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Implementing the BioBlend

An Evaluation of Two Technical Applications

Master's thesis in Product Development

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CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2018

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ABSTRACT

The BioBlend is a device designed to keep the food waste processed in a garbage disposal separated from the wastewater (Silva et al. 2016). If the bio-waste is mixed with the wastewater, chemicals used in wastewater treatments systems have an inhibitory effect on the production of biogas (Hamilton 2017). This project has been focused on evaluating a prototype of the BioBlend by installing it in a kitchen at the HSB Living Lab, and the user's experience of using the BioBlend has been investigated thru in-depth interviews. An impact analysis of the BioBlend has also been performed, with a focus on economics and environmental impact. In conclusion, the BioBlend is faced with economic challenges, since its energy potential is relatively low. Certain aspects of the BioBlend require further research, such as its eutrophic impact or the effect the BioBlend might have on the overall environmental consciousness of the user. Cost reduction and focus on the user experience is likely to be key areas for future development of the BioBlend. Co-digestion of alternative bio-waste sources may enhance the performance of an HIB-system.

ACKNOWLEDGEMENTS

This project has been assisted by the staff at HSB Living Lab, most of all Shea Hagy and Amanda Sandquist. The input from the project supervisor, Isabel Ordonez Pizarro and the project examiner, Helena Strömberg has also been of great assistance. Also, this project would not have been possible without the participation from the tenants at HSB Living Lab.

Thanks for your support.

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GLOSSARY

CC	Centralized composting
CD	Codisposal
GDU	Garbage disposal unit
HC	Home composting
HIB	Household Integrated Bio-Waste Treatment System
HLL	HSB Living Lab
TAM	Technology Acceptance Model
UTAUT	Unified Theory of Acceptance and Use of Technology

1 INTRODUCTION

The world faces a growing need to move to a more sustainable society and the concept of the Circular Economy, where prevention of waste is central, is becoming increasingly important (Markard et al. 2012; Geissdoerfer et al. 2016). The Swedish government has a goal that by 2018, 50% of all biodegradable waste (bio-waste) generated from households, institutional kitchens, shops and restaurants shall be sorted for biological treatment, and in 2014 households generated 74% of all bio-waste. In 2014, 25% of household generated bio-waste were sorted properly (Naturvårdsverket 2016b; Naturvårdsverket 2016a). Following technology acceptance models, the perceived ease of use of a technology has a positive effect on the user's acceptance of the technology (Davis 1989). As the use of an in-sink garbage disposal (GDU) may simplify the process of sorting the bio-waste it is possible that this technology can be used to increase the amount of bio-waste sorted, and thus working towards the national goal.

GDUs are commonplace in the U.S., where over 50% of all households have a unit installed (US Census Bureau 2013). However, when a conventional GDU is used, the bio-waste is mixed with the wastewater. Chemical cleaners often used in wastewater treatment systems (USALCO 2017) have been found to have an inhibitory effect on the production of biogas in biogas digesters (Hamilton 2017; Silva et al. 2016). A prototype for a GDU with this function (the BioBlend) has been developed at Rice University (Silva et al. 2016).

In several Swedish cities, household food waste is sorted into brown paper bags and collected by garbage trucks, to be used for the production of biogas (Stockholm vatten och avfall 2016; Uppsala vatten och avfall AB 2016; Kretslopp och vatten 2017). An alternative way to manage bio-waste is the use of small-scale biogas digesters. For this purpose, a textile biogas digester unit aimed at single households or smaller apartment buildings has been developed in collaboration between the University of Borås (UB) and FoV Biogas (Rajendran et al. 2013). Using the bio-waste for local biogas production in a digester unit may have a positive effect on the perceived benefit of sorting food waste.

Combining these two systems, the BioBlend and the biogas digester could create a closed system for single households or buildings, where the bio-waste is immediately used in a closed-loop system. Such a household integrated bio-waste treatment system (HIB) could make bio-waste sorting easier for the user while simultaneously creating a more apparent benefit of bio-waste sorting. This should, following the technology acceptance model, have a positive effect on the acceptance of the technology (Davis 1989), and hopefully increase the amount of bio-waste sorted.

1.1 THE BIOBLEND

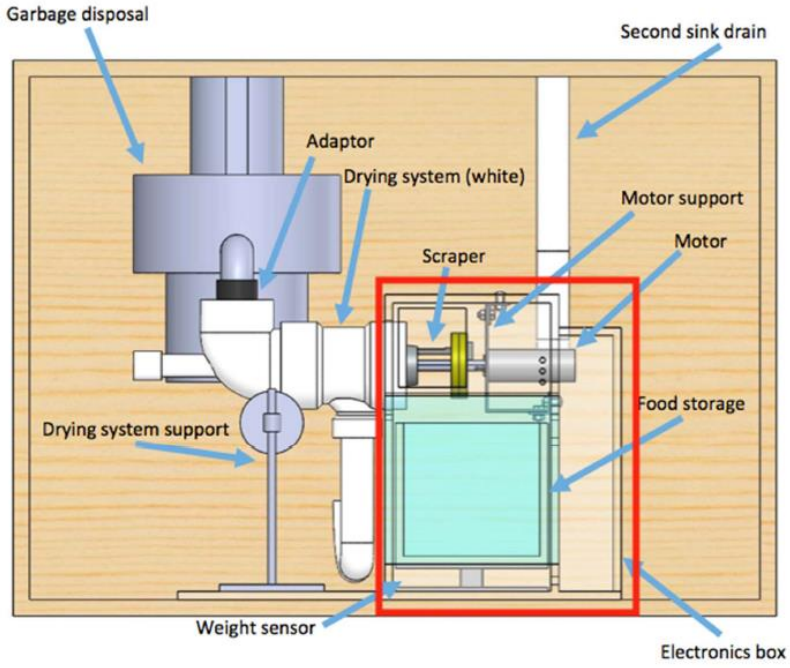

Figure 1 – basic description of the BioBlend and a GDU (Silva et al. 2016)

The BioBlend, illustrated in Figure 1, is a device designed to separate bio-waste from wastewater, to produce a product that is better suited to produce biogas. The BioBlend is designed to be installed in a kitchen, under the sink. The BioBlend requires a GDU and is designed as an add-on to an existing GDU (Silva et al. 2016). In this report, two different implementations of the BioBlend is discussed. In one configuration, the BioBlend and a GDU is used together, but without being connected to any additional systems. In this configuration, the user would process food waste into the GDU, and the processed waste would be collected into a storage bin in the BioBlend. The user would then be required to empty the storage bin. The BioBlend is designed to automatically turn on and off, warn the user when the bin in full and to measure the weight of the collected waste (Silva et al. 2016). A functional model of the BioBlend in this configuration is illustrated in Figure 2.

