live outside the area can still access the application and investigate the connection between energy consumption and the climate in the future. By inserting a Copenhagen address, users can identify how future changes might affect that area.

Key Concept
Mapmyclimate has several elements. At its core is a climate simulator that uses advanced algorithms to predict the climate in 2100.

The algorithms require users to report their behaviour in different areas of everyday life that affect the climate, e.g. the temperature in the home, use of their car, and food consumption.

The user's CO_2-profile is aggregated on the basis of the information provided, and the simulator indicates the consequences of the user's behaviour on the climate in 2100 if everybody were to behave in the same way as the user. The simulator might for example show that the area in which the person lives will become flooded.

If this result motivates the user to consider making lifestyle changes, the application then produces a 'CO_2-diet.' There are two versions of the 'CO_2-diet: 'easy advice' and 'radical advice'. The 'easy advice' covers initiatives that the user can implement straight away, such as turning off lights when not needed, eating less meat and more locally produced vegetables, or considering not using the car once in a while. The 'radical advice' requires changes in lifestyle and/or substantial investment, e.g. changing all windows and doors into energy efficient ones or permanently giving up the use of a car or air travel.

Data Output
The primary output is the simulated climate map of the Greater Copenhagen area. Below is a simulation of how a user's behaviour will result in increasing water temperatures which may cause the death of fish and growth of unwanted algae:

The simulation in figure 5 was generated on the basis of a profile of an average Danish father with three children. The implicit message to this particular user is that he might need to follow some of the 'radical advice' in the 'CO_2-diet' if he wants a city that would be habitable for his children, grandchildren and great grandchildren in 2100.

