MAKING PEOPLE CARE

Application of group approach towards energy conservation and environmentally friendly behavior

Ismayil Jabiyev

Master thesis for the Master of Philosophy Degree in Development and Environmental Economics

UNIVERSITY OF OSLO

May 2010
© Ismayil Jabiyev, 2010

Making people care: Using group approach towards energy conservation and environmentally friendly behavior

http://www.duo.uio.no/

Printed: Reprosentralen, Universitetet i Oslo
Preface

This thesis is a consequence of a row of observations I have made recently. Once I remember when I shared my thoughts with a friend about electricity waste and lights turned on when it is unnecessary, she straight gave me an example of how her neighbor left a flat for travelling two weeks and left lights on. She was very disappointed, but she did not show any disapproval to this “careless” person. But could it have some effect if she did it (in a polite manner)?

I want to thank the supervisor of my thesis, Professor Kjell Arne Brekke, for his important advices, theoretical consultation and assistantship throughout my work. His personal effort helped me to organize my ideas in a proper order and achieve great improvement in the analysis. In addition I want to show my gratitude to Professor Harold Wilhite at SUM (Center for Environment and Development) for providing interesting and motivating materials. All shortcomings of the thesis are a matter of my responsibility.

Ismayil Jabiyev

Oslo, May 2010
Summary

One of the most challenging problems the humanity facing in the coming decades is exhaustion of fossil fuels and environmental consequences from burning them. While countries put investments in developing alternative energy sources, less fuel consuming devices and motors, the role of humans in energy consumption is often underestimated. Human is a complicated social actor, and his decision making regarding energy is formed not only by his individual preferences, but also by his social environment. At the same time there is a conflict between private and social interests that can bring failure in cooperation and considerable free-riding regarding pro-environmental actions. From this point of view this thesis aims at investigation of present achievements from behavioral economics and insights from allied sciences in order to analyze the potential of the environmental policies targeting at groups rather than individuals. For this purpose the results from public good experiments are provided in order to define basic conditions increasing the cooperation, followed by a theoretical model covering the social norm factor. The observations from the experiments and predictions from the model can have an implication for the policy makers designing an energy conservation or environmental friendliness campaign.

The thesis is organized in the following manner:

The Introduction chapter provides evidences from social sciences to illustrate various factors influencing human decision making. In chapter 1.3 features of social behavior are stated, especially the social proof and bandwagon effect (informational cascade) showing how we can be affected by the others’ behavior. It is also shown how the uncertainty about the right decision and the perceived similarity with others in the social environment can strengthen the mentioned effects. The chapter 1.4 illustrates how the groups are formed, and once they are, how strong can the group identity be to make people do even irrational decisions.

In the Chapter 2 the problem of common resource exploitation (with reference to the energy conservation) is presented via classical game model of prisoner’s dilemma. The conflict between individual and group interests explains the individual’s incentives to free-ride. A link to the famous Tragedy of the Commons is being made as an example of a failure to exploit a common pool resource. But the uncooperative prediction can be amended once the social
factor is introduced. In sub-chapter 2.5 such element like reciprocity can bring players to cooperation.

Chapter 3 provides results from various group experiments in order to describe conditions encouraging cooperation inside a group. The group size, partners and strangers format, communication factor and sanctioning mechanism are being discussed. The chapter 3.4 the importance of not crowding out the intrinsic motivation is touched, which has an important implication on policy design. Chapter 3.5 provides a dynamic model of public good game with an introduced social norm factor (conditional warm glow) and the morally accepted level of provision that dynamically changes and depends on average level of other’s provision, previous moral ideal and the external advice factor. The importance of social pressure factor and policy advice effect to achieve cooperation is stressed.

On the basis of the results above I introduce the group-based environmental policy for the analysis in Chapter 4. The possibility of using the group approach for promotion of the energy conservation is shown on the neighborhood responsibility program. How the specific setting of a group can help to achieve a cooperation in terms of environmentally friendly behavior is being discusses with a link to the theoretical model and group experiments.

Sub-chapter 4.6 provides description of the EcoTeam intervention program organized by the Global Action Plan organization. The team approach close to the discussed in the thesis is illustrated, and considerable improvement of the participants’ performance in terms of various environmental behaviors (energy consumption as well) is shown. The consistency of the EcoTeam program with the model predictions is discussed at the end.

The Conclusion in Chapter 5 summarizes the potential of group approach and highlights its main advantage: expected long-lasting effect and opportunity to achieve permanent shift to environmentally friendly behavior.
# Table of contents

Summary ................................................................................................................................... V

1 Introduction .............................................................................................................................. 1
   1.1 Energy conservation ........................................................................................................ 1
   1.2 Crossing of sciences ...................................................................................................... 4
   1.3 Social behavior ............................................................................................................. 5
   1.4 Group identity ............................................................................................................... 8

2 Typical Games and Models ................................................................................................... 9
   2.1 Social dilemma ............................................................................................................. 9
   2.2 Prisoner’s dilemma ...................................................................................................... 12
   2.3 Incentives to defect ..................................................................................................... 14
   2.4 Repeated prisoner’s dilemma ..................................................................................... 15
   2.5 Reciprocity ................................................................................................................ 17

3 Effects on cooperation: group experiments ...................................................................... 20
   3.1 Group size .................................................................................................................. 20
   3.2 Partners and strangers ................................................................................................. 21
   3.3 Communication ......................................................................................................... 23
   3.4 Sanctioning and punishment ...................................................................................... 24
   3.5 A simple model of reciprocity and group norm ......................................................... 27

4 Development of Energy Conservation Policy ..................................................................... 33
   4.1 Policy target ............................................................................................................... 33
   4.2 Working idea ............................................................................................................. 33
   4.3 Achieving policy effect .............................................................................................. 35
   4.4 Group formation ........................................................................................................ 38
      4.4.1 Participants ........................................................................................................... 38
      4.4.2 Group size .......................................................................................................... 39
      4.4.3 Team building ..................................................................................................... 39
      4.4.4 Con-environmental groups ............................................................................... 40
   4.5 Utility concerns ......................................................................................................... 41
   4.6 EcoTeam Program Example ...................................................................................... 42
      4.6.1 Treatment ........................................................................................................... 43
List of graphs

Graph 1. Prevos (2006). Effect of a confederate’s presence on increase of helping behavior. Social pressure at work

Graph 2. Komorita (1976). Graphic Treatment of N-person Prisoner’s Dilemma

Graph 3. Andreoni (1988) results (percent of endowment donated to public good)

Graph 4. Croson (1996) results (percent of endowment donated to public good)

Graph 5. Fehr & Gächter (2002). Time trend of mean cooperation together with the 95% confidence interval

Graph 6. Staats et al (2004). Mean scores of ETP Participants and Nonparticipants on the Pro-environmental behavior Index (PBI) Across the Phases of the Study
1 Introduction

1.1 Energy conservation

Today’s world experiences a transformation period caused by exhaustion of fossil fuels, global warming caused (presumably) by the emissions of CO2 and other gases, problems of pollution and other cases closely related to the human economic activity. Reduced energy consumption would make an important contribution to alleviating these problems, but at the same time the energy demand continues to grow fast. According to the projections of International Energy Outlook report 2009, total world consumption of marketed energy is projected to increase by 44 percent from 2006 to 2030. In such a type of situation a large effort is being made by governments and environmental agencies to control this growth and make people concern about the amount of energy they consume.

The energy consumption in households takes an important place, as they stand for 25% of total energy requirements in the European Union (27 countries)\(^1\). Yet the dominating strategy in the past decades was much device-centered. As discussed in Wilhite et al. (2000)\(^2\), in early 80s the energy use was approached by scientists trained in engineering and physics, who were focused on development of more effective devices (lights, home equipment, motors etc.) and considered buildings rather than people as energy consumers. In Winett & Ester (1983) this physical design was criticized, as it ignores the importance of human behavior. As it was pointed out, the consumer life-style is probably the major determinant of energy use in US homes, and a major factor in European ones.

Already in early studies\(^3\) it was shown that physically identical townhouses can vary in energy consumption by 2:1 ratio, presumably due to consumption style of residents. Though there were significant gains in energy efficiency over the intervening 20 years, the fact is that total energy demand in US and in most European countries actually increased. The possible explanation for this fact is that people’s demand for comfort and convenience has increased, (desire for higher living standards), which is supported by higher incomes. In the household

---

\(^{1}\) Eurostat, Final energy consumption, by sector, 2007 (provisional values)

\(^{2}\) Taken from E. Jochem et al. (2000)

\(^{3}\) Socolow (1978) example is being used
sector the creation of new goods and services implies permanent growth of electricity consumption. Home appliances are becoming more efficient, at the same time there are more of them and they are being used more often⁴.

The idea of the rampant consumerism is closely connected to this process. For example in the research of Hille (1997) it was shown that though the doubled thermal efficiency of a Norwegian home from 1960 to 1980, the energy use for space heating increased due to doubling of per capita size of dwelling.

In a recent research conducted in the American market⁵, polling 1,006 consumers across the country, it was found out that 60 percent of Americans are looking for greener products, at the same time given a choice between their comfort, convenience or the environment, 38 percent of respondents said they would choose their convenience, 35 percent said they would choose comfort, only 26 percent said they would choose the environment. Another example from the survey is that given a question: “If you thought these things were harming environment, which of the following would you be willing to give up?” most Americans wouldn’t give up their iPod, microwave oven, air conditioning, cell phone or computer, even if they thought it harmed the environment. The survey did not provide relative prices of the choices, so the opportunity cost of selecting comfort and convenience in terms of environment was not clearly stated. Anyhow the question is that the information about environmental consequences of our behavior is quite wide-spread, yet in my opinion the individuals do not behave in a manner that could reveal their concern about it.

The technological innovations and device-centered improvements at home aimed at reduction of energy consumption can bring even opposite results on account of omitting behavioral consequences of their application. In an interesting case indicating the effect of getting people actively involved in environmental activities was described in Hamrin (1979) where a comparison was made between two Californian suburbs: Blue Skies Radiant Homes (equipped with active solar energy systems and conservation facilities) and Village Homes (equipped with the same, but passive system, requiring residents’ active involvement in the

conservation like closing shutters and setting thermostats). The result was that residents of Village homes consumed less energy than their more technologically sophisticated neighbors. Not changed life-style of the Blue Skies Radiant residents could be considered as the reason for this high level of consumption.

The residential sector has been for a long time a target for state level energy conservation campaigns. The fact that consumers have energy consumption at excess over its socially optimal level can be explained in the way that the environmental consequences of it (like pollution, exhaustion of resources) are not properly internalized. From this point of view there came a necessity to introduce social sciences into the solution of the problem. As discussed in Steg (2008) policy makers have psychological strategies for achieving this purpose, i.e. changing people’s knowledge, perception, motivation, cognitions regarding environmental problems. Informational programs for example included promotion of energy conservation, among which there are prompts, individualized social marketing, commitment and modeling. Except modeling, all these methods were aimed individually for each household without involving neighborhood members’ activity or closer circle of people. The thesis in question will make a focus on the group behavior and necessary factors needed to take into consideration while designing energy conservation campaigns.

It is important to mention that from an economic point of view the comfort and other services provided by energy are likely to increase with increasing income, unless relative prices changes or preferences changes. While energy is so pervasive in all kinds of economic activity, it may be hard to substitute away from increased energy consumption as income and hence consumption increase, some substitution possibilities exist. In this thesis I will focus on the preferences. How do group processes influence preferences and can such processes help enhance lower energy consumption.
1.2 Crossing of sciences

The problem of description and modeling of group behavior is studied both within economics and other sciences. Individual behavior in classic economics is often explained by models of rational and self-interested consumers who try to maximize their own utility. Such an individual in the literature is named *homo economicus*, the model of which consequently was revisited by a row of economists. As discussed in Nyborg & Rege (2003), challenges for this model is that individuals are not only motivated by economic costs and benefits, but also act under the influence of moral or norm-based motivation. In the works of economic anthropologists as Marshall Sahlins, Karl Polanyi, Marcel Mauss or Maurice Godelier, it was shown on logical ground and empirical cross-cultural comparison that choices people make regarding production and exchange of goods follow patterns of *reciprocity* which differ from possible predictions from "homo economicus" preferences.