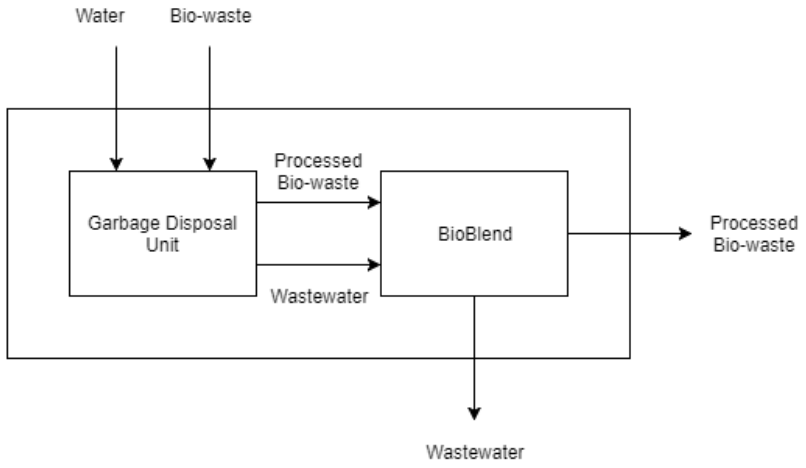

Figure 2 – Functional model of the BioBlend and a GDU

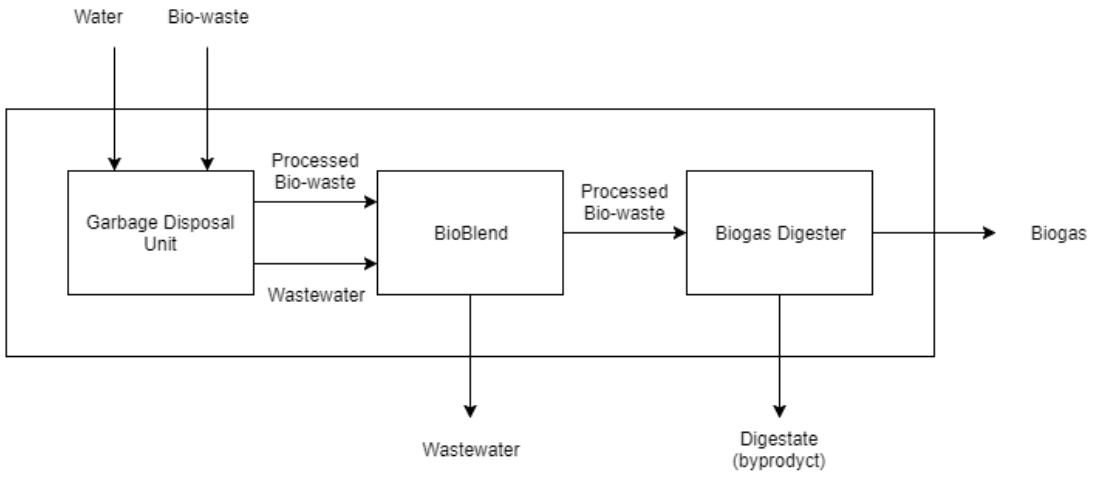

Figure 3 – Functional model of an HIB-system composed of a GDU, the BioBlend and a biogas digester

The other configuration of the BioBlend that is discussed in this report is to install the unit connected to a biogas digester and thus creating an HIB-system (illustrated in Figure 3). This is also the original intent of the BioBlend. In this configuration, the operation of the BioBlend is similar to that of a conventional GDU. Food waste is fed into the GDU, and the BioBlend will automatically start and stop. The BioBlend would not have a storage bin, as the processed waste would be sent to a biogas digester (Silva et al. 2016).

Compared with brown paper bags commonly used for bio-waste recycling in Sweden, the BioBlend produces a dryer and more compact bio-waste, while also storing the bio-waste in a sealed environment, when used without a biogas digester. This have the effect of (1) reducing the frequency of which bio-waste need emptying, (2) reduce risk of wet, messy bags, (3) reduce risk of unpleasant odors and (4) reduce the risk of bugs, such as fruit flies (Silva et al. 2016).

Furthermore, the BioBlend provides a solution that may make it possible to install GDUs in areas where such units are not allowed.

1.2 Aim

This project has aimed to investigate two different technical applications of the BioBlend; the BioBlend used with a GDU as a stand-alone system, and the BioBlend implemented in an HIB-system. The project has investigated these applications with regards to the potential value (both energy potential and ease of use). The main focus has been on the investigation of the BioBlend as part of an HIB-system, with the investigation of a simpler implementation (only the BioBlend + GDU) as a second priority.

As this project has been focused on the BioBlend, no effort to investigate the usability of a biogas digester unit have been made.

1.2.1 Research Questions

The project has aimed to answer the following questions:

- How, and to what extent, does the use of an in-sink garbage disposal unit affect bio-waste sorting levels?
- Does an HIB-system provide a net environmental benefit?
- Is the BioBlend likely to be accepted, and if not, what is needed for user acceptance of the technology?

1.3 DELIMITATIONS

Since this project has focused on evaluating the potential benefit of the HIB-system, the project has not included any technical development or redesign of the units.

Since this project has been specifically aimed at investigating the possible benefits of two different systems utilizing the BioBlend, the project excluded the investigation of other technologies that may provide similar benefits.

The project has focused on the application of the BioBlend in household environments and has not investigated any uses of the technology outside of this environment.

The project has had access to one BioBlend unit, with the possibility to install the unit in the HSB Living Lab.

The project had an estimated timeframe of 20 weeks.

1.4 OUTLINE OF THE REPORT

In the 2nd chapter of this report the theory that was used for the analysis of the experiments is presented. The 3rd chapter describes the overall process of the project, and the 4th chapter presents the experiment findings based on the theory previously explained. Chapter 5 presents an analysis of the potential economic and environmental impact of the BioBlend and HIB-systems. Chapter 6 discuss this analysis and the experiment findings, and based on that gives recommendations for future work. Chapter 7 focuses on a few conclusions regarding the execution of the project.

2 THEORY

Several theories regarding the implementation of a new technology have been developed, and this chapter examines a few core values from the Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology (UTAUT) and Rogers Diffusion of Innovation.

These models have been analyzed as a way to understand how to successfully penetrate the market with the BioBlend. Actual implementation of the technology is critical if the product is to have a positive environmental effect. The theories have also been analyzed in order to understand how to ensure usage of the BioBlend, once implemented, as any environmental effect of the system is reliant on the usage of the system.

2.1 TECHNOLOGY ACCEPTANCE MODEL

Per TAM, the actual use of a technology is directly related to the user's attitude towards using the technology. The attitude towards the technology and the actual use are linked by the behavioral intention to use (BI), and the user's attitude is defined by the perceived usefulness of the technology (U) and the perceived ease of use of the technology (E). The model defines this relationship as BI = U + E. This relationship is also illustrated in Figure 4 (Davis et al. 1989).