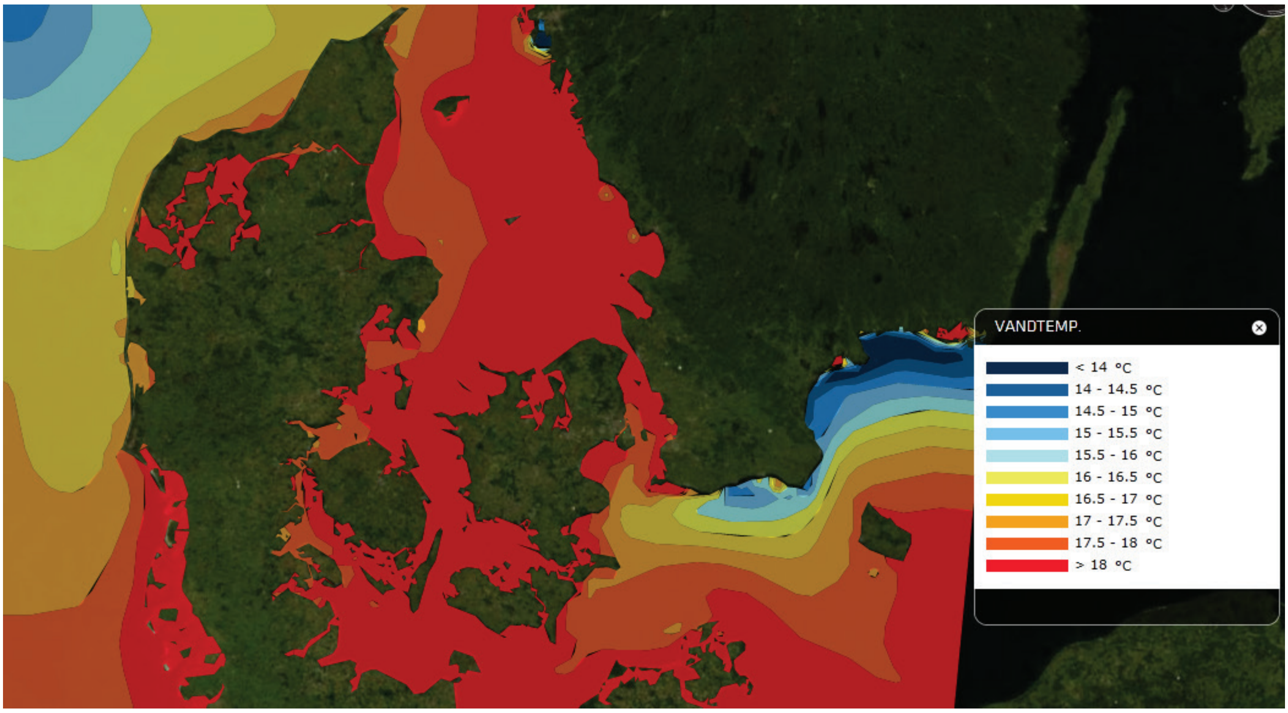

Figure 6: *Simulation at www.mapmyclimate.dk*

5. Incentives in Green Web Applications

In this section, the incentives in each application will be described according to the framework used above. In most cases more than one incentive is in play, thus the incentives will be ranked according to importance and relevance.

Goenergi is an interactive energy calculator that gives the user two types of advice. The first suggests physical changes to the owner's home that will reduce energy consumption. The application generates advice with economic saving potential – e.g. 'insulate the walls and save DKK 5,000'. The types of advice can even be sorted according to how large an economic gain a given change will produce. The second type of advice is based on suggested behaviour changes that will reduce the amount of energy used, e.g. turning down the thermostats on the radiators. Both types of advice revolve around an economic incentive.

The application also makes use of ranking or 'benchmarking' as a tool, as depicted in Figure 2 where the user is in the 'red zone'. This signals that too much energy is being used. Traditionally benchmarking is a tool used in conjunction with economic or fiscal analysis. However, in this context there is no economic information in the benchmarking instrument shown in Figure 2. Instead, the focus is placed on behavioural incentives rather than economic ones because the benchmarking display makes use of framing as a potential driver for behaviour change.

Lastly, Goenergi may be said to contain an element of the 'socio-psychological' approach – it can be argued that our decisions are always part of a complex relationship between (social) institutions and norms in society (Summerton 1992). The use of the application can promote certain norms and values. The red area in the benchmarking display is not where sustainable energy users would like to see themselves. However, the socio-psychological approach is considered to have little importance in this application.

Klimabevidst revolves around the possible economic gains that can be achieved by changing behaviour and reducing energy consumption. The 'energy reduction guides' or 'energy savings guides' contain economic information on the amount of money saved and depreciation period of the investment necessary to implement the guide. Thus the primary part of the application is based on a conventional economic incentive.

Each guide also tells the user the reduced amount of CO_2 that will be emitted as a result of implementing the recommendations in the guide. This information is not strictly relevant for the user when selecting one guide rather than another. Because of this it can be argued that the application also contains a behavioural incentive.

The second part of the application is a 'climate battle' that records energy saving achievements in terms of points. Here the incentive is to win a competition – and with it a climate-friendly reputation - which can be seen as a behavioural incentive. In the climate battle there is also an apparent socio-psychological element. It is, in principle, a battle for glory, i.e. a normative battle where the contestants compete to see who can implement the recommendations of the most energy saving guides and thus gather points. When gathering points, the contestants also experience positive economic effects but the theme of the game is to challenge friends, family or colleagues. These groups of people all belong to the inner circle – some more, some less – of the contestant's personal and professional life.

Mapmyclimate is based on a simulation of the climate in and around the Greater Copenhagen area in the year 2100. The user loads energy consumption data into the application by answering a survey. Consumption is measured using different parameters that affect the climate, such as domestic heating, electricity consumption, eating habits, and use of a car. The application uses this information in its simulations of the climate in Denmark in 2100 – i.e. air temperature, water temperature and air pollution. The simulation is based on the concept of how the climate will be in 2100 if everybody were to have the same consumption as the user. If the user consumes too much energy and subsequently emits too much CO_2, Copenhagen is flooded and polluted by 2100. In order to prevent this, the user can go on a tailor-made CO_2-diet. The application does not address other benefits from going on a CO_2-diet, e.g. better personal health or money saved on groceries and petrol.