A great contribution to economics by introducing the psychological methods was made by psychologists Daniel Kahneman and Amos Tversky. Their classic works were targeted at combination of cognitive models of decision making under risk and uncertainty into economic models of rational behavioral. Kahneman was consequently awarded with the Nobel Memorial Prize in Economics in 2002 for the development of the Prospect Theory. These works together with others strengthened the Behavioral Economics as a direction in the existing field in studying economic decisions of consumers. As discussed in Winett & Ester (1983), the behavioral science approach for solving energy conservation problems incorporates concepts and strategies from behavioral psychology, social learning theory, social and ecological psychology, organizational, environmental and community psychology, consumer behavior and economic psychology, behavioral economics, to some extent communications, diffusion theory, marketing and sociology.

So far the main emphasis was made to individual choices, which are governed by mental constructs like attitudes and values. Yet not much economics literature exists describing purely group choices. When talking about the group behavior, we imply interpersonal processes like reciprocity, social norms, approval or disapproval that bring the group as a

---


7 Taken from Group Identity, Personal Ethics and Sustainable Development suggesting new direction for social marketing research, Johanna Moisander, Society, Behavior and Climate Change Mitigation, p.128, 2000.
whole to a specific choice. The complicated social interdependence of individuals makes it important to allow psychological and social insights into the discussion.

1.3 Social behavior

I think it is worth to give an overview of how our decision making is affected inside the society we live in. There are documented evidences how the social environment has this kind of impact. Robert B. Cialdini (2001) vividly describes several social mechanisms specific to human communities, one of which is a major social proof phenomenon: we consider our action correct depending on how we see others performing this action. In other words, there is a tendency to consider an action proper if the majority of people around perform it. Such dependence on the others is stimulated by the ambiguous and uncertain situations, where individuals cannot make proper decision basing on their own knowledge or experience.

This behavior is called informational cascades in economics and is described as a result of rational choice. The illustration for it can be found in Tesser et al. (1983) in a social experiment, where individuals were place into groups and asked to evaluate the loudness of sounds (stimulus) presented to them. The task was to check the ability of participants to properly identify the difference in loudness under the social pressure of others’ opinion. The results showed that in a situation of high social pressure the greater the self-doubt reported by the subject, the less attention was paid to the actual stimuli. Thereby the greater self-doubt increases the conformity to the opinion of others. This type of conformism is closely related to the bandwagon effect – a notion used in Microeconomics (regarding consumer demand) and Political Science (regarding election process). The bandwagon effect describes the situation where individuals follow the behavior of the crowd, i.e. decisions prevailing in the surrounding society. Liebenstein (1950) suggested reformulation of static theory of consumer demand by relaxing the assumption that consumption behavior of any individual is independent of the other’s one. This implies addition of non-functional factors to demand formation, having external effect on utility, like bandwagon effect.

In the process of following the majority the working condition is also similarity. The principle of social proof is strengthened if the people we observe are considered similar to us. In the
paper of social psychologist Leon Festinger\textsuperscript{8}, the proposer of social comparison theory, noted that people don't tend to evaluate themselves against others that are too different than themselves. This is supported in field experiments (Hornstein, Fisch, Holmes, 1968), in which subjects faced a wallet in the street with a return letter to the owner written in normal and broken English. According to the result of experiment only 33\% of the wallets were returned if the writer was considered dissimilar; and 70\% in the opposite case. The effect of “similarity” was experienced in the study by Atkin\textsuperscript{9}, according to which the opinion of students was influenced by exposure to the poll information only if the reference group was associated with themselves (e.g. college students).

Another phenomenon revealing our attitude towards private responsibility in various social situations is \textit{pluralistic ignorance}. The uncertainty and dependence on what others do can lead to the failure of the entire groups of bystanders to help a victim requiring help. The psychologists provide at least two reasons why with the increasing number of bystanders the help provided to the victim decreases\textsuperscript{10}. The first, and most important from the view of application to environmental problems, is that with several helpers around, the personal responsibility of each bystander is reduced. The basic approach here is that any individual expects one of the many others definitely to make an emergency call or help. The social proof mechanism can work as the second explanation for it. In case of uncertainty (about the seriousness of the victim’s suffering) it is a common action to look around and compare your own behavior with others. This bystander effect was examined in Darley & Latane (1968) and in the following meta-analysis by Latane & Nida (1981), where it was found that the number of help provided is much more frequent if there is one bystander, and much less if there is a group of bystanders. In a recent paper of Stalder (2008) this approach was revisited and found that in case of restricted communication (case where bystanders were aware of each ones presence, but were not able to see each other and communicate) the groups were more helpful than individuals. (Latane & Nida, 1981) provides three factors in the inhibiting effect of groups:

\textsuperscript{8} See Festinger (1954)
\textsuperscript{9} As mentioned in Mendelsohn and Crespi (1970) Polls, Television and the New Politics. Scranton: Chandler.
\textsuperscript{10} As discussed in Robert B. Cialdini (2001)
• Audience inhibition (fear of negative evaluation from others).

• Social influence (conforming to the inaction of others or reinterpreting the situation due to the inaction).

• Diffusion of responsibility (feeling less personal responsibility to act by shifting responsibility to other bystanders).

Latane and Nida pointed that only diffusion of responsibility works for pluralistic ignorance phenomenon, yet Stalder (2008) argues that this alone can be a not sufficient explanation, as the helping is facilitated in a restricted communication case. A possible explanation suggested in the paper is conformity to the helping (i.e. social) norm, which is facilitated by the presence of other actors. The importance of social norms was highlighted in Prevos (2006) by the mean of a naturalistic experiment in which subject were expected to provide help in a minor emergency. The data showed that there is an increase in helping behavior in case of the presence of a confederate (in cases with both helping and non-helping ones):

![Graph 1. Prevos (2006). Effect of a confederate’s presence on increase of helping behavior. Social pressure at work](image)

These examples provide evidence of the considerable effect of social environment on individual decision making. The point is that there can be negative consequences of such dependence (like in bystander case), and all these cannot be underestimated in solving common environmental problems.
1.4 Group identity

Individuals are united in various types of groups (friends, colleagues, neighbors, etc.) not stochastically, and a group can be considered as a stable formation. “People tend to move into groups of similar opinions and abilities, and they move out of groups that fail to satisfy their drive for self-evaluation. Possibly this effect allows society to harbor and sustain groups of very different opinions and abilities” (Festinger, 1954). The selection of groups that are harder to select and rotate (like neighbors in an apartment) can be anyway in a long-term possible, as individuals would like to move one day to a neighborhood more similar to them.

The group experiences all the social features discussed previously. A bright example of high group conformity is a famous Jonestown mass suicide case. The individuals united in a cult organization The People’s Temple, originating in San Francisco, secluded themselves in a South American rainforest in Guyana, where they were practicing their religious activities until the suicide order received by their spiritual leader. A total of 909 died in this massacre voluntarily taking cyanide. Cialdini (2001) discusses it as a consequence of the social proof phenomenon. In any strong-leader dominated groups there will be fanatically obedient individuals who will first take such deathful order as normal and cause consequent compliance of other group members. Such a behavior was strengthened by uncertainty situation: individuals were placed in a hostile isolated environment far from their homes. Also this isolation could strengthen the sense of similarity and unity among them. The idea here is that the leadership method in this organization could use a social proof to work for its own benefit, as “no leader can hope to persuade, regularly and single-handedly, all the members of the group”. It would be more efficient to convince a fraction of the group, and the others would be affected by them. This example shows the high potential for implementing the group approach in other sciences.
2 Typical Games and Models

2.1 Social dilemma

Previously it was discussed that human consumption of energy has environmental externalities that are not properly internalized, and thus the level of consumption is not adjusted by this to be socially optimal. The environment can benefit only in case of common action aiming to produce a group good (in particular case energy conservation). The one obstacle is that individuals has an incentive to free-ride and benefit more on the actions of others. The model below describes this incentive in case where individuals bear some environmental damage.

The private utility function can be presented as a benefit caused by the energy consumption $E$ subtracted the immediate damage\(^{11}\) caused by the sum of amounts of energy consumed in the society. In a simple static case taking that the energy consumption is a flow pollutant, we can present this in the following way:

$$U_i = B(E_i) - D\left(\sum_j E_j\right)$$

$B'(E) \geq 0, B''(E) \leq 0$ Increasing and concave function

$D'(E) \geq 0, D''(E) \geq 0$ Increasing and convex function

I would like to discuss the differences between the utility maximizing energy consumption for an individual and the social optimal one. First deriving the first order condition we will get the utility maximizing solution for an individual:

$$B'(E_i) = D'_{E_i}$$

In other words, the marginal benefit should be equal to the marginal damage incurred by an individual from his own consumption.

\(^{11}\) This can be costs born due to global warming, which in its place is a consequence of burning the fossil fuels and CO\(_2\) emissions. The higher is energy consumption, the higher is amount of fossils fuels burnt, etc.
To define a social optimum in the simple utilitarian way we need to maximize the sum of utilities:

$$\max \sum_j U_j$$

Then the F.O.C. with respect to the individual consumption level $E_i$ provides the following condition for a social outcome:

$$B'(E_i) = \sum_j D_{E_i}'$$

This shows that in social optimal case the environmental consequences of individual energy consumption are taken with respect to the whole society. Thus marginal benefit in optimal case is supposed to be higher than in the previous case implying lower consumption level $E$. This difference can be used as an illustration for the concept of lacking internalization. The task is then to make people care of the consequences that their behavior has on others.

Such conflict between private utility maximization and social optimum can be presented as a social dilemma, in particular the Tragedy of the Commons. The energy resources in this way can be presented as a common, while the energy consumption as an exploitation of it. The users explore these resources which are limited, and high consumption of which brings negative long-term effects. The classical work of Hardin (1968) describes the situation of common failure of the society to achieve long term sustainability in resource usage. Each individual maximizes his initial benefit and suffers a delayed cost. On the example of an open pasture, every herdsman tries to increase the herd as much as possible as he owns all gains from the livestock, yet he experiences only partial cost of overgrazing in a share with other herdsmen. The situation is so typical for human behavior, that it was cited in a classic work of Aristotle (335-323 BC)

"There is a further drawback to common ownership: the greater the number of owners, the less the respect for the property. People are much more careful of their own possessions than of those communally owned; they exercise care over public property only in so far as they are personally affected. Other reasons apart, the thought that someone else is looking after it tends to make them careless of it."\(^{12}\)

\(^{12}\) Aristotle, Politics, Book II, Chapter 3
Going further, we can make a simplifying assumption that there are two individuals who can make a dichotomous decision. It is either a high consumption: behavior as usual (to defect), or a low consumption: conserving some amount of it (to cooperate).

Attaching some hypothetical values for these cases, we can calculate the pay-off for each situation:

\[ B(Low) = 20, \quad B(High) = 32 \]

\[ D(Low + Low) = 10, \quad D(Low + High) = 21, \quad D(High + High) = 32 \]

Inserting the assumed values into the utility function we get pay-offs in each situation:

- Both cooperate and get: \( U_i = B(Low) - D(Low + Low) = 20 - 10 = 10 \)
- One defects, while the cooperator suffers: \( U_i = B(Low) - D(Low + High) = 20 - 21 = -1 \)
- One Cooperates, while another defects and enjoys: \( U_i = B(High) - D(Low + High) = 32 - 21 = 11 \)
- Both defect and get nothing \( U_i = B(High) - D(High + High) = 32 - 32 = 0 \)

Already at this step it can be seen that individuals have an incentive to free-ride on conservation of others, and that illustrates the conflict between self and common interest. Using these values we can construct a pay-off matrix that coincides with the one in a prisoner’s dilemma:

<table>
<thead>
<tr>
<th>A/B</th>
<th>Cooperate</th>
<th>Defect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooperate</td>
<td>10,10</td>
<td>-1, 11</td>
</tr>
<tr>
<td>Defect</td>
<td>11,-1</td>
<td>0,0</td>
</tr>
</tbody>
</table>
2.2 Prisoner’s dilemma

In a basic formulation of it\textsuperscript{13}, the game is presented as a partial conflict of interests between two players: A and B. Each of them has two strategies: to Defect or to Cooperate. In relation to the common resource, we can say that both players will benefit if both of them cooperate (i.e. conserve energy). If both of them do not take care of conservation, they do not benefit from the common good and achieve non-cooperative equilibrium. The main feature of this game is that there is an incentive to free-ride, to continue exploitation of the resource no matter of the strategy of the opponent. The pay-off matrix based on the values has been just shown above.