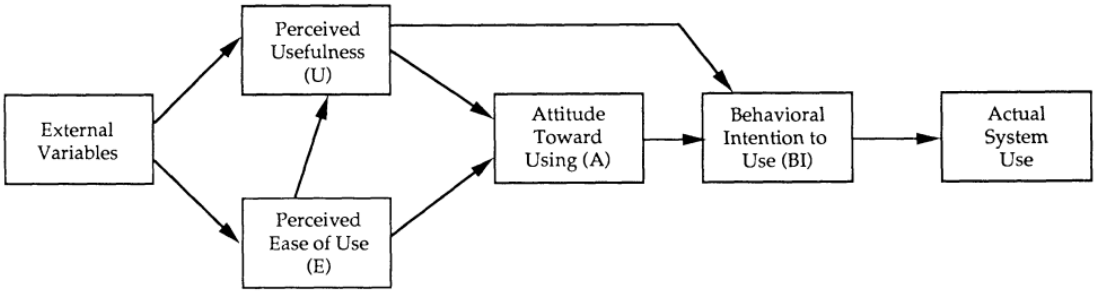

Figure 4 – Technology Acceptance Model (TAM) (Davis et al. 1989)

In the development of TAM, it was shown that the perceived benefit of a technology is of greater significance towards the user's attitude than the perceived ease of use when examining professional tasks (Davis 1989). It should also be noted that while TAM was developed as a tool to evaluate software, the theory has been commonly accepted to be applicable to general cases (Davis 1989; Davis et al. 1989).

2.2 USER ACCEPTANCE AND USE OF TECHNOLOGY

UTAUT is developed as an acceptance model based on several pre-existing models. Similar to TAM, the perceived effort required to use a technology is theorized to impact the use of the technology. UTAUT does, however, make the distinction between first-time use period and sustained usage, stating that expected ease of use becomes nonsignificant over time (Venkatesh et al. 2003).

UTAUT also explores the influence of social beliefs, and how they impact behavior. The model theorizes that, in a voluntary context, an individual will be affected by how he or she believes others will perceive them for using the technology, and the model claims that the individual tends to comply with the social demands (Venkatesh et al. 2003).

2.3 ROGERS DIFFUSION OF INNOVATION

E. M. Rogers defines diffusion of an innovation as the process where information about an innovation is spread thru a social structure. According to Rogers, this information exchange is required for an innovation to be implemented on any scale. In this theory, an innovation is defined as a technology that is received as new by the individual adopting the innovation. Whether or not the technology actually is new is irrelevant when one is observing human behavior (Rogers 1983).

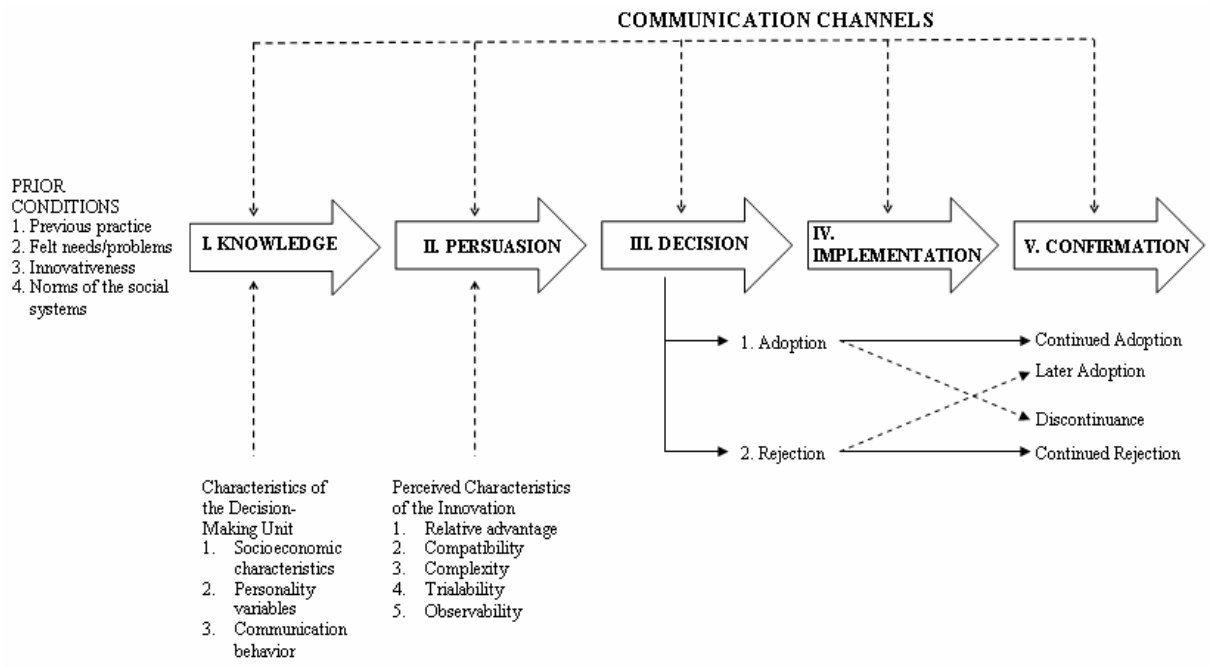

Figure 5 -The innovation-decision process (Rogers 1983)

Rogers also describes the process where an individual decides to adopt a technology or not. He calls this the innovation-decision process, and it is described in Figure 5. The five stages in the process describes when the individual (1) is made aware of the existence of the technology, (2) forms an attitude towards the technology, (3) decides to adopt or reject the technology, (4) begins usage of the technology and (5) seeks to confirm any previous decision in this process (Rogers 1983).

In the persuasion stage, the individual will seek (or unintentionally gain) information regarding the technology. This is often related to the possible advantages and/or disadvantages associated with the technology, and information gained from near-peers is typically valued higher. Also, innovations differ in that some are described as preventative, meaning that the purpose of the innovation is to avoid an unwanted certain future scenario. These innovations will typically result in the individual having a lower motivation to adopt the technology. This lowered motivation can be countered by a cue-to-action, where an acute event brings new attention to the problem. The cue-to-action can, for example, be a change of rules by a governing organ (Rogers 1983).

2.4 SUMMARY

The theories analyzed in this chapter present a few ideas that are easily applicable to the BioBlend. Both TAM and UTAUT highlights the effect of both perceived usefulness and perceived ease of use on actual usage. UTAUT, however, makes the distinction that perceived ease of use becomes less important once regular usage is achieved. The Diffusion of Innovations theory highlights the difference in a preventative technology and a non-preventative, and how preventative technologies has the effect of a lowered degree of motivation to adopt the technology for the intended user, but that this can be countered with a 'cue-to-action' event. The BioBlend can, to a large degree, be

considered a preventative technology, as it is primarily a technology meant to reduce the environmental impact of household waste management. All three theories highlight the importance of the perceived benefit associated with a technology, and often the case is made that this is of greater importance than the perceived ease of use. Finally, the Diffusion of Innovations theory argues that most users tend to place the highest value on information received from near peers, and UTAUT argues that individuals tend to comply with social demands (Davis et al. 1989; Davis 1989; Venkatesh et al. 2003; Rogers 1983; Silva et al. 2016).

3 METHOD

The execution of this project has been divided into two parts;

- a user study where the effect of the BioBlend on bio-waste sorting levels and the acceptance of the technology have been examined
- a literature study where the potential economic and environmental impact of the BioBlend have been examined

The user study was preceded by a mapping of the demographics of the participants thru a questionnaire. During the study, information regarding the performance of the BioBlend was collected thru an error log, kept by the research group, and a log book used by the participants. After the study, participants were asked to participate in interviews regarding their experience with the BioBlend. The information collected in these activities were organized and analyzed based on the theory described in OBSERVING THE USER EXPERIENCE (Goodman et al. 2012).