The application plays on our sense of responsibility towards our community by showing the consequences of our behaviour on the entire city. It could be argued that the threat of having one's city flooded in the future would constitute a behavioural incentive for users living in Copenhagen. However, this incentive is considered weak and perhaps only valid for users who expect to have (great) grandchildren living in the Greater Copenhagen area. The reason the incentive is weak is that, even if users reduce their energy consumption it will have very limited effect. The application focuses primarily on morally responsible energy behaviour. The principle in the application matches Kant's concept of the Categorical Imperative which states that a person acts morally if the maxim or rule of conduct on which he acts could be willed as a universal law that would govern all people in similar circumstances (Kant 1785). This application is an example of an almost pure socio-psychological incentive. The reason for the application do not belong to sociology (as briefly mentioned above in the earlier discussion of incentives) is that the application does not address the 'systemically configured' energy demand created by society's definition of what a normal life constitutes, e.g. regarding cleanliness, comfort levels and infrastructure (Wilhite *et al.* 2000).

6. Conclusion

This paper has addressed the following research question: '*What decision-making models and incentive structures are embodied in different green web applications?*'

It has shown how conventional economic, behavioural economic, and socio-psychological incentives are used in the context of energy use. It can be difficult to distinguish the incentives from each other completely. In some cases they also overlap. Conventional economic incentives may in some circumstances also function as behavioural economic incentives. It can also be argued that both the conventional and the behavioural incentives can function as catalysts for the socio-psychological incentive – and vice versa. In most cases it can be argued that several incentives are employed simultaneously – but with different visibility - in the application. The conclusions are displayed in the table below. The different incentives are ranked according to how visible they are in the application.

There are also challenges with regard to using web applications as a large-scale approach. The challenges can be divided into two categories. These two categories consist of practical issues and methodological issues - in some cases they overlap.

	Key concept	**Behavioural aim**	**Incentives**
Goenergi	Online, 3D, climate-friendly home refurbishing guide Sub functionality: Benchmarking display	Physical adaptations of the user's home in order to reduce energy consumption Reduce energy consumption when being compared to similar residential users	Refurbishing guide: Highly visible conventional economic incentive; very slightly visible socio-psychological incentive Benchmarking display: Visible behavioural incentive, slightly visible socio-psychological incentive
Klimabevidst	Catalogue of energy-saving guides Sub application: Climate battle competition	Carry out energy-saving guides, reduce energy consumption and collect points Compete on who can carry out most energy guides and collect points	Energy guides: Visible conventional and behavioural economic incentive Climate battle: Visible conventional , behavioural incentive and visible socio-psychological incentive
Mapmyclimate	Climate simulator covering Copenhagen	Go on a 'radical' or 'easy' CO_2-diet and thereby reduce CO_2-emission	Highly visible socio-psychological incentive.

Figure 7: *Comparing applications*

With regard to the practical problems it is important that the information is as personalised as possible (Wilhite & Ling 1995; Benders *et al.* 2006). The energy-saving information should be designed to suit the user or household that requires it in order to avoid overloading them or giving them information that is irrelevant. This principle is equally important for feedback.

With regard to the methodological challenges, public administrators must consider the disciplinary approach employed in the web application. It has been shown that there are different spatial and temporal scales of decision-making – individual to social, psychological to contextual, and short- to long-term, as shown by the categorisation of the incentives in the analysis. One approach is not more correct than the other. The best possible solution is one in which the disciplinary approaches are integrated into each other.

A very important question that remains to be answered in a Danish context is whether the web applications have an effect. It has been shown in Holland that a web application can reduce energy consumption by 0.85 %. (Benders *et al.* 2006). Less than one per cent might not sound as much, but if the cost of achieving this effect is compared to the cost of developing the application it is worth taking into consideration for policy makers. Secondly, the applications might also have an effect with regards to awareness that also has value. If the applications make us more aware of the problematic issues associated to our consumption of energy derived from fossil fuels we might be more open to legislation that reduces this consumption – even if it means increased energy prices. Lastly, an increased awareness on unwanted climate changes might also affect which policy makers are being placed in office.

Notes

1 Http://www.goenergi.dk/om-os/annoncering-af-udbud/tidligere-udbud

2 Https://www.retsinformation.dk/Forms/R0710.aspx?id=129379

3 Http://www.sbi.dk/miljo-og-energi/energiberegning/anvisning-213-bygningers-energibehov/bestilling-og-priser-1/bestilling-og-priser

4 The author has made an extensive empirical analysis in another publication where there were no physical limitations to the length of the paper (Scheele 2011)

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