So the dominant strategy for a player is to defect, which causes the non-Pareto efficient outcome and overexploitation of the resource. Two notes about the model’s assumptions should be made: firstly, it is a complete information game, i.e. all players are aware of all pay-offs and available strategies of the other player; secondly, it is a non-cooperative game, as players’ communication and any contracts between each other are forbidden.

The better description of the real-world problems is provided in N-person prisoner dilemma (NPD). This type of dilemma was suggested to explain various social situations, including the by-stander intervention effects. The model of NPD will be presented following Komorita (1976) who summarized previous developments in this field.

- Each of the N persons has two choices, cooperative (C) or competitive (D).
- The outcomes for both choices increase monotonically with the proportion of people who make the cooperative choice.
- The competitive choice always yields a higher outcome than the cooperative choice;
- The outcome if everyone makes a cooperative choice is greater than the outcome if everyone makes a competitive choice.

In the simplified version the pay-off functions can be presented in a linear way. The notations \( C_i \) and \( D_i \) will be used to show the outcomes for cooperative and competitive choices, while

\textsuperscript{13} For example as provided in Varian, H., (1992) Microeconomic Analysis, Norton and Company
the subscripts denote number of persons made cooperative decisions. The graphic treatment of this game can be presented in the following way:

Graph 2. Komorita (1976). Graphic Treatment of N-person Prisoner’s Dilemma

Here $P_c$ shows the proportion of individuals making a cooperative decision. It is obvious why there is no outcome for cooperators if $P_c=0$ (no cooperators) and no outcome for competitors if $P_c=1$ (no competitors). This graphic treatment satisfies all the game conditions stated above: a competitive decision is preferred for any $i$ from 1 to n-1. Yet the absolute cooperative outcome is preferred to the competitive one: $C_N>D_0$. Presenting outcomes as positive functions of proportions of cooperating people we get:

$$C_i = m_c P_{c_i} + C_0, n = 1..N$$

$$D_i = m_d P_{c_i} + D_0, n = 0..N - 1$$

Where $P_{c_i} = \frac{i}{N}$, $m_c$ with $m_d$ are slopes, $C_0$ and $D_0$ are intercepts.

---

14 Adapted from Kelley H.H. and Gryzelak J. (1972)
2.3 Incentives to defect

As a possible measurement for the likeliness of cooperation equilibrium Rapoport (1967) suggested an index of cooperation for 2-person prisoner’s dilemma, which was updated for the n person case by Komorita (1976):

\[ K = \frac{C_n - D_0}{O_{\text{max}} - O_{\text{min}}} = \frac{C_n - D_0}{D_{n-1} - C_1}, 0 < K < 1 \]

Where \( O_{\text{max}} \) is maximum available outcome, and \( O_{\text{min}} \) is correspondingly the minimum one. In the case of N-person prisoners dilemma, maximum outcome is achieved by a defector and all others being cooperators: \( D_{n-1} \). The minimum outcome is achieved by one single cooperator while others being defectors: \( C_1 \). This coefficient clearly shows the fraction of group interest over the individual interest. Making substitutions of the linear functions into the coefficient, we get:

\[ K = \frac{m_c + C_0 - D_0}{m_dp_{c_{n-1}} + D_0 - m_cp_{c_1} - C_0} = \frac{m_c - d}{m_d \frac{N - 1}{N} + D_0 - m_c \frac{1}{N} - C_0} \]

\[ = \frac{m_c - d}{m_d - \frac{1}{N} (m_d + m_c) + d} \]

Here \( d \) is denoted for the difference of intercepts. The larger is the value of \( d \), the greater is the motivation to defect. Slope parameters \( m_d \) and \( m_c \) reflect the increment in payoffs. So logically in case of unequal slopes, the greater \( m_c \) is in comparison to \( m_d \), the higher is incentive to make cooperative decision.

An interesting implication here is view of group size effect. Unrestrictedly increasing the number of players we get:

\[ \lim_{N \to \infty} K = \frac{m_c - d}{m_d + d} \]
The coefficient reaches zero if $m_c = d$, or if $m_d$ is infinite. The cooperative case 1 is observed if $d$ is equal to zero (no motivation to defect) and if slopes are equal. In case of equal slopes the limit is presented as function of only one parameter $d/m$:

$$\lim_{N \to \infty} K = \frac{1 - d/m}{1 + d/m}$$

By using numerical examples for the equal slope case, Komorita (1976) shows that $K$ closely reaches its asymptote already at $N=30$ and in this way states that group size has larger effect on $K$ in smaller $N$. It is suggested that cooperation among large number of individuals can be more easily coordinated if they could form subsets and act as coalition units. This idea founds support in Weil (1966) who used computer simulation for N-person prisoner’s dilemma case and concluded that the larger is the number of players, the harder it would be to make cooperative decisions.

### 2.4 Repeated prisoner’s dilemma

The process of human activity in a group can be more realistically illustrated on the multi-period model of a prisoner’s dilemma. The one-shot scenario implies no future and diminishes the main characteristic of human nature: reputation building and reciprocity. In a repeated game a player can behave in response to how she was treated in the previous period(s).

Kremps (1982) describes an N times repeated prisoner’s dilemma game with not discounted payoffs. At each stage each of the two players recalls his previous actions and is informed about those of his opponent. The players move simultaneously at each stage. If we tie it to the idea of energy conservation, this seems plausible. The actors in a conservation game can be informed about each one’s effort. While players will not actually discuss the actions exactly before doing them, and such behavior is also considered as a simultaneous decision making. As discussed in this setup, by the method of back induction the repeated prisoner’s dilemma has the only unique Nash equilibrium: to defect each period. The final period has the defection as obvious strategy, the penultimate stage can not affect the final one, so the defection still selected. The fact that actually in experiments players at the beginning provided cooperative decisions was explained by the asymmetry of information about the player’s type in the frames of rationality.
Yet taken that the players are following a tit-for-tat strategy, a reciprocal response is implied that brings some positive feeling. In Andreoni et al (1993) this discussion felt under the model of Reciprocal Altruism, according to which the player’s utility is $U_i = p_i + \alpha, \alpha > 0$, where the parameter is zero if both players played defective. So some pleasure in successful cooperation is predicted. The experiment results supported the sequential equilibrium prediction. Subjects in a finitely repeated prisoner's dilemma were significantly more cooperative than subjects in a repeated single-shot game.

In case of infinite repetitions we can present the player’s preferences as discounted sum of all future payoffs in each separate period. The discounting brings all future payoffs to the present value and allows us to calculate which strategy is more attractive to the player$^{15}$. Given that payoff in each game is denoted as $r$, and the discount factor is $\delta$, $0 < \delta < 1$, the present value of the rewards for the player “i” is:

$$PVR = \sum_{t=1}^{\infty} \delta^t r_t$$

One possible strategy for the repeated game is grim trigger: the player will cooperate until the opponent defects. Afterwards the only defect strategy is implemented, illustrating the very unforgivable character of the player. Whether the player would like to defect and deny all future benefits from cooperation will depend on this discount factor (taking payoff from the previous two person case):

Cooperation: $PVR = 10 + 10 \cdot \delta + 10 \cdot \delta^2 + 10 \cdot \delta^3 + \cdots = \frac{10}{1-\delta}$

Defection: $PVR = 11 + 0 \cdot \delta + 0 \cdot \delta^2 + 0 \cdot \delta^3 + \cdots = 11$

So the player will select cooperation if the discount factor is large enough to consider future benefits from cooperation:

$$\frac{10}{1-\delta} > 11$$
$$\delta > 1 - \frac{10}{11} \approx 0.09$$

The format of infinite repeated games with discounting was mentioned in Fudenberg & Maskin (1986) where it was connected to The Folk Theorem. It asserts that any individually rational outcome can arise as a Nash equilibrium in infinitely repeated games with sufficiently little discounting.

### 2.5 Reciprocity

The reciprocity is fundamental part of our psychology and various experiments and questionnaire studies show that this notion is realistic and powerful. The tit-for-tat strategy was an example of reciprocal behavior. Thus this kind of behavior may be embedded in our preferences, we want to cooperate if and only if others cooperate, and do so even in a one-shot game. The reciprocity can be applied to the prisoner’s dilemma case in the one-shot format of it (emitting reputation building) and show that with this mechanism individuals can achieve fair equilibrium. There are several models of reciprocal preferences that are intended to capture this idea. The following is the most cited, but we will return to an alternative later on. The utility function in the model is presented in the following way:

\[ U_i = x_1 + \alpha_i(k_{ji} + k_{ij} \tilde{k}_{ji}) \]

Where \( \tilde{k}_{ji} \) - “i”’s belief about “j”’s kindness to “i”; \( k_{ij} \) - “i”’s kindness to “j”; \( \alpha \) - weight of kindness concerns. Taking the simpler specification with only a multiplicative term (as anyway the other’s intentions are not affected by us) the formula becomes:

\[ U_i = x_1 + \alpha_i k_{ij} \tilde{k}_{ji} \]

---

16 The overview of the literature supporting this can be found in Falk & Fischbacher (2006)

17 Information taken from lecture notes, ECON4260, University of Oslo, Karine Nyborg, 2009
The kindness function will be defined in the following way:

\[ k_{ij} = x_j(s_i, b_{ij}) - \frac{1}{2}(x_j^{\text{max}}(b_{ij}) + x_j^{\text{min}}(b_{ij})) \]

\[ \bar{k}_{ji} = x_i(b_{ij}, c_{iji}) - \frac{1}{2}(x_i^{\text{max}}(c_{iji}) + x_i^{\text{min}}(c_{iji})) \]

Where \( s_i \) is “i” strategy, \( b_{ij} \) is “i” belief about “j” strategy and \( c_{iji} \) is “i” belief about “j” guess about “i” strategy. Using the 2-person prisoner’s dilemma pay-off matrix described previously, we can calculate values of the kindness function in case of reciprocal cooperation:

\[ k_{ij}(C) = x_j(C, C) - \frac{1}{2}(x_j^{\text{max}}(C) + x_j^{\text{min}}(C)) = 10 - \frac{1}{2}(10 - 1) = 5.5 \]

The utility of player “i” will be then (taking weight of the kindness equal to 1):

\[ U_i = 10 + \frac{11 \cdot 11}{4} = 40.25 \]

Considering the defection:

\[ k_{ij} = x_j(D, C) - \frac{1}{2}(x_j^{\text{max}}(C) + x_j^{\text{min}}(C)) = -1 - \frac{1}{2}(10 - 1) = -5.5 \]

\[ \bar{k}_{ji} = x_i(C, D) - \frac{1}{2}(x_i^{\text{max}}(D) + x_i^{\text{min}}(D)) = 11 - \frac{1}{2}(11 + 0) = 5.5 \]

The utility of player “i” will be then:

\[ U_i = 11 - \frac{11 \cdot 11}{4} = -19.25 \]
So the reciprocity working makes cooperation a desired strategy rather than defection, removing the incentive to free-ride. As it was mentioned in Falk & Fischbacher (2006), the unconditional cooperation in such kind of public good game is practically inexistent. In a cited experiment of a public good game, in spite of the fact that predicted the best response was to defect irrespectively of what other group members are doing, subjects contributed more if the other group members contributed more. The conditional character of such cooperation was stated in a classical work of Rabin (1993). On the example of various experimental studies, he pointed that the willingness to help seems to be highly contingent on behavior of others, and the enthusiasm to sacrifice own benefit is diminished “if people do not think that others are doing their fair share”. In the paper of Dufwenberg & Kirchsteiger (2001) Rabin’s principles were extended to a sequential case, and the existence of sequential reciprocity equilibrium found its proof.