An impact analysis of the effect of the BioBlend and an HIB-system were also performed as a literature study. Evaluation of the energy potential of an HIB-system was based on the calculator provided by FoV Biogas (FoV Biogas 2015).

Data and information from both the user study (with surrounding activates) and the impact analysis were used as a base for the discussion, and the data was related to the frameworks presented in Chapter 2.

3.1 USER STUDY SET-UP

The user experiment was conducted in the HSB Living Lab (HLL). HLL is a combined research facility and apartment building. Part of HLL is dedicated to student apartments. These apartments are grouped into clusters of six apartments each, and each cluster has a shared area with kitchen, living room, bathrooms, and a balcony (HSB 2017).

The BioBlend was installed in one of these clusters at HLL. Only the BioBlend (with a GDU) have been used in this project, and thus no installation of a biogas digester to create an HIB-system took place. In an introduction meeting, the participants in the study were informed about the BioBlend that were to be installed in the kitchen. No information regarding further implementation, or simulation, of an HIB were given, as the execution of these elements were still undecided.

Participant selection for this study was not performed by the research group, instead being done by staff at HLL. Access to HLL for execution of the experiment was given as part of the thesis proposal. Due to restricted access to prototypes of the BioBlend (only one were provided) and time restrictions, the number of participants in the study was limited to those of a single HLL cluster. For a cluster to be selected for this study, two criteria had to be met:

- All the tenants in the cluster had to agree to participate, as a result of the home-invasive nature (replacing part of the kitchen equipment) of the experiment.
- No other experiment interfering with the BioBlend experiment could take place at the same time in the selected cluster

While each cluster contains six apartments, the cluster appointed to this project by HLL staff had five tenants during the experiment period. These five tenants represent all the participants in the user study.

The participants were told to use the BioBlend in their daily life but were instructed not to empty the BioBlend, as this was performed by the research group. This was done partly to enable the research group to monitor the amount of bio-waste sorted in the BioBlend (by weighting the bio-waste at each waste collection), but also to closer emulate an HIB-system where the user would not have to empty the bin. The BioBlend, as installed in the HLL kitchen, is pictured in Figure 6.

Figure 6 - The BioBlend installed at HLL

3.2 PRE-EXPERIMENT

Prior to installing the BioBlend, the experiment had a baseline period. This did not involve any alteration to the kitchen in HLL, but the amount of sorted bio-waste was monitored by collecting the sorted bio-waste in the kitchen and weighing it. The waste was collected and measured three times per week. The baseline period was performed to enable comparisons with the amount of sorted bio-waste during the experiment. Weight corrections were needed, as the BioBlend affects the water content in the bio-waste. This was to be performed after the experiments but was excluded due to reasons discussed in Chapter 4.

During the baseline period, the participants were also asked to answer an online questionnaire. The questionnaire mapped the demographics of the participants, asked questions about their current habits and experiences surrounding food waste management and any previous experience with a GDU. For all the questions used in the questionnaire, see Appendix A.

3.3 DURING THE EXPERIMENT

During the experiment, weight data for the accumulated bio-waste were collected following the same procedures as during the baseline period. No weight corrections were required for these measurements, as the collected waste already had been processed by the BioBlend.

Errors and problems with the BioBlend were recorded by the research group in an error log, see Appendix B for detailed information regarding the specific malfunctions.

The participants were also encouraged to record any thoughts, problems or reactions related to the BioBlend in a logbook during the experiment. The logbook was placed next to the kitchen sink for easy access.

3.4 INTERVIEWS AND ANALYSIS

The qualitative data from the user experiment was collected and analyzed based on the theory described in OBSERVING THE USER EXPERIENCE. In short, the process consisted of in-depth interviews with the participants (tenants at the HSB Living Lab), transcription and translation of the data from the interviews, organization of the data according to patterns and themes, and using the data in the creation of personas and as a base for discussion (Goodman et al. 2012).

The post-experiment interviews aimed to explore the more complex data regarding the experiment, such as the opinions and experiences of the interviewees. The face-to-face interviews, performed one-on-one, is a tool well suited for capturing this sort of data. The interviews were semi-structured, and an interview guide was used to guide the conversation, although the interviewees were encouraged to elaborate on their own ideas. To reduce the risk of altering the data in the later analysis, and to retain the maximum amount of data, each interview were recorded (Denscombe 2014; Taylor et al. 2015). During the interviews, the interviewee was asked questions about how the system they had been using compares to the conventional system with brown paper bags, what they thought of the two concepts utilizing the BioBlend proposed in this report, and what they thought about the relocation of the biogas production to the individual household. For the complete interview guidelines used, see Appendix C.

The data was organized by breaking up the data into smaller units. These units were then sorted into groups and coded (labeled). Based on the frameworks presented in Chapter 2, the following labels were created:

- Economic benefit
- Environmental benefit
- Ease of use
- Knowledge & information
- Alternative technologies/methods
- Prototype

Economic benefits represent a non-preventative area for a perceived benefit of the BioBlend, while the environmental benefit represents an area of preventative benefits. These two labels, coupled with the ease of use label, represent the basics of how technology acceptance is increased, per TAM and UTAUT. The three remaining labels were used to gain knowledge around preferred methods and to be able to separate the issues that were specific to the prototype of the BioBlend, and not to the product concept.

The reorganizing and labeling were performed digitally since this allowed for simple iteration and easy manipulation. It also had the advantage of simplifying the presentation of the data in this report. The disadvantages associated with digital tools for this work are the difficulties to use in groups and the unpractical handling of photographs (Goodman et al. 2012). These disadvantages were considered minor or irrelevant since this has been a project mostly performed by one person and the use of photographs in this stage has been limited.

The qualitative data have provided the foundation for a large part of the deliverables in this project. The aim of this project has been to evaluate the two technical applications of the BioBlend, and examine the possible benefit of the systems. The interviews and experiments have provided insight

into reasons to use the BioBlend, which features that are valued and when the BioBlend might be helpful.

3.5 IMPACT ANALYSIS

The impact analysis was based on previously published literature and research regarding food waste, biogas production, and waste management. Calculations were done to evaluate the potential energy production from an HIB-system in Swedish households. The calculations were based on the information given by FoV Biogas (FoV Biogas 2015). Where assumptions had to be made, these were done in favor of high energy output, as this was decided to better illustrate the maximum potential from an HIB-system.

The impact analysis also investigated the potential environmental impact of an HIB-system, and research, where different waste management technologies were compared to each other, were used as a base for this section.

4 FINDINGS

The findings from the experiment at HLL, with the surrounding interviews and questionnaire, are presented in this chapter.

4.1 MAPPING THE PARTICIPANTS

The participants in the study were asked to fill out a questionnaire early in the project. This was done to map the demographics of the group, their current habits regarding food waste and any possible previous experience with in-sink garbage disposals. The group consisted of equal parts men and women, all were students and the median age was 22 years. All the respondents claimed to always (or almost always) sort food waste separately, and the main reason for doing so were environmental concerns. Also, half of the respondents answered that they regularly found the handling of bio-waste to be unpleasant (smelly and messy). As the BioBlend provides a way to address this problem by reducing the mess involved with waste handling and by controlling the odors, this represents an opportunity where the BioBlend might provide a consumer benefit. The full results of the questionnaire can be found in Appendix A.

4.2 QUANTITATIVE DATA

An attempt to monitor the level of bio-waste sorted were made during the experiment. This was done by allowing the research group to be in charge of emptying the bio-waste from the BioBlend and weighing the contents each time. The data were however deemed corrupted, due to the technical problems with the BioBlend unit.

Initially, a seal in the piping between the BioBlend and the GDU broke, causing heavy leakage every time water was flushed down the drain. The automatic start and stop of the BioBlend also proved to cause problems, as these sensors were malfunctioning. A workaround with the auto-off when the waste bin is open were done, with the downside of adding an unwanted step in the operation of the BioBlend and thus lowering the ease of use. Other sensors, such as the sensor for detection of a full bin, had to be bypassed as there were preventing the BioBlend from starting.

Later in the experiment, the performance of the BioBlend was drastically lowered. The unit could not separate enough water from the processed bio-waste, and thus the water content in the waste bin was abnormally high. This caused additional leakage problems, and the participant in the study was forced to frequently interrupt their usage of the BioBlend as a result. Not only did the large water content in the processed waste cause leakage problems, but the weight of the bio-waste was abnormally high as well. The weighted waste data can be found in Table 1 and a log of the malfunctions/errors for the BioBlend can be found in Appendix B. The reason for the suddenly reduced performance of the unit is unknown.

No data were collected in the log book provided to the participants, as none of them used this.

Table 1 – Waste weight data during the baseline period (CC) and BioBlend experiment.

Date	Weight [g]	Set-up	Comment
2017-05-03	285	CC	
2017-05-05	513	CC	
2017-05-08	162	CC	
2017-05-10	490	CC	
2017-05-15	314	BioBlend	
2017-05-16	1236	BioBlend	
2017-05-19	906	BioBlend	High weight due to large water content
2017-05-22	811	BioBlend	High weight due to large water content
2017-05-24	1254	BioBlend	High weight due to large water content
2017-05-26	747	BioBlend	High weight due to large water content

CC, centralized composting

4.3 INTERVIEWS

One-on-one interviews with some of the participants in the experiments were done. Out of the five participants in the study, only two were available for these interviews. The interviews focused primarily on the interviewees previous experience with bio-waste sorting and the experience with the BioBlend during the study. Apart from this, the participants (both those that participated in the interviews and those who did not) shared their thoughts with the research group during brief (spontaneous) meetings during the experiment.

4.3.1 Perceived Benefits, economic and environmental

The perceived benefits expected or observed by the participants were, in large, focused on economic and environmental benefits. Some focus on the individual's personal values were also observed, but this was largely tied to their desire to either save money or to reduce environmental impact. The potential economic gain presented by an HIB system received a lot of attention from the participants, and some stated that a personal economic gain was a requirement for them to be interested in the product.

> *But in the end, I must feel that I'm saving something on this, otherwise, I'm not on board. – interviewee no. 1*

> *It's a matter of scale, I think it depends on how much of what we eat can be turned into biogas and how far that goes towards heating a house. But it's a step in the right direction. And it's a source of energy that works even when it's cold outside. – interviewee no. 1*

> *Well… in the end it's still about using the waste? Here at home, I thought the idea was for us to use the waste to maybe use as manure or something else. But in a concept like that, a large centralized one, you can't do that. – interviewee no. 2*

It was also observed, both by the project group and by the interviewees (observing their roommates) that even if the HIB presented a low potential economic benefit, the system highlights the possibility of using household waste for energy production. It was theorized by some participants that this might have a positive effect on the user's behavior in a larger context.

> *I get a closeness to it. I get to feel that, alright, this can create energy at home. And thus, I'm thinking more about the value in this, and therefore I will do it more. You get a better*

understanding, and I think that it makes you want to sort more, and maybe you choose to read up on it. I think it triggers you, at least students. – interviewee no. 2

Yes, absolutely. Or it feels like it at least. Some in the kitchen haven't done so much sorting because they find it too much work. But with the BioBlend they find it easier, and they do it. So it activated them to start to think more about food waste, instead of just throwing it in the regular garbage. – interviewee no. 2

4.3.2 Ease of Use, Difficulties, and Prototype

Participants were, in general, positive towards the concept of the HIB and/or BioBlend with regards to ease of use. However, this seemed to be largely due to the garbage disposal, and not something unique to the BioBlend. However, the experiments were corrupted with frequent malfunctions in the BioBlend, causing unwanted problems for the participants (see Appendix B - Error Log BioBlend for more information). Also, the BioBlend as used in the experiment, and not in a full HIB-system, were observed to create more work for the users, compared to a conventional garbage disposal unit.

Q: Well, what do you think of using the garbage disposal?
A: It has been simple. It's just to push things down, turn on the water, and then it manages by itself. Well, if you look past the details with the bin, turning on the power and such. – interviewee no. 2

But in the beginning, it looked quite dry as far as I can remember. But later it started to be wet. At least from what I saw, when [resident no.1] introduced us to it and when I tested it myself. – interviewee no. 2

I'm spoiled to have one of these (garbage disposal) at home that's connected to the drain. So, I feed the disposal, and someone else will take care of them for me. So, I'll save a lot of steps right there. You won't have to carry the garbage down and it's simple and clean. You just put the garbage down the drain and then it's gone, there's no mess. And with the BioBlend, you first must make sure that you're doing it correctly since there have been a lot of trouble. – interviewee no. 1

4.3.3 Knowledge & Information

The issue of knowledge regarding the purpose of the BioBlend (or an HIB-system) was raised by the interviewees. As seen in some of the statements above, the BioBlend gave the participants the impression of highlighting the benefits of proper garbage disposal. However, there was a general agreement among the participants that if the BioBlend and/or HIB-system requires additional work compared to conventional food disposal systems, the benefit of the new system must be communicated to the user.

Yeah… and it's a question about information as well. I mean, you must tell me that if I do something, things will get this good, right? Sure, sure, I'll do this thing. But if I can't see the profit, then I'll just see it as work. – interviewee no. 1

4.4 PERSONAS

As an aid to future product developers or researchers working with the BioBlend, two basic personas were created. These personas were developed to better understand the potential adopters of the BioBlend, and therefore enable the product developer/researcher to better understand the desired features in the product, as this may currently be unclear. The personas were based on information gained from the interviews, presented in this chapter. The two personas represent users who would be motivated to invest in the system for different reasons; one is mainly motivated by personal perceived benefits associated with the product (economic gains and/or simplified garbage disposal)

while the other is mainly motivated by communal perceived benefits (reduced environmental impact) and self-identification. The personas are presented below.

4.4.1 Persona – Jennifer

Jennifer is 27 years old, have a job in web-design and lives in the city. She lives alone and is single, but she has a rather active social life. She prides herself as an environmentally active person, which is the main reason for her vegetarian diet.

As a young woman in with her job, Jennifer considers herself rather tech-savvy. Sure, there's always those that know a lot more than her, but she is unafraid of trying new things and have the natural ability to understand tech that comes with youth.

Jennifer is heavily involved in the environment: it's the reason for her diet, it's why she chooses to ride a bike and it's always a large influence when she purchases something. She realizes that she is an outlier, and her friends might find her a bit over-the-top at times. But for her, this is important.