Returning to the Tragedy of Commons again, the pessimistic approach in it was revisited in Ostrom et al. (1999), where it was stated that besides degrading cases, for thousands of years people have self-organized to manage common-pool resources, and users often do devise long-term, sustainable institutions for governing these resources. The reciprocity and other social mechanisms seem to be the possible explanation for this observation. Hardin’s solution for socialism or the privatization was called as not the only available, as both government ownership and privatization are themselves subject to failure in some instances.
3 Effects on cooperation: group experiments

3.1 Group size

The previous chapter covered the theoretical model how the cooperation can be achieved. The social mechanism like reciprocity was found to be effective to shift individuals to social equilibrium. The question to be put now is which results does empirical and experimental data provide to state conditions encouraging cooperation in a group. I start the discussion below with the group size effect.

How the group size can theoretically play role in the Tragedy of Common games was mentioned above in Komorita (1976) that cooperation among large number of individuals can be more easily coordinated if they could form subsets and act as coalition units. This also found its support in Weil (1966).

As shown in experiments by Mark Isaac & Walker (1988), large groups have a more difficult time providing public goods than small groups. In the laboratory experiments two factors were tested: marginal return to an individual from contribution to a public good and total number of participants in the group. The experiments were held with undergraduate students in a typical public good game (implying investment decision to the monetary public good), in anonymity and absence of communication conditions. The results provided would suggest that public goods provision would be closer to efficient in the small group, but only under the condition of crowding effect (i.e. condition that the benefit from public good provision for each individual is reduced with the larger number of participants: decreasing the marginal return of investments).

The observation that group size and cooperation are not in so easy relationship was discussed in Bonacich et al. (1976). In computer-administered experiments using various group sizes he concluded that the provision to public good could be difficult as a potential cooperative consensus in a group can be thwarted by a critical number of non-cooperators. Increasing
number of such participants will reduce the probability that others will continue to cooperate, and the fact is that in larger groups will be likely more non-cooperators. In addition participants can use communication to discuss intentions and influence others to cooperate in the sake of common benefit. In larger groups such communication is complicated.

### 3.2 Partners and strangers

The higher cooperation can also depend on the kind of people cooperating together. The intuitive answer is that to achieve long-term cooperative equilibrium the participants should consider each other like partners. Following the description of the prisoner’s dilemma, the game with absolute strangers will be like multiple repetitions of one shot games, in which defection is more likely. Yet the experiments do not provide specific answer to this. Andreoni (1988) used two group types in public good experiments: partners (in finitely repeated games) and strangers (who played in a repeated single-shot). The result surprisingly showed more cooperation among strangers. In the replication of such experiment made by Croson (1996) the opposite result was found. In both series of experiments the restart notion was used to control learning effects. Restart was made after 10 periods and if no learning effects are present, the restart will have no effect. The major results are shown below:\(^\text{18}\):

\[\text{Graph 3. Andreoni (1988) results (percent of endowment donated to public good)}\]

\(^{18}\) Taken from Andreoni, J, Croson, R., (2008), from a Handbook of Experimental Economics, Elsevier
Graph 4. Croson (1996) results (percent of endowment donated to public good)

As it is seen in the graph, two experiments bring different observations. But in common partners show more willingness to restart with higher contributions, what can support the idea of reputation building. Other series of experiments held by other authors also give ambiguous results. The difference between strangers and partners has compelling explanation in couple of papers of Palfrey & Prisbrey (1996, 1997). They tried to estimate a separate effect of warm-glow in an experiment with 12 subjects playing four ten-period games as partners (not rematching during 10 periods) and strangers (rematching after each period). The individuals were assumed to have marginal return on investment in public good equal to V, at the same time having privately known cost of giving r_i. The warm glow was presented as individual parameter W_i. With linear preferences, individuals will make “cut-point” decision to invest everything if V-r_i+W_i > 0, or to free-ride otherwise. As the authors argue, the partners more complied with cut-point rule, while strangers showed more variance and unpredictability.

The main conclusion that can be derived from the above-mentioned is that dealing with players that consider each other partners will bring more possibilities for policy makers to achieve high contributions to public good. The first is because they are more predictable, and providing proper incentives will more likely bring expected results; the second is that partners have willingness to improve themselves in the sake of reputation.
3.3 Communication

The members in natural groups that are formed on the basis of some common activity or interest are expected to have communication among each other. From this point of view the case of prisoner’s dilemma with independent decision making cannot be taken as describing the real life. Group members are more likely to discuss the common strategy regarding donation to public good. This implies some kind of informal agreement made by the participants and commitment to keep a promise. The pre-play discussions are often called “cheap talk”, as following free-riding is expected due to of absence of formal incentives. In contrast the social dilemma experiments provide strong evidence that communication prior to decision making increases the cooperation dramatically. Ostrom (2006) provides an overview of experiments aimed at testing the communication effect. After introduction of face-to-face communication into a baseline study (specifically open discussions in a circle when only aggregate investments were known to the participants), in many rounds, subjects did exactly as they had promised to one another, only some defections did occur over time. If promises were not kept, subjects used this information about the aggregate investment levels to castigate the unknown participant who had not kept to their agreement. Interestingly, is that especially face-to-face contact has some psychological influence ability on individuals to keep their promise, while any other computerized form of discussion reduces the cooperation\textsuperscript{19}. In a huge meta-analysis of communication testing experiments from 1958 to 1992 made by Sally (1995), it was showed that in 100 rounds prisoner’s dilemma with discussions before each round would have 40\% more cooperation than the same game without, and 36\% more cooperation than the game with discussion each 10 trials.

The attempt to explain communication effect was made by Miettinen & Suetens (2008) by the feeling of guilt from deviation of common agreement. The guilt feeling was specifically experienced in case of unilateral defection. The communication is expected to increase cooperation rates given that subjects learn to avoid guilt-causing choices and that payoff of mutual cooperation is higher than in mutual defection. But the feeling of guilt was reduced in case some fine was imposed on defection what can point at crowding out the intrinsic motivation. The implication for policy is that it would be better to make people do social

\textsuperscript{19} See Rocco, E., Warglien, M., (1995)
accusation of the defector showing how it affects common benefit rather than putting monetary fines.

Another interesting moment in Ostrom (2006) overview is an external rules making. Necessity of imposing external rules of sanctioning was explained by the fact that group member will not spend time and effort on creating their own endogenous rules. But contrary to the theoretical expectation, individual show such self-organization in the field. In an experiment of Cardenas et al. (2000), where the subject harvesting in the Columbian forest were told about external monitoring and probability to be checked and fined in case of exceed of optimal harvesting time. But actually subjects increased their harvesting time, while in experiments with face-to-face communication the time was less, and subjects achieved higher joint return. It shows that environmental policies can be totally ineffective, even if they were designed to achieve some social optimality. This argument meets the idea in the previous chapter describing tragedy of the commons, that people for centuries were able to sustainably exploit some common pool resource with only self-regulation. The implication here is that group could at some extent be allowed to regulate, for example, energy consumption on their own.

### 3.4 Sanctioning and punishment

It is necessary to discuss how the sanctioning system can be introduced into the group. The free-riders are expected to exist in public good games, so can only social norms and reciprocity affect them? The punishment itself implies a cost, thus it can be considered as second-order public good. Fehr & Gächter (2002) tested the altruistic punishment mechanism in an experiment with 240 students with two treatment conditions: punishment and not punishment. Each member received an endowment of money units and was able to donate to a public good up to this endowment. Each treatment was conducted in 6 periods to introduce some learning possibility, and the composition of groups changed each period to rule out reputation building and reciprocity effects on cooperation. In spite of the fact that a cost was imposed on punishment, it did happen frequently by cooperators (above average contributors) altruistically punishing defectors (below average contributors). The results of the experiment show the unambiguous effect of punishment on cooperation (no matter which treatment is applied first):
The similar support for sanctioning as an instrument to sustain cooperation is provided in Sefton et al. (2006). Comparing reward and punishment mechanisms, the latter was found to be more effective in achieving cooperation. In contrast in absence of both reward and punishment the contribution path showed decline throughout periods.

If the punishing brings higher contributions, it is straightforward to claim that some sanctioning mechanism should be present in any real-life group games. Yet another side of this mechanism should be pointed out. First punishing implies some cost which can be subtracted from the common contribution to the common pool resource. From this side the resource suffers under-provision. From another side, the punishing and monitoring can cause undesired crowding out effect of intrinsic motivation. Especially this is related to the external regulation, e.g. from the government agency. Nyborg & Rege (2003) provide references to empirical findings that governmental provision to public good incompletely crowds out the private contributions. The same effect is observed in monetary incentives and fines where there may be even more than complete crowding out (violations actually increase).
Frey & Jegen (2000) survey provides prove that crowding out effect is well empirically founded and is observed in many different areas of economy and society. The external interventions thus crowd-out intrinsic motivation if the individuals perceive them to be controlling and if they feel that their motivation is not taken into consideration.

From this point of view any external sanctioning can bring reduction for social norm effect. At the same time any monitoring implies as well a cost. The possible suggestion is to avoid such type of penetration and letting the group itself handle the violators. As it follows from the previous paragraph regarding communication, it can be enough for achieving cooperation as it implies some social disapproval for defectors. This disapproval can work as non-monetary internal sanctioning system that can sustain cooperation.

Ostrom et al. (1992) provides a comparison of common pool resource experiments with covenants alone (one-shot and repeated communication opportunities), swords alone (repeated opportunity to sanction each other), and covenants combined with swords (one-shot communication followed by repeated opportunities to sanction). The communication brought substantial improvements for outcomes, while sanctioning alone had shortcoming: subjects were willing to bear a cost and place a fine on another one far more than was predicted, i.e. overuse of mechanism happened letting the net average net yield actually to fall. The main outcome was that subjects using the opportunity to communicate to make an agreement over common investment strategy and choosing their own sanctioning mechanism achieve close-to-optimal results.

The implication from the above mentioned for the policy strategy is to make stress on communication factor for the effect of covenants, social approval and the possibility of creation of endogenous sanctioning mechanism.

\[20\] In case costs and fines are subtracted from the average net yield.
\[21\] This holds for situations both low and high endowments
3.5 A simple model of reciprocity and group norm

Following the examples above, it comes a necessity to formalize the group effect on individual decision making. Any model of the personal utility should capture not only the utility of the consumption, but also internal preferences for provision and external social preferences. The internal motivation for public good donation can be presented by a warm glow effect like in the description provided by Andreoni (1990).

The external social effects on utility are characterized by a great variety: as it was shown above factors like communication, sanctioning, reputation building and other possible ones increase compliance of individuals to some social norm followed by others. The reciprocity described in the sub-chapter 2.5 was considered as a social factor able to bring the individuals to the cooperative equilibrium in the prisoner’s dilemma game. There the cross-kindness of individuals towards each other had an effect on utility, thus the defection of one over the cooperating partner imposed a utility loss. Bringing all these ideas together, we can set up some morally accepted and practiced action of the group, and the deviation from which will cause a decline in utility. This set-up is supposed to catch up the major external effects motivating the individual to comply with a group action, including the reciprocity.