As part of her efforts to improve the environment, Jennifer is always careful to sort her trash, whether it is packaging or food waste. She already sorts all her food waste, but she does find it slightly annoying. Bags tend to get wet, she's always dealing with fruit flies and her kitchen never smells fresh.

4.4.2 Persona – Dan

Dan is 52 years old. He lives in the suburbs with his two kids, aged 17 and 15, and his wife. He works as a middle-grade teacher at the local school and is generally a liked person in the local community. Like most of his old friends, he doesn't get out of the house too much these days.

When pressed on it, Dan doesn't really care that much about technology. Sure, he likes his new TV and claims that he needs the bigger screen with his reduced eye sight. But other than that, he just wants his stuff to work.

Dan is aware of the problem with the environment, but he tends to keep it at arm's length. He knows that there is a problem and that he probably should care more about the problem, but he just can't bring himself to do it. If Dan is to make any investment that might be good for the environment, he must have an economic incentive to do so as well.

In most things, Dan does what he's always been doing. He recycles his cans and bottles because the small economic incentive is enough to get him going. In recent years, however, he has actually begun to recycle his cardboard and plastic packaging. Well, for the most part. Dan doesn't want any dirty packages in the kitchen, causing bad odors and other problems.

4.5 SUMMARY

The overall response to the BioBlend, both from those that partook in the interviews and those that did not, seemed to be positive. Several people noted on the simplicity of using a GDU for waste disposal, and the reduction of messy waste handling was appreciated. However, it was noted by several participants that while it was simple for them to use the BioBlend, this was in large a result of them not having to empty the waste bin on the BioBlend. It was noted that if the user would have to do this, the BioBlend might result in a net gain of work, as the operation of a GDU can be more labor intensive than simply throwing waste in a paper bag.

Although the participants did not receive any information on pricing of the BioBlend, many of them seemed to assume that the cost of installing and operating a GDU and a BioBlend would be too high if the only gain is the simplification of waste management, as this was not seen as a large enough benefit. However, if the BioBlend could provide an economic benefit as well (in the configuration as

an HIB), this provided extra incentive, and participants stated that this was a requirement for them. The problems with the prototype unit may also have negatively affected the user experience.

While all of the participants that responded to the questionnaire claimed to sort nearly all of their food waste, parts of the interviews indicated that this may not be true for all the tenants in the cluster. Interviewees claimed that they observed an increased level of bio-waste sorting from these individuals, but due to the technical problems, this is difficult to ensure, both due to the corrupted weight data, but also due to forced interruptions in the usage of the BioBlend.

The personas were developed to illustrate the different expectations two kinds of user groups might have of the BioBlend. The first persona (Jennifer) represents a user who would invest in the BioBlend primarily for environmental reasons. For her, a simplification of the handling of food waste would not result in an increased level of sorted food waste, as she is already diligent in this. The BioBlend (or the HIB) would have to provide a net environmental benefit, which is also the main purpose of the product.

The second persona (Dan) represents a user who might not be interested in the BioBlend due to environmental reasons, but who would invest in the technology if other benefits are provided. For this user, a simplification of food waste management may or may not influence their desire to adopt the technology, as they may not have any current interest in doing so. However, if the user is currently sorting some of the food waste at home, the BioBlend may provide a large enough benefit in this area to be attractive. The most significant reasons to invest in the technology for this user would probably be the possibility of an economic benefit; this requires the BioBlend to be cheap enough to install and operate while providing a large enough economic advantage in the operation of the HIB-system. It is also worth noting that most user groups would be interested in any economic benefit from the system, as long as it is large enough.

5 IMPACT ANALYSIS

This chapter is divided into two parts; the first part is an analysis of the energy potential from an HIB-system, and the system is evaluated from an economic perspective. This is done as the economics of the system is important for the users' willingness to adopt the technology, as discussed in Chapter 4. The other part of this chapter examines the environmental impact that the system might have, as a reduced environmental impact is the main purpose of the BioBlend. This is done by comparing a GDU to other waste management systems, as a GDU is a requirement for the BioBlend. This second part of the chapter is applicable both to the BioBlend as a standalone unit and as part of an HIB-system.

5.1 ENERGY POTENTIAL

In Sweden, the total food waste generated nationally was, in 2010 and 2012 1 104 000 and 1 211 000 metric tons, respectively. Yearly amounts of food waste in Sweden is presented in Table 2. Food waste has here been divided into two categories – unnecessary and unavoidable waste. Unnecessary food waste is defined as food that could have been consumed if it were treated properly or consumed in time. The unavoidable food waste is defined as waste that's difficult to decrease and often are associated with cooking or food manufacturing (Naturvårdsverket 2014).

Table 2 - Accumulated food waste in Sweden (Naturvårdsverket 2014)

Sector	*Amount, 2010 [metric ton]*	*Kg/person, 2010*	*Amount, 2012 [metric ton]*	*Kg/person, 2012*	*Of which unnecessary [%]*
Industry	171 000	18	171 000	18	-
Grocery stores	67 000	7	70 000	7	91
Restaurants	127 000	14	142 000	15	62
Large-scale catering	58 000	6	58 000	6	52
Households	680 000	72	771 000	81	35
Total	*1 104 000*	*117*	*1 211 000*	*127*	-

For the purpose of an HIB-system, both the unnecessary and the unavoidable food waste is useful, although avoiding the unnecessary food waste is preferable than to use it in the HIB. Table 2 shows that approximately 501 000 metric tons of food waste (for 2012) is considered unavoidable while also being generated by households. This is essentially what can be considered the ideal fuel for an HIB-system. The additional 270 000 metric tons of food waste generated by households can be considered as less than ideal fuel for an HIB-system. The fuel will, presumably, be of equal quality for biogas production, but could be better used for human consumption.

In Table 3, calculations for two different buildings are represented. The accumulated waste fed into the HIB-system is based on the data in Table 2. This assumes that every household in the two scenarios does sort everything that is to be sorted into the HIB-system. The calculations for the energy produced is based on data provided by FoV Biogas, and the fuel (bio-waste) used is presumed to consist entirely of waste from kitchens (FoV Biogas 2015). The two scenarios investigated are a single villa household with 4 residents and an apartment building with a total of 20 apartments and an average of 1.5 residents per apartment. Total energy consumption by the two buildings is based on average energy consumption for villas and apartments in Sweden (E.ON 2017a). The villa scenario

is based on the current concept of the HIB-system, with a private unit installed in the kitchen, while the apartment scenario is based on a theoretical concept where the entire building has a shared and centralized HIB-system.