In this way the mentioned factors are introduced into the pay-off function of each individual. The idea of warm glow or altruism themselves are not depending on the presence of the group, yet they alone may not be enough to achieve proper energy conservation. The group presence provides additional factors affecting decision making. Taking the decision making as process of division budget Y between private good x and public one with amount $g_i^t$, following Brekke et al. (2010) the pay-off function of an individual “i” at time t (game is repeated T times, $0 \leq t \leq T$) can be presented in the following way:

$$u_i^t = x_i^t + \beta_i g_i^t - \frac{\alpha}{2} (g_i^t - \hat{g}_i^t)^2$$

s.t.

$$Y = x_i^t + g_i^t$$, i.e. the budget constraint.

$$x_i^t = Y - g_i^t + \frac{M}{n} \sum_{j=1}^{n} g_j^t$$, assuming $1 < M < n$. 
Recalling the previous reciprocity model in sub-chapter 2.5, we can notice the resemblance between the deviation from social ideal \((g_i^t - \tilde{g}_i^t)\) and kindness parameters \(k_{ij} \tilde{k}_{ij}\). The cooperating partner’s kindness \(\tilde{k}_{ij}\) was positive; while the defector’s \(k_{ij}\) was negative, what in the product gave negative result. Here the term \(-(g_i^t - \tilde{g}_i^t)^2\) can catch the same dependence in case of many players: the provision lower than the morally accepted in a group (interpreted like a feeling of guilt) or higher (interpreted as a feeling of being a “sucker”) brings the negative effect on utility. Followed we will show that morally accepted level will depend on the average provision in the group, and that has the element of “tit-for-tat” reciprocity, i.e. morally accepted level will fall if group in average donates less to the public good. Thus the deviation from the morally defined level \(\tilde{g}_i^t\) has a negative effect on utility, weighted by a parameter \(\alpha\). The parameter \(\alpha > 0\) is reflecting the strength of social influence from other group members. From the point of social norms, the variable \(\tilde{g}_i^t\) shows morally ideal contribution and this depends on the perceptions formed in a group. This parameter should be expected to be high in smaller groups as for example the individual’s defection can be harder to be not considered by others. In this way \(\alpha\) can be presented as a function of group size \(n\) and some constant22:

\[
\alpha = \frac{\bar{\alpha}}{n}
\]

The cooperation and common provision can yield benefit in terms of private good to each individual, what can be presented by the multiplier \(M\) increasing common provision which is then distributed equally among each participant. It is noticeable to state that, in the specific case of global environmental scope, the energy conservation by itself will not bring considerable return to the donors: the benefit that the global society gets from emission reductions of is shared by a very large number of people. From this point of view the term \(\frac{M}{n}\) will equalize to zero.

The parameter \(\beta > 0\) here shows the increment to utility from unconditional warm grow of provision. This addition shows altruistic preferences of each group member which also extend outside the group.

22 This is made for the illustration of such dependence. Actually parameter \(\alpha\) is expected to depend on more variables.
While Brekke et al. (2010) considered $g_i^t$ as a monetary contribution, yet in our case the energy conservation is considered, some measures of which can be cheap and others expensive. From this point of view it is worth to introduce a cost function $c(g_i^t)$ of a donation to public good. The function is convex and increasing in its argument:

\[ c'(g_i^t) > 0 \]
\[ c''(g_i^t) > 0 \]
\[ c'(0) = 0 \]

Assuming this, the utility function can be rearranged taking into consideration the zero group returns from donations, so we get the following (note that $c(g_i^t)$ replaces $g_i^t$):

\[ u_i^t = Y - c(g_i^t) + \beta_i g_i^t - \frac{\alpha}{2} (g_i^t - \hat{g}_i^t)^2 \]

Assuming the specific form of the cost function like $c(g_i^t) = \frac{1}{2} (g_i^t)^2$ for each period first order condition provides optimal $g_i^t$:

\[ \beta_i - \alpha (g_i^t - \hat{g}_i^t) - g_i^t = 0 \]
\[ \beta_i + \alpha \hat{g}_i^t = (1 + \alpha) g_i^t \]
\[ g_i^t = \frac{\beta_i + \alpha \hat{g}_i^t}{1 + \alpha} \]

Taking into consideration that the donation level to public good cannot be negative or greater the budget constraint, for the simplicity reasons we consider only internal solutions. Thus we can already say that individual is expected to donate more if the morally accepted level is high (social norm working), and if the same is the unconditional warm glow effect. In addition the higher is the growth rate of the cost function, the fewer donations are expected. This cost factor can be affected by some external policy. In order to reduce these costs a reward system seems to be plausible to increase provision. Alternatively some environmental taxation on the private good $x_i^t$ can be adapted, what implies a substitution from private good consumption to
the provision to public good (with respect to warm glow effect to the utility). Though these measures seem straightforward, they should be apprehended as they can cause considerable crowding out effects on intrinsic motivation, as it was discovered in previous paragraph. In terms of the model above, that may decrease the strength of parameter $\alpha$ and weaken the long-term purpose of the intervention.

It is noticeable to state that the moral level of donation is more likely to vary for each period and depend on the donations of others $^{23}$. This dependence can be shown by the weighted sum of the average contribution in the last period and the previous ideal:

$$\hat{g}_{i}^{t+1} = (1 - \lambda) \bar{g}^{t} + \lambda \hat{g}_{i}^{t}, \quad \lambda \in [0; 1]$$

Following the thesis approach as I want to discuss the group-based intervention policy, it is noticeable to point out the additional effect such policy can bring on the formation of the morally accepted norm. The measures like household consultation and informational spread are likely to advocate some socially optimal level of donation that can be presented as $\bar{g}^{t}$. Introducing this factor with a parameter $\mu$ ($> 0$ if the policy has this effect, and $\mu = 0$ otherwise):

$$\hat{g}_{i}^{t+1} = (1 - \lambda - \mu) \bar{g}^{t} + \lambda \hat{g}_{i}^{t} + \mu \bar{g}^{t}, \quad \lambda + \mu \in [0; 1]$$

Developing this proposition, we can define the steady state expression for the moral ideal in this case and discuss the effect of model parameters on it.

Assuming that the warm-glow parameter is equal among individuals, the average donation will then equal to the private one. Inserting the private donation into the formula and setting a steady state condition ($\hat{g}_{i}^{t+1} = \hat{g}_{i}^{t}$), we get the following expression for the moral ideal:

$$\hat{g}_{i}^{t} = (1 - \lambda - \mu) \frac{\beta_{i} + \alpha \bar{g}_{i}^{t}}{1 + \alpha} + \lambda \hat{g}_{i}^{t} + \mu \bar{g}^{t}$$

Solving this expression for $\hat{g}_{i}^{t}$ through the following calculations we get:

---

$^{23}$ In the paper in question evidences from Fischbacher and Gächter (2006), Fischbacher and Fehr (2001) and Hauge (2009) are provided to support this proposition.
\[(1 + \alpha)\hat{g}_i^t = (1 - \lambda - \mu)(\beta_i + \alpha\hat{g}_i^t) + (1 + \alpha)\lambda\hat{g}_i^t + (1 + \alpha)\mu\hat{g}_i^t\]

The further simplifications lead to the final result:

\[
[(1 + \alpha) - \alpha(1 - \lambda - \mu) - \lambda(1 + \alpha)]\hat{g}_i^t = (1 - \lambda - \mu)\beta_i + (1 + \alpha)\mu\hat{g}_i^t
\]

\[
[(1 - \lambda) + \alpha\mu]\hat{g}_i^t = (1 - \lambda - \mu)\beta_i + (1 + \alpha)\mu\hat{g}_i^t
\]

\[
\hat{g}_i^t = \frac{(1 - \lambda - \mu)\beta_i + (1 + \alpha)\mu\hat{g}_i^t}{(1 - \lambda) + \alpha\mu}
\]

Transforming the result into a more visual one we get:

\[
\hat{g}_i^t = \frac{(1 - \lambda - \mu)\beta_i + \alpha\mu\beta_i - \alpha\mu\beta_i + (1 + \alpha)\mu\hat{g}_i^t}{(1 - \lambda) + \alpha\mu}
\]

\[
\hat{g}_i^t = \frac{(1 - \lambda + \alpha\mu)\beta_i - (1 + \alpha)\mu\beta_i + (1 + \alpha)\mu\hat{g}_i^t}{(1 - \lambda) + \alpha\mu}
\]

\[
\hat{g}_i^t = \beta_i + \frac{\mu(1 + \alpha)}{(1 - \lambda) + \alpha\mu}(\hat{g}_i^t - \beta_i)
\]

From this expression it is obvious that higher social pressure will cause higher morally accepted level if \(\hat{g}_i^t > \beta_i\) and \(\mu < 1 - \lambda\)

From another point of view, the absence of the policy effect, i.e. \(\mu = 0\), in this expression implies the convergence \(\hat{g}_i^t = \beta_i\). In case the private donation level \(g_i^t\) as well converges to the morally accepted level \(\hat{g}_i^t, g_i^t = \beta_i\) and the impact of parameter \(\alpha\) vanishes.

The same result is obtained by finding the first order condition with respect to \(\alpha\):

\[
\frac{\partial \hat{g}_i^t}{\partial \alpha} = \frac{[(1 - \lambda) + \alpha\mu]\mu\hat{g}_i^t - [(1 - \lambda - \mu)\beta_i + (1 + \alpha)\mu\hat{g}_i^t]\mu}{((1 - \lambda) + \alpha\mu)^2}
\]

Given as \((1 - \lambda) + \alpha\mu)^2 > 0\), the identification of the sign of this expression falls only to the numerator:

\[
[(1 - \lambda) + \alpha\mu]\mu\hat{g}_i^t - [(1 - \lambda - \mu)\beta_i + (1 + \alpha)\mu\hat{g}_i^t]\mu > 0
\]
Dividing by $\mu > 0$ and collecting the terms provides the following:

\[
\bar{g}(1 - \lambda) + \alpha \mu - \mu - \alpha \mu - (1 - \lambda - \mu) \beta_i > 0
\]
\[
\bar{g}(1 - \lambda - \mu) - (1 - \lambda - \mu) \beta_i > 0
\]
\[
(\bar{g} - \beta_i)(1 - \lambda - \mu) > 0, i f \bar{g} > \beta, \text{a}nd \ \mu < 1 - \lambda
\]

The specified conditions imply that the morally accepted level should be at a specific extent dependent on the average donations in the group and the moral ideal from previous period and the recommended level should not have a full impact ($1 > \lambda + \mu$) on the formation of the ideal. The norms are not robust and change under the actions of other people. This description seems to be plausible from the view of social influence of what others are doing on the individual decision making. Recalling the social proof factor this condition is expected to be present in real-life situations.

As it was mention before, in case $\mu = 0$ the derivative of the steady state moral ideal with respect to $\alpha$ is zero meaning the absence of social pressure effect.

This relationship provide reciprocation and social norm character of the game dynamics: ideal level of contribution is growing in high social pressure case, what in its turn causes higher private contributions. The presence of the policy prompted level $\bar{g}$ together with a social pressure can move the group to higher provision level. Talking about a possible intervention policy theoretically it seems plausible reinforcing internal social mechanisms in groups of individuals to increase their compliance.
4 Development of Energy Conservation Policy

4.1 Policy target

As it is expected, the energy consumption will continue to grow, and the capacity of alternative energy sources is not yet sufficient to replace other sources. How CO2 emissions from burning fossil fuels and climate change in connection can affect socio-economic sphere is described in IPCC 2007’s “Impacts, Adaptation and Vulnerability” report, stating that coping with the consequences of natural disasters will impose huge costs on affected areas (e.g. from 4 to 6% of GDP in a relatively small country\(^\text{24}\)).

In this proposal the path of behavioral change is discussed as a measure to tackle environmental externalities: policy of energy efficiency and conservation (including other environmentally friendly behaviors). The question is how the policy can be designed in order to meet conclusions from the previous chapters in order to make individuals active participants in environmental initiatives like changing private cars to public transport, buying energy efficient home equipments, recycling, energy conservation at home and any other activities.

4.2 Working idea

The main objective of the thesis is to investigate an intervention strategy that uses social mechanisms in a group to achieve cooperation. It is the time to introduce the main working idea of a group approach. This idea has been scattered around a number of works. Personal ethics and group identity were suggested as significant motivators of environmentally friendly consumer behavior (Granzin and Olsen, 1991; Moisander, 1996; Osterhus, 1997; Sparks and Shephard, 1992; Wiener, 1993)\(^\text{25}\). Social reference and community approach was mentioned as one the main factors in behavioral model of energy use in Van Raaij & Verhallen (1983). If

\(^{24}\) Climate Change 2007: Impacts, Adaptation and Vulnerability, Contribution of Working Group II to the Fourth Assessment Report of the IPCC, Chapter 7, Industry, settlement and society

\(^{25}\) As discussed in Johanna Moisander, “Group Identity, Personal Ethics and Sustainable Development Suggesting New Directions For Social Marketing Research”, 2000
the communication occurs in social networks of cliques and liaisons (persons connecting cliques), it has a more convincing power for a behavioral change (Nan Lin 1973). It means that diffusion of environmentally friendly behavior can be stimulated in more integrated and communicating groups.