Table 3 - Energy production for villas and apartments

	Single household, villa	*Multiple households, apartment building*
No. Of households	1	20
No. Of residents/household	4	1.5
Yearly generated household waste [kg]	324	2 430
Yearly energy consumption [kWh]	25 000	240 000
Yearly energy production [kWh]	876	7 884
Yearly energy production [% of consumption]	3,5%	3,3%

Per the data in Table 3, both of the scenarios will generate less than 4% of the yearly energy requirement. With the price of electricity in Sweden at 0.28 SEK per kWh in 2016, the HIB-system would enable house owners to save less than 250 SEK per year in energy cost and the residents in the apartment building would, on average, save approximately 110 SEK per year, per apartment (Bixia 2017). The same data suggests that for the villa scenario, just under 1300 kg of food waste per year would be necessary to produce 4 380 kWh per year, or approximately 18% of the yearly energy consumption. This corresponds to a 400% increase in food waste, for the 4-person family. The relation between yearly food waste fed into the HIB-system and the yearly energy production is illustrated in Figure 8. Performing similar calculations as above, but utilizing the biogas produced by the HIB directly, either for use in a gas stove of for heating of the building, the HIB will enable house owners to save approximately 635 SEK per year, given a gas price of 0,725 SEK per kWh in 2017 (E.ON 2017b).

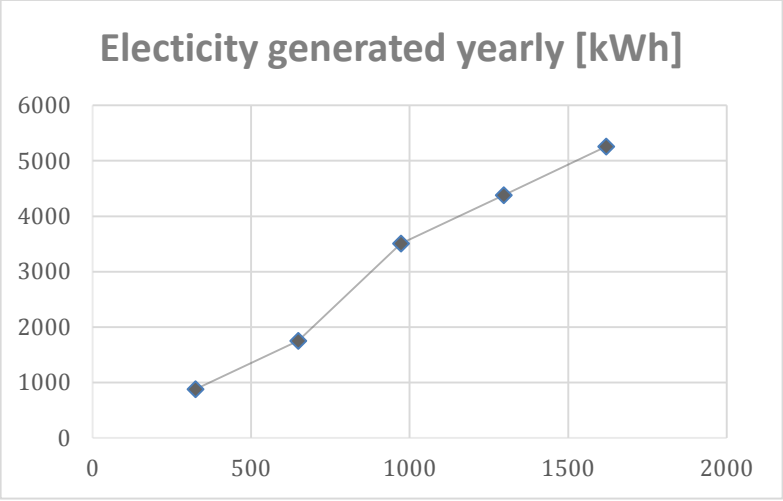

Figure 8 - Food waste and maximum energy production with a BioBlend/FoV Biogas HIB-system.

It is worth noting that combining different sources of bio-waste can have a synergistic effect on the biogas production, and digestion of different kinds of bio-waste can enhance the nutrient balance, and help maintain pH-levels, thus enhancing the overall efficiency of the biogas digester (Rajendran et al. 2012). The potential of such a system has not been examined in this project, and a system utilizing different kinds of bio-waste generated by households may have an increased energy potential.

5.2 ENVIRONMENTAL IMPACT

A study done in 2005 by S. Lundie and G. M. Peters compares regular in-sink garbage disposal units (GDU), home composting (HC), centralized composting (CC) and co-disposal (CD) of bio-waste with regards to energy usage, greenhouse gas emissions, and water usage, and some of the results from this study are shown in Table 4. In this comparison, CC refers to what currently is the conventional bio-waste sorting system in Sweden, where the bio-waste is sorted for separate collection by garbage trucks. CD refers to un-sorted bio-waste, where the waste ends up in a landfill. Furthermore, two different scenarios of HC have been compared; one where the compost is well maintained and aerobic degradation occur and one where the compost is badly maintained, causing anaerobic digestion to dominate the process. The comparison shows that HC if managed properly, has the lowest environmental impact. The garbage disposal also performs well with regard to energy usage and greenhouse gasses but has high water consumption.

Table 4 - Energy usage, greenhouse gas emissions and water usage of food waste disposal options (Lundie & Peters 2005)

	Energy usage [MJ/fu]				*Greenhouse gas emissions [kg CO_2-eq./fu]*					*Water usage [kL/fu]*			
	GDU	HC	CC	CD	GDU	HC aerobic	HC anaerobic	CC	CD	GDU	HC	CC	CD
Capital equipment (materials)	24	47	53	54	5,6	0,61	0,61	4,8	1,2	33	10	10	15
Collection of organic waste			487	147				3,8	10			6,9	29
Organic waste processing	38		122	17	2,5	0,1	273	13	71	24		1,7	3,6
Transportation of byproducts and waste	57		4,9		3,5			31		2260		0,07	
Water supply	15				1					9,2			
Wastewater treatment	15		0,2	0	1			0,05	0,08	9		0,93	0,11
Avoided transportation	-2,3	-6,8	-6,8		-0,14	-0,41	-0,41	-0,41		-0,12	-0,36	-0,36	
Total	*146*	*40*	*661*	*218*	*13*	*0,3*	*273*	*52*	*82*	*2335*	*10*	*19*	*48*

GDU, garbage disposal unit; HC (aerobic), home composting (aerobic conditions); HC (anaerobic), home composting (anaerobic conditions); CC, centralized composting; CD, co-disposal

Investigating the aquatic and terrestrial ecotoxicity, the toxic effect on these eco systems caused by natural or synthetic pollutants (Truhaut 1977), and the potential for human toxicity, the GDU is shown to have the largest negative impact of the systems investigated. However, the majority of the toxicity potential related to the GDU is a result of the production of the unit, rather than the operation of one. 68% of the aquatic toxicity is a result of the production of the GDU, and 13% is a result of the electricity needed for operation of the unit. The impact of operating the unit is also dependent on the energy source. (Lundie & Peters 2005)

The eutrophication, a change of the nutritional status in the water caused by increasing nutrients (Pathak & Pathak 2012), was also shown to be the largest in the GDU amongst the compared other systems. The GDUs eutrophic impact depends on the ability of the water sewage treatment plant to remove nutrients from the water (Lundie & Peters 2005). The ability of the BioBlend to remove nutrients from the water has not been properly investigated, and therefore the potential eutrophic impact of the proposed HIB-system in this report is unknown (Silva et al. 2016).

6 DISCUSSION

This chapter discusses the findings in the studies performed during the project, suggest future research related to the BioBlend and discuss the development needed for successful market implementation.

6.1 ECONOMICS

The personas created (presented on page 18) illustrates two possible market groups. While no claim is being made that these are the only market groups that products utilizing the BioBlend can target, they illustrate that some market groups would likely only be interested in an HIB-system (or other systems utilizing the BioBlend) if it brings either an economic benefit or significantly reduces the effort required for garbage disposal. It is also a possibility that these market groups motivated by personal comfort and economics currently are not sorting food waste, and therefore the current effort required is low. Thus, a system utilizing the BioBlend that also provides an economic benefit for the user creates additional market opportunities.

As shown in Chapter 5, the energy potential of an HIB-system is low. The impact analysis done on the system is quite basic and certain elements, such as production, distribution, maintenance and energy usage of the BioBlend (or the biogas digester) have not been investigated properly, with regards to either economics or environmental impact. The economic analysis is done as a 'best-case' scenario, assuming that all bio-waste generated by an average household is processed in the BioBlend. The calculations also disregard the cost of operating the BioBlend. Despite this, the HIB-system only shows potential to produce just under 4% of the energy requirement by an average household.