As it was shown before, in groups consumers are expected to have two different goals: individual and collective benefit. These two goals actually go into conflict with each other. The prisoner’s dilemma often cited as a good example to show the difficulty for achieving cooperation among rational and self-interested individuals. In addition the benefits of cooperative behavior often are postponed to future that makes the temptation for short-term benefits a significant barrier. As discussed previously, such unpleasant scenario can be avoided if reciprocity and social norms are present in group game dynamics. Wiener (1993) has indentified three obstacles for reaching the cooperative group behavior:

- Self-interest, a temptation to free-ride or a perception that the social pay-off is too small compared with personal sacrifice.
- Mistrust and suspicion that others not cooperating.
- A fear of being a “sucker”, a fear that the goal of sustainable development will not be made even if a sacrifice is made.

The obstacles above and their effects can be found in the model description in sub-chapter 3.5. The fact that social pay-off is too small is reflected in M/n term, that was taken to be zero. At the same time the self-interest and temptation to free ride are presented through either high cost of public good provision or the low warm-glow parameter $\beta$. Under this condition it is plausible to state that personal sacrifice in terms of private good $x$ is expected to be low. The other statements regarding mistrust in others’ cooperation and a fear to be a sucker is connected to the dynamics of the model described before. As the morally accepted norm depends on the average donation in a group, so if $\bar{\tilde{g}}^i < \bar{\tilde{g}}_i^f$, the moral ideal will decrease in the next period. That in turn causes decay in provision explained by a disappointment in others and reciprocal response to it. In the model in sub-chapter 3.5 the provision above the morally accepted level also caused the negative effect on utility, and that was associated with a feeling of being a “sucker”.

34
From the other point of view the mistrust in others means a low social effect from them on personal decision making. Thinking about a possible solution to the problem, a group setting can have some features to overcome these obstacles. The approach to unite people to a group with common interests and fate helped them to overcome suspicion, skepticism and the feeling of insignificance and powerlessness in social dilemma situations (Granzin and Olsen, 1991; Wiener, 1993).

4.3 Achieving policy effect

The group-based policy supposes some baseline procedures to be implemented first. These procedures will have an objective to achieve the policy effect of \( \mu \bar{g}_i^\text{t} > 0 \). As it was shown previously, such condition is crucial for achieving higher morally accepted donation level in equilibrium. That in its turn will mean the higher donation for public good from each individual. Talking particularly, it can cause better energy conservation in total. At the same time in general participants should be able to identify environmentally friendly and not friendly behavior, be aware of greener consumer choices, know the common benefit of mutual cooperation and other fundamental concepts used previously and be able to compare performances of the group members. So the group approach actually embraces the major measures in previous energy conservation campaigns, and the measures in question include:

- **Energy awareness and consultation**

Among reasons cited for bad energy efficiency followed by households there is mainly low awareness of amount of total energy consumed, existence of efficient home appliances and externalities of energy waste. Also the way how benefits of efficient energy use are presented should be thought: environmental protection and tackling climate change can be valued more rather than pure energy saving\(^{26}\). This kind of informational spread is likely to have an increase effect on the warm glow parameter \( \beta \). Understanding more or less fully the environmental consequences of the behavior and benefits from the conservation individuals are expected to get higher marginal utility from a donation. Taking the supposition that the individual warm glow can be affected by such advice, two effects will be observed. First looking at the equilibrium social accepted level and rearranging it a bit we get:

---

\[ g_i^r = \beta_i + \frac{\mu(1+\alpha)}{1-\lambda} + \frac{\alpha\mu}{1-\lambda}(g^r - \beta_i) \]

\[ g_i^r = (1 - \frac{\mu(1+\alpha)}{1-\lambda} + \frac{\alpha\mu}{1-\lambda})\beta_i + \frac{\mu(1+\alpha)}{1-\lambda} + \frac{\alpha\mu}{1-\lambda}g^r \]

As the condition set in the model description \( \mu < 1 - \lambda \) means \( \frac{\mu(1+\alpha)}{1-\lambda} + \alpha\mu < 1 \), so the increase in warm glow will increase the morally accepted donation in equilibrium. It is worth recalling that this will happen even in absence of recommendation effect \( \mu \), as in this case the socially accepted and individual donations converge to \( \beta \).

From the other side, the utility maximizing donation \( g_i^r = \frac{\beta_i + \alpha g_i^r}{1+\alpha} \) will also be higher with larger warm glow parameter. Following the model, consultation and information can have considerable effect on provision through the individual warm glow.

At the same time consultation can work as a promotion of the recommended level \( g \) and maintain the influence of it on the moral ideal formation \( (\mu > 0) \). Without this initial measure, further group intervention may not bring a desired effect. In addition, following the model, recommended level \( g \) is supposed to be higher than \( \beta \) to make the social pressure factor working on increase of the morally accepted donation. Taking the fact that the warm glow parameter can increase from the consultation services, so should do the advised donation. It seems logical to ask more conservation from the more pro-environmental individuals. Some pro-environmental actions can bring also cost savings, especially talking about energy conservation. From this point of view the cost function of a provision \( c(g_i^r) \) may be affected and get reduced values.

- Creating modeling and benchmark system

The feedbacks of energy usage to end-consumers were among typical measures in various campaigns (home IT, energy calculators, leaflets etc.). Here the comparative feedbacks are taken into consideration, i.e. each participant of the neighborhood receiving information about others’ consumption. This information can be added to a typical monthly energy bill or come online. The presence of the reciprocity mechanism and compliance with a social norm implies that participants should analyze others’ behavior and react on it. Thus such system is fundamental to make the morally accepted norm depend on the average donation in a group.
Reinforcing the reciprocity mechanism with benchmarking will mean higher social pressure parameter $\alpha$. Taking that the conditions formulated in the model of sub-chapter 3.5 are met (particularly that the moral level is not robust and changing under the actions of others) the higher parameter $\alpha$ will cause higher morally accepted level of donation. It is interesting to note, that possibly this condition will be satisfied as soon as this benchmark system is introduced, given that the individuals could have no opportunity to compare their energy conservation efforts before. Returning to the recommended level $\bar{g}$ a local environmental agency can prompt conservation attempts, so that the participants could have target for improvement.

- **Social Networks**

The neighborhood approach is very straightforward. Taking into consideration how fast the social networks\(^{27}\) grow and how integrated people become through internet, various pro-environmental ideas can be easily spread there. The same group approach, but now your group can include more people that can affect your opinion. The neighborhood and workplace responsibility area sometimes can drop friends that are similar to you in socio-demographic sides and influence your opinion. Also digital feedback through internet should be more advanced. The computerization is moving on, and such a common online database where everyone has his own profile may be common in future. Yet this cannot be taken as major development area because, as it was stated previously, face-to-face live communication has advantage over the computerized one.

\(^{27}\) Like Facebook, MySpace, blogging systems
4.4 Group formation

If the previous paragraph was discussing the baseline policy measures aiming and bringing the effect $\mu \tilde{g}_i > 0$ or affecting the personal warm glow, this part will discuss more the ways to increase the social norm factor $\alpha$ and additional details following the policy discussion.

4.4.1 Participants

The question is whether a group targeting policy will have advantages over other types of interventions. Generally speaking the group approach aiming at changing the behavior would better cover the sphere where social interactions of people are easily observable and exposed, i.e. a limited number of people interacting with each other in a bounded area and consuming energy as a group. The purpose of this setting is to achieve a high social pressure $\alpha$ that was defined as necessary for higher contributions to a public good. In this way close residential areas and work places are perfect candidates for the policy target. This notion will be called neighborhood in a wider meaning of the word.

In situation when the individual has no experience in energy conservation, or has the information but is unsure about how much convenience he must sacrifice in trade-off to be environmentally friendly, he will “scan” the environment and look to others. As it was seen in the previous chapters, other participants should have a considerable influence on the decision making that can be achieved if the group members know each other face-to-face, and are in long-term a collaboration. In the model discussed previously that will be represented in higher $\alpha$ parameter of social pressure. The policy idea is not to forcefully attach people to some group, but rather use the existing ones. Participants in natural groups will likely not be strangers but rather at least acquaintances, and thus their collaboration should be more predicted and include reputation building. The observation that social proof phenomenon is more effective within homogeneous group also supports the idea that self matched neighborhood members will possess many similarities. The neighborhood concept embraces these conditions: people self organized in a group are at some extend homogeneous, long-term partners, knowing each other face-to-face. So the morally accepted ideal is expected to be more dependent on the average group provision, what meets the model description in sub-chapter 3.5.
### 4.4.2 Group size

As it was shown in group experiments, such an influence circle should not be large, as the individual should know his weight inside a group and know that his behavior is observed and cannot be missed. Also many factors having implication to the policy making will be facilitated in smaller groups:

- Communication and bargaining will be easier.
- The benchmarking and comparison of energy consumption will be more obvious.
- The social norms and reciprocity mechanism will be stronger as each individual is easier observed by other members.

All these improvements increase the compliance of the individuals to some morally ideal norm. The expectation that any deviation from the covenant made at the group meetings will be easily observed and meet a social disapproval (in addition possible endogenous sanction if the group members created one) will have an effect in higher $\alpha$ in the group game model, which in its turn encourages higher public good provision.

### 4.4.3 Team building

The possible consequence of the group based approach is that using all social mechanisms in groups will create strong teams, not only groups in narrow meaning. The initial acquaintance of group members will of course create good fundament for this, but “the team” is a higher degree of simple collaboration regarding energy conservation. The presence of a group identity, common purpose and social support from other team members can have an effect increasing the unconditional warm glow parameter $\beta$. A lot of ideas can be taken from business studies regarding creating an “ideal team” at work place. In order to bring inspiration and common feeling of a team, the possible measures are present:

- Creating team concept (special name, logo). These measures should create self-determination of participants like one unit with one common task. They should
identify themselves as a united group with some strong group identity. How strong the devotion to common idea is (in our case environmental protection) was illustrated in the introduction. From this point of view such team identity and support can bring additional increment to utility, which is though not specifically covered in the model.

- Holding regular gatherings. These meetings should facilitate mutual trust, support and communication. As a matter of fact, daily activities of each member can create obstacles to live communication. As it was shown above, face-to-face discussions have a crucial role in increasing cooperation and are to be reinforced by the policy. The covenants that could be agreed and social disapproval that could be exercised during these meetings are closely connected to the strength of social pressure factor $\alpha$.

- Making energy conservation entertaining and not routine. For example, there can be contest among various groups with prizes, some yearly festival of the best teams, giving prestigious signs to best conservators.

### 4.4.4 Con-environmental groups

All individuals vary by preferences and life style, and it is probable that some group of pure con-environmental individuals can be formed. The question is whether they can be affected enough by the described group-based intervention by creating neighborhood responsibility setup (i.e. smaller groups residing together, having comparative feedback and face-to-face meetings.). What kind of social disapproval can be present in such group if all participants are initially con-environmental? And can measures like informational spread and consultation influence them? Such groups will be identified by the policy makers after some time (thanks to some benchmark mechanism), so they can be treated in a specific way. If information has no effect, possible solution is that this con-environmental group can be split, and each part attached to closest neighborhood that can be more environmentally friendly and will create higher social pressure on the attached. As group size is designed not to be large, some close geographical area can consist of several groups that are still similar and connected, so the rotation will not radically change the format of intervention. Another possibility is to aggregate groups on a higher level, for example further implementation can include clustering.
the groups and building reciprocity mechanism on a larger scale. Yet this measure requires larger discussions regarding how a group behaves differently from an individual in public good games, and that falls out of the thesis focus.

4.5 Utility concerns

Shifting from the private good consumption to the donation to private good supposed from a group setting will have consequences for the utility. As we remember, the consultation and benchmarking system are supposed to introduce some advocated donation level \( \bar{g} \) that is supposed to be higher than the marginal warm glow benefit to the utility. This advocated level should be in effect \( (\mu > 0) \) for the formation of a group moral ideal, but should not be increased unlimitedly by purpose: policy advice should not dominate in the formation of moral ideal \( (\mu < 1 - \lambda) \) as it can cause considerable crowding out and meaningless of social factors in decision making.

Once these conditions are done, the proper group setting can increase social control factor \( \alpha \) and bring higher moral ideals and donations. It is interesting to track the change in utility happing due to higher social pressure. Recall the utility function from the sub-chapter 3.5:

\[
\begin{align*}
    u_i^t &= Y - c(g_i^t) + \beta_i g_i^t - \frac{\alpha}{2} (g_i^t - \bar{g}_i^t)^2 \\
    u_i^t &= Y - \frac{1}{2} \left( \frac{\beta_i + \alpha \bar{g}_i^t}{1 + \alpha} \right)^2 + \beta_i \left( \frac{\beta_i + \alpha \bar{g}_i^t}{1 + \alpha} \right) - \frac{\alpha}{2} \left( \frac{\beta_i + \alpha \bar{g}_i^t}{1 + \alpha} - \bar{g}_i^t \right)^2
\end{align*}
\]

Finding the derivative with respect to \( \alpha \):
\[
\frac{\partial u_i^t}{\partial \alpha} = -\left( \frac{\beta_i + \alpha \hat{g}_i^t}{1 + \alpha} \right) \beta_i + \alpha \hat{g}_i^t - \hat{g}_i^t (1 + \alpha) \left( \frac{1}{1 + \alpha} \right)^2 + \beta_i^2 + \beta_i \alpha \hat{g}_i^t - \beta_i \hat{g}_i^t (1 + \alpha) \left( \frac{1}{1 + \alpha} \right)^2
\]

\[
-\frac{1}{2} \left( \frac{\beta_i + \alpha \hat{g}_i^t}{1 + \alpha} - \hat{g}_i^t \right)^2 - \alpha \left( \frac{\beta_i + \alpha \hat{g}_i^t}{1 + \alpha} - \hat{g}_i^t \right) \frac{\beta_i + \alpha \hat{g}_i^t - \hat{g}_i^t (1 + \alpha)}{(1 + \alpha)^2}
\]

Making simplifications and collecting terms provides with the following result:

\[
\frac{\partial u_i^t}{\partial \alpha} = -\frac{(\beta_i + \alpha \hat{g}_i^t)(\beta_i - \hat{g}_i^t)}{(1 + \alpha)^3} + \frac{\beta_i(1 + \alpha) - \frac{1}{2} (\beta_i - \hat{g}_i^t) (1 + \alpha) - \alpha (\beta_i - \hat{g}_i^t)}{(1 + \alpha)^3}
\]

\[
= -\frac{1}{2} \frac{(\beta_i - \hat{g}_i^t)^2 (1 + \alpha)}{(1 + \alpha)^3} \leq 0
\]

From this point of view the utility of the individuals will diminish with stronger social control. The private "sacrifice" mentioned previously can be interpreted here in the reduced utility. The group setting stimulates higher public good provision via the social pressure, but at the same time makes any small deviation from the morally accepted level a considerable loss to utility. Also the higher donations are expensive, and that is observed in convex cost function used in the example. So the main implication here that the policy is not supposed to reinforce the social control maximally, rather there should be some optimal setting. This negative consequence can be smoothed if the cost function is relaxed (for example energy conservation requires some effort to be spent, but also makes a monthly energy bill smaller. Also compensation for recycled bottles seems to be a plausible example) or additional non-material factors increasing utility (besides warm glow, like team feeling or group support). Yet more research needed to estimate how the individual can be compensated and by which means to avoid crowding out effects.

4.6 EcoTeam Program Example

Taking the wide variance of different energy conservation campaigns, we must take out the one using a group or team setup to cite a proper example. The Staats et al. (2004) provide description of previous intervention policies and show the main shortcoming of them: inability to sustain the environmentally friendly behavior. As a counter example a more
advanced policy is The EcoTeam program (ETP) - a project of Global Action Plan\textsuperscript{28} organization (hereinafter: GAP), targeting many of the behaviors (approximately 100), with 20,000 households participated worldwide. The more description following Staats of this program implemented in Netherlands is provided below:

4.6.1 Treatment\textsuperscript{29}

Team building. A combination of all previous methods like information spread, feedback, and social support was put into practice. The main method in this program was a group setting: EcoTeams are groups of 6 to 10 people who usually know each other already as neighbours, friends, club members, etc. EcoTeams met once a month. During these meetings, personal experiences, ideas, and achievements related to environmental household behaviour were shared. This setting exactly follows the discussions provided earlier regarding the group size, neighbourhood grouping and communication effect.

Information. EcoTeam members were provided with a personal EcoTeam Workbook which included a short introduction to garbage, gas, electricity, water, transport and consumption themes, and an explanation of the goals GAP pursues. This introduction was followed by a listing of a large number of pro-environmental actions that can be undertaken in the household. Each team is also provided with a logbook in which the actions taken by each participant are recorded.

The feedback system. In each EcoTeam the quantitative group-data (used amount of natural gas, electricity, etc.) was recorded and sent to a central database at the national GAP office in The Hague, The Netherlands each month. This quantitative information was compared with the situation before participation. The result of this comparison is returned to the team by means of a so-called team report. The Dutch EcoTeams also received feedback about the accumulated results of all EcoTeams in the Netherlands and in other countries by means of the 'EcoTeam-Newsletter'. This feedback system aims to weaken people's opinion that their effort is negligible.

\textsuperscript{28} http://www.globalactionplan.com
\textsuperscript{29} Taken from the summary version of the paper by Henk Staats, Paul Harland: Effectiveness of The EcoTeam Program in the Netherlands: A Long Term View
www.globalactionplan.nl/.../samenvatting_onderzoek_rul_naar_effectiviteit_ecoteam_programma.doc
4.6.2 Data collection design

EcoTeam members.
A group of 445 people who were ready to start the ETP in January or February 1994 received a request to participate in the research. Of this group, 289 (65%) cooperated prior to participation in the ETP by completing the first set of mail questionnaires (T0). Yet it is not clearly stated how was the sample procedure to recruit the mentioned group of people. In October 1994, 205 participants (71%) completed the post-ETP questionnaires (T1). In December 1996, this group was approached again with the request to complete a third set of mail questionnaires in order to obtain a similar set of data 2 years after participation (T2). The sample of respondents who completed both T1 and T2 was reduced to 150, meaning around 48% drop out until the final stage. This sample of ETP participants had an average age of 52 years, a higher income and higher education level than the average Dutch population, and consisted of 85% women.

Comparison group
The comparison group was also surveyed at the same longitudinal basis regarding only eight specific behaviors among the annual panel of 1500 respondents of Dutch population. In order to equalize the initial performance (in terms of M and SD) at T0 over a Pro-environmental Behavior Index (PBI)\(^{30}\) of the EcoTeams and control group a subsample of 332 was taken from the panel, which was studied also in following periods T1 and T2. No drop out was reported in the survey description.

The main body of the questionnaires administered to EcoTeam participants at T0, T1, and T2 was identical. At each phase, the survey contained questions about the performance of a series of 38 specific environmental household behaviors, measures of intention, perceived behavioral control, and habit strength for one of these behaviors, and registration forms for the weight of solid waste disposed of and the amount of gas, electricity, and water consumed during a 2-week period.

\(^{30}\) PBI is created from the set of eight pro-environmental behaviors: separation of organic waste from solid waste, having dirty laundry until the washing machine can be fully loaded, leaving the faucet running while doing the dishes, bringing a shopping bag from home when going shopping, using unbleached coffee filter bags, using detergents in refill packaging, using unbleached toilet paper, and refusing plastic bags or wrappings offered by shopkeepers. Scores on these 8 items, all on 7-point Liker-type scales ranging from 1 (never) to 7 (always) were averaged.
4.6.3 Results

The survey observations show considerable and significant improvement of the environmentalism in household behavior. The tables showing changes regarding the estimated behaviors can be found in the appendix to the thesis. The performance improvement in general had also a long-term effect. As regards the energy consumption, respondents consumed in later period T2 in comparison to T0 7.6% less electricity and 16.9% less gas.

![Graph 6](image)

**Graph 6** Staats et al (2004). Mean scores of ETP Participants and Nonparticipants on the Pro-environmental behavior Index (PBI) Across the Phases of the Study

The similar results under the scope of EcoTeam Program are reported in the USA, reporting 41-51% less garbage sent into the waste stream, 25-34% less water used, 17% less energy used, 16-20% less fuel used for transportation\(^{31}\). The EcoTeams site covering activity in UK informs about reduction of rubbish by 20%, more recycling and improvement in energy and water management, cut of CO2 emission by 17% among participants\(^{32}\).

---


\(^{32}\) [http://ecoteams.org.uk/](http://ecoteams.org.uk/)
Such change in behavior is consistent with the group dynamics discussed. Yet there are alternative interpretations necessary to point out. There is still possibility that these PBI improvements were caused rather by selfish preferences (i.e. if some cost saving was realized from environmental change) though it was not directly stated whether the economic savings from environmental behavior were discussed during the group meetings. Staats et al. (2004) checked the functioning of EcoTeam on an example of travel mode behavior and tried to show intentions together with habit formation as a predictor of a change. The specific behavioral intention expressed before participation was identified to predict that respondents would change from cars to more environmentally friendly means of transport for short distances. In addition the ones “who reported strong social influence from their EcoTeam members, social interaction with EcoTeam members appeared to have resulted in intentions predictive of pro-environmental behavior change, irrespective of the degree to which habits were consolidated.” Though detailed study only of one behavior does not allow considering social factor and intentions as reason for the change.

At the same time the considerable drop-out should be mentioned. The data can be biased due to the absence of information about respondents who split off. It can be the case that the ones who dropped the program did it due to their unwillingness to keep on behaving environmentally and poor performance. Plus the initially recruited participants ready to participate in the survey can be considered as already pro-environmentally intended. Thus intervention policy could be a success due to high warm glow of donation present in the sample. And the comparison group from this point of view might not be initially so pro-environmental.

Though the EcoTeam program illustrates the implementation of the group approach in action, there are still areas requiring more research. There should be more evidences about the effect of social mechanisms in a group on the behavioral improvement, and the influence of group setting on the individual preferences. The results at least do not go opposite the idea that the combination of the methods used in previous campaigns, predictions from various experiments and group setting can be used in achieving environmental goals.
5 Conclusion

The results from a number of behavioral experiments aimed to test the cooperation conditions in a group provide a good insight for policy makers. Preferences of an individual are affected by various social factors like norms and reciprocity. The classical prisoner’s dilemma cited as an example of common pool resource exploitation problem provides game theory’s prediction about “the defection” as the best strategy. Yet it was observed that people did cooperate, both historically in terms of using some common resource, and experimentally in groups. Applying the experimental setting aimed at increasing the social norms effect (i.e. using smaller groups, encouraging communication, provision of feedback) can theoretically increase the cooperation rates inside a group.

Gathering the previous achievements in experimental and behavior economics with application of insights from social sciences provides an idea for policy makers about the group approach to promote environmentally friendly behavior among the population. Using neighborhood selection of people residing or working close to each other, in this way taken as partners in a repeated game, providing them with feedback and benchmark information, arranging regular meetings (taken as pre-decision communication and covenants, plus opportunity to punish defectors via social disapproval) were stated to have a large potential to help individual improve environmentally friendly performance and to sustain it in a long term. EcoTeam program provided an illustration of how this approach can be implemented in a real-life.

Talking about the policy instrument it is necessary to compare its costs and benefits. The benefits that can be acquired for the society in general are lower resource requirements for the energy production and less CO₂ emissions. Worth noticing, that the return from the energy conservation in terms of global climate consequences of it are not felt by individuals and enjoyed in terms of the utility, and internalization of it can compensate lower energy consumption. The costs of the discussed policy will include initial consultation, creation of the benchmarking system with the group setting. The main trait of such policy though is that the individuals in groups are expected to handle their behavior on their own without strict external intervention. So the follow-up costs will include only monitoring of the energy
consumption and other environmental indexes and maintaining the system. As it was shown the utility sacrifice of individual for higher public good provision can be compensated both directly (as it is done nowadays regarding recycling of the packaging) and via social factors affecting utility (like groups competition, team feeling, prizes for best conservators). In other words the cost of an individual to be involved into such policy can be presented as a compensation for his loss in the utility.

Repeating again, such intervention policy should in first place provide supportive help to the neighborhood avoiding external rules settings, sanctioning or strict standards. The social norms principle will work in case of strong intrinsic motivation and the groups could be provided with freedom to set their own rules. This idea requires much deeper discussion about the role of government in the population’s decision making. Any attempt to amend the preferences on a larger scale can be considered as intervention to private life and personal freedom. In spite of these nuances to be considered by the policy makers, the group approach can help to avoid one of the main shortcomings of intervention policies in past decades: a very limited duration of pro-environmental change. Yet additional field research is required to estimate specifically how group setting affects the personal decision making regarding energy conservation and other environmental behaviors, and how strong the social pressure, policy advice and compensations should be to avoid the crowding-out effect.
6 Literature list


Aristotle, Politics, Book II, Chapter 3.


www.empowermentinstitute.net/files/Chapter5.pdf


European Environmental Agency, Household Energy Consumption.
http://ims.eionet.europa.eu/Sectors_and_activities/households/indicators/energy


Nyborg, K., lecture notes, (2009), Reciprocity, ECON4260, University of Oslo.


Staats Henk, Harland, Paul: Effectiveness of The EcoTeam Program in the Netherlands: A Long Term View.
http://www.globalactionplan.nl/upload/docs/samenvatting_onderzoek_rul_naar_effectiviteit_ecoteam_programma.doc


Internet links

European Environmental Agency
http://ims.eionet.europa.eu/

Eurostat by European Commission
http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/

Global Action Plan Organization
http://www.globalactionplan.com

UK EcoTeams Program
http://ecoteams.org.uk/

World Energy Outlook by International Energy Agency (IEA)
http://www.worldenergyoutlook.org/
APPENDIX. (Performance evaluation of Dutch EcoTeam Program) according to Staats et al. (2004).

<table>
<thead>
<tr>
<th>Environmental Behaviors in the Household, Performance at Time T0, T1, and T2</th>
<th>T0</th>
<th>T1</th>
<th>T2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separation of organic waste from solid waste (PBI)</td>
<td>5.96a</td>
<td>6.68b</td>
<td>6.74b</td>
</tr>
<tr>
<td>Separation of textile waste from solid waste</td>
<td>6.17a</td>
<td>6.77b</td>
<td>6.68b</td>
</tr>
<tr>
<td>Composting your organic waste</td>
<td>3.77</td>
<td>3.78</td>
<td>4.07†</td>
</tr>
<tr>
<td>Did you put aluminum foil behind central heating radiators where possible?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1 = nowhere, 4 = everywhere)</td>
<td>1.59</td>
<td>1.63</td>
<td>1.74†</td>
</tr>
<tr>
<td>Did you put insulation material around the pipes of your central heating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>system, apart from the rooms, in the corridors? (1 to 4)</td>
<td>2.87</td>
<td>2.94</td>
<td>2.87†</td>
</tr>
<tr>
<td>Do you have double glazed windows in your house? (1 to 4)</td>
<td>2.93</td>
<td>2.96</td>
<td>3.07†</td>
</tr>
<tr>
<td>Are the outer walls of your house insulated? (1 to 4)</td>
<td>2.27</td>
<td>2.23</td>
<td>2.26†</td>
</tr>
<tr>
<td>To what temperature do you set your central heating? (°C)</td>
<td>18.69a</td>
<td>18.27b</td>
<td>18.19b</td>
</tr>
<tr>
<td>Do you have lights burning in nonoccupied rooms?</td>
<td>2.79a</td>
<td>2.39b</td>
<td>2.37b</td>
</tr>
<tr>
<td>Is your television set on “off” instead of on “standby”?</td>
<td>5.10a</td>
<td>5.55b</td>
<td>5.85c</td>
</tr>
<tr>
<td>Do you save your dirty laundry until you can load your washing machine fully</td>
<td>6.11a</td>
<td>6.34b</td>
<td>6.54c</td>
</tr>
<tr>
<td>(PBI)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To what temperature do you set your water heater? (°C)</td>
<td>70.83</td>
<td>69.66</td>
<td>66.83†</td>
</tr>
<tr>
<td>How many energy-saving light bulbs do you use? (no.)</td>
<td>2.83a</td>
<td>3.72b</td>
<td>4.32c</td>
</tr>
<tr>
<td>Do you close the faucet while washing hands?</td>
<td>2.82a</td>
<td>4.26b</td>
<td>4.77c</td>
</tr>
<tr>
<td>Do you close the faucet while doing the dishes? (PBI)</td>
<td>5.83a</td>
<td>6.15b</td>
<td>6.38c</td>
</tr>
<tr>
<td>Do you close the faucet while brushing your teeth?</td>
<td>5.36a</td>
<td>5.95b</td>
<td>5.91b</td>
</tr>
<tr>
<td>How often do you take a bath? (1 = daily, 6 = &lt;2 weekly)</td>
<td>5.20</td>
<td>5.32</td>
<td>5.35†</td>
</tr>
<tr>
<td>How often do you take a hot shower? (1 = &gt; daily, 5 = &lt; weekly)</td>
<td>2.17</td>
<td>2.19</td>
<td>2.32†</td>
</tr>
<tr>
<td>How long are you showering? (1 = &lt; 3 min., 5 = &gt; 20 min.)</td>
<td>3.66a</td>
<td>2.97b</td>
<td>2.98b</td>
</tr>
<tr>
<td>Is there a low-flow showerhead installed in your shower? (1 = no, 2 = yes)</td>
<td>1.37a</td>
<td>1.56b</td>
<td>1.64c</td>
</tr>
<tr>
<td>Did you reduce the volume of the toilet flusher? (1 to 2)</td>
<td>1.06</td>
<td>1.13</td>
<td>1.14†</td>
</tr>
<tr>
<td>How many toilets in your house have a toilet dam installed? (no.)</td>
<td>0.56a</td>
<td>0.76b</td>
<td>0.88c</td>
</tr>
<tr>
<td>Do you engage in carpooling?</td>
<td>1.73</td>
<td>2.05</td>
<td>2.03†</td>
</tr>
<tr>
<td>Question</td>
<td>T0</td>
<td>T1</td>
<td>T2</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>What is your regular speed on roads where 120 km/h is the speed limit? (km/h)</td>
<td>112.41</td>
<td>111.37</td>
<td>110.49†</td>
</tr>
<tr>
<td>On average, how much fuel does your car use? (km/l)</td>
<td>13.71</td>
<td>13.99</td>
<td>13.62†</td>
</tr>
<tr>
<td>To travel distances less than 5 km do you use alternatives for the car (or motorbike)?</td>
<td>4.63&lt;sub&gt;a&lt;/sub&gt;</td>
<td>5.14&lt;sub&gt;b&lt;/sub&gt;</td>
<td>4.90&lt;sub&gt;b&lt;/sub&gt;</td>
</tr>
<tr>
<td>How often do you eat a dinner without meat?</td>
<td>2.70&lt;sub&gt;a&lt;/sub&gt;</td>
<td>3.12&lt;sub&gt;b&lt;/sub&gt;</td>
<td>3.32&lt;sub&gt;b&lt;/sub&gt;</td>
</tr>
<tr>
<td>How much meat do you eat for dinner? (grams)</td>
<td>97.02&lt;sub&gt;a&lt;/sub&gt;</td>
<td>87.36&lt;sub&gt;b&lt;/sub&gt;</td>
<td>94.88&lt;sub&gt;a,b&lt;/sub&gt;</td>
</tr>
<tr>
<td>How often do you eat organically grown food?</td>
<td>3.81</td>
<td>4.03</td>
<td>4.06†</td>
</tr>
<tr>
<td>How often do you eat...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deep frozen vegetables?</td>
<td>2.79&lt;sub&gt;a&lt;/sub&gt;</td>
<td>2.41&lt;sub&gt;b&lt;/sub&gt;</td>
<td>2.42&lt;sub&gt;b&lt;/sub&gt;</td>
</tr>
<tr>
<td>Canned vegetables?</td>
<td>2.06</td>
<td>1.85</td>
<td>1.90†</td>
</tr>
<tr>
<td>When you go shopping do you bring a shopping bag from home? (PBI)</td>
<td>6.55</td>
<td>6.73</td>
<td>6.71†</td>
</tr>
<tr>
<td>How often do you use...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detergents in refill packaging? (PBI)</td>
<td>4.31&lt;sub&gt;a&lt;/sub&gt;</td>
<td>5.16&lt;sub&gt;b&lt;/sub&gt;</td>
<td>6.02&lt;sub&gt;c&lt;/sub&gt;</td>
</tr>
<tr>
<td>Unbleached toilet paper? (PBI)</td>
<td>4.99</td>
<td>5.23</td>
<td>4.89†</td>
</tr>
<tr>
<td>Unbleached writing paper?</td>
<td>3.75</td>
<td>4.34</td>
<td>4.00†</td>
</tr>
<tr>
<td>Unbleached coffee filter bags? (PBI)</td>
<td>5.76&lt;sub&gt;a&lt;/sub&gt;</td>
<td>5.83&lt;sub&gt;a&lt;/sub&gt;</td>
<td>6.20&lt;sub&gt;b&lt;/sub&gt;</td>
</tr>
<tr>
<td>Do you refuse plastic bags or wrappings of shopkeepers for environmental reasons? (PBI)</td>
<td>4.93&lt;sub&gt;a&lt;/sub&gt;</td>
<td>5.40&lt;sub&gt;b&lt;/sub&gt;</td>
<td>5.45&lt;sub&gt;b&lt;/sub&gt;</td>
</tr>
<tr>
<td>Are you inclined to repair products or have them repaired instead of buying them new?</td>
<td>5.47</td>
<td>5.68</td>
<td>5.75†</td>
</tr>
</tbody>
</table>

**NOTE:** °C = Celsius; min. = minutes; km/h = kilometers per hour; km/l = kilometers per liter. Behaviors followed by (PBI) make up part of the Proenvironmental Behavior Index. Unless indicated otherwise, scales run from 1 (never) to 7 (always). Means in the same row with different subscripts differ at p < .05 in the t test comparisons. †Overall F test nonsignificant at p < .001.
<table>
<thead>
<tr>
<th></th>
<th>T0</th>
<th>SD</th>
<th>T1</th>
<th>SD</th>
<th>T2</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid waste deposition (kg per person per day)</td>
<td>0.216&lt;sub&gt;a&lt;/sub&gt;</td>
<td>0.15</td>
<td>0.153&lt;sub&gt;b&lt;/sub&gt;</td>
<td>0.12</td>
<td>0.145&lt;sub&gt;b&lt;/sub&gt;</td>
<td>0.12</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td></td>
<td>−28.5%</td>
<td></td>
<td>−32.1%</td>
<td></td>
</tr>
<tr>
<td>Natural gas consumption (m&lt;sup&gt;3&lt;/sup&gt; per person per degree day)</td>
<td>0.299&lt;sub&gt;a&lt;/sub&gt;</td>
<td>0.21</td>
<td>0.237&lt;sub&gt;b&lt;/sub&gt;</td>
<td>0.18</td>
<td>0.248&lt;sub&gt;b&lt;/sub&gt;</td>
<td>0.18</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td></td>
<td>−20.5%</td>
<td></td>
<td>−16.9%</td>
<td></td>
</tr>
<tr>
<td>Electricity consumption (kWh per person per week)</td>
<td>27.2&lt;sub&gt;a&lt;/sub&gt;</td>
<td>15.4</td>
<td>25.9&lt;sub&gt;ab&lt;/sub&gt;</td>
<td>15.6</td>
<td>25.1&lt;sub&gt;b&lt;/sub&gt;</td>
<td>14.3</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td></td>
<td>−4.6%</td>
<td></td>
<td>−7.6%</td>
<td></td>
</tr>
<tr>
<td>Water consumption (m&lt;sup&gt;3&lt;/sup&gt; per person per week)</td>
<td>0.854&lt;sub&gt;a&lt;/sub&gt;</td>
<td>0.38</td>
<td>0.830&lt;sub&gt;ab&lt;/sub&gt;</td>
<td>0.38</td>
<td>0.796&lt;sub&gt;b&lt;/sub&gt;</td>
<td>0.33</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td></td>
<td>−2.8%</td>
<td></td>
<td>−6.7%</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** kg = kilograms; m<sup>3</sup> = cubic meters; kWh = kilowatt-hours. Means in the same row with different subscripts differ at p < .05 in the t test comparisons.