Further, more in-depth, research is needed in order to fully investigate the economics of the BioBlend and/or an HIB-system, but the assessment done in this project indicate that an HIB-system will require additional research and development in order to become economically justifiable. However, some factors have not been taken into consideration in this assessment; the reduced need for transportation of household waste, the ability to sell or use the byproduct (digestate) as a fertilizer, or the use of co-digestion in the HIB. All of these factors may have a positive impact on the economics of the BioBlend and the HIB-system.

The cost of the BioBlend and an HIB-system has also not been investigated, as this information has not been available. If the systems are offered at a low cost, or if subsidizing of the systems are available, this will have a positive effect on the economics of the system for the end user.

6.2 ENVIRONMENTAL IMPACT

As noted earlier, the BioBlend or an HIB cannot have a positive environmental impact if the system is neither implemented or used. A strong economic incentive for implementation and usage, as discussed above, is helpful, but other aspects must be considered as well.

The BioBlend provides a (somewhat) easier and a much cleaner way to sort food waste, compared to the use of paper bags. A full HIB-system, on the other hand, does enhance this even further, and the food waste management in simplified greatly.

In some cases, not sorting food waste at all might be considered a competing solution to the BioBlend, and competing with this in terms of ease of use may be difficult. As only 25% of the generated food waste in Swedish households is currently properly sorted (Naturvårdsverket 2016a), a simplification of this process might prove to have a large impact. If restrictions on food waste were implemented, of if socials norms were to be altered, viewing no sorting at all as a competing solution might be unnecessary.

It was noted in the interviews that the BioBlend did elicit a positive change of behavior in some of the participants. It is possible that the BioBlend can be used to inspire a more general change in behavior, and may increase the environmental awareness of the user. This effect has not been measured in this project.

Another problem with the BioBlend is that it is, in part, a preventative technology. As Rogers points out, this may reduce the individual's motivation to adopt the product. If the BioBlend can be shown to have a net positive environmental impact, governing bodies might be persuaded to create a 'cue-to-action', and this is something that might be interesting to research further (Rogers 1983).

As discussed in Chapter 5.2, one of the bigger problems with garbage disposals is the effect on eco-toxicity and the eutrophic impact. Whether or not the BioBlend is used in an HIB-system or not, this impact from the unit on toxicity must be investigated, and further research is needed.

6.3 METHOD

This purpose of this study has been to explore possible opportunities and limitations regarding the BioBlend and has not been intended to be used as a complete research material to base development off. The findings in this study can be used to direct further research concerning HIB-systems and the BioBlend. The project has not determined the application where the BioBlend will provide the greatest benefit but has provided a base for doing so in the future.

While an attempt at measuring the effect of the BioBlend on the level of sorted bio-waste was made, the data from this were corrupted by the frequent problems that the participants had with the BioBlend. The initial problems (pipe leakage and sensor failures) created frequent interruptions in the usage of the BioBlend, causing the participants to use both the BioBlend and the old sorting systems simultaneously. The latter problems (large water content in processed food waste) made it impossible to compare the data. If this was to be repeated, one would need to ensure that the prototype is working properly. Also, the small sample size and relatively short test periods introduces a lot of uncertainty to these measurements and trying to monitor the actual amount of sorted bio-waste may have been inappropriate for his project. The project has been unable to determine the actual effect of the BioBlend or an HIB-system on the level of sorted bio-waste, stated as two of the research questions. On the other hand, information regarding the performance of the BioBlend prototype has been gained that will be useful in future development. Long-term performance of the BioBlend and working sensors for automatic operation seems to be the most critical areas for improvement. The error log (see Appendix B) can be used as a guide for this continued development.

Ideally, this project should have been preceded by an evaluation of the long-term performance of the BioBlend, and an implementation of the necessary changes. This would have enabled this project to truly test the impact the BioBlend has on the users' behavior.

When analyzing the data, it is important to remember that this study revolves around a small sample group, with only 5 participants in the study. Furthermore, only two of the participants were available for the post-experiment interview. As this is where the main data regarding user behavior has been collected, this is a large limitation of this study. Ideally, the study would have been performed on a larger scale, allowing both more participants and more interviewees. As the study was carried out, it would have been preferable to send out questionnaires to a larger sample group after the interviews, in order to confirm or deny the interview findings. It would also have been beneficial to adjust the timing of the study, partly to move the interviews further away from the exam periods and summer break of the participants and to allow for larger time windows where interviews can be held.

7 CONCLUSIONS

The project aimed to answer the following questions:

- How, and to what extent, does the use of an in-sink garbage disposal unit affect bio-waste sorting levels?
- Does an HIB-system provide a net environmental benefit?
- Is the BioBlend likely to be accepted, and if not, what is needed for user acceptance of the technology?

The project has been unable to determine the effect on the level of sorted bio-waste that a GDU combined with the BioBlend has. The interviews with the participants do indicate that the effect is positive, but how large this effect is remains unknown. Had the participants needed to empty the waste bin on the bio-blend themselves, this positive effect may or may not have been removed.

Parts of the study suggest that the BioBlend when implemented in an HIB-system, may have a positive environmental impact. Whether or not this impact is large enough to compensate for the manufacturing and operation of the HIB remains to be determined in a future LCA study.

Development of systems utilizing the BioBlend will benefit both from focusing on the user experience and on building a strong economic incentive for adopting the system. Lowering the cost of the system (and thus lowering the threshold for adoption) and increasing the economic gain by the methods discussed in Chapter 6 will be important. As the BioBlend was used in the study, acceptance of the technology is questionable but will improve with the suggested improvements.

The research in this report indicates that the use of the BioBlend in an HIB-system has the greater potential, both in terms of ease of use and user benefit. The use of the BioBlend in an HIB-system is where future research and development should be focused. The use of the BioBlend without a biogas digester does not seem to add enough value to the user to be worth further consideration. The BioBlend, when used in an HIB-system, is considered to be far more likely to be accepted by the users, compared to the standalone GDU/BioBlend system.

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Appendices

Appendix A Questionnaire Results

Time stamp.	2017-05-01 13.37.33	2017-05-01 15.10.50	2017-05-03 18.17.19	2017-05-09 09.58.43
Sex.	Male	Female	Female	Male
Age (years).	22	22	21	57
Current occupation.	Student	Student	Student	Student
Do you have any previous experience with an in-sink garbage disposal unit?	No	No	No	Yes - at home
Please rate the overall experience of using the garbage disposal.				5
Please list no more than 3 positive sides of the in-sink garbage disposal.				Easy to use, makes energy, saves money
Please list no more than 3 negative sides of the in-sink garbage disposal.				increased water concumption
Do you separate your food waste?	Yes, always or almost always	Yes, always or almost always	Yes, always or almost always	Yes, always or almost always
What are your reason(s) for separating food waste? You may choose multiple answers.	Concerns about the environment	Concerns about the environment	Concerns about the environment	Concerns about the environment, I save money, Easier handling of trash
What are your reason(s) for not separating food waste? You may choose multiple answers.		Difficult or unpractical handling of thrash	I always separate food waste	I always separate food waste
Do you sort other household trash (paper, plastic, glass and metal)?	Yes, always or almost always	Yes, occasionally	Yes, always or almost always	Yes, always or almost always
What are your reason(s) for sorting household trash? You may choose multiple answers.	Concerns about the environment	Concerns about the environment	Concerns about the environment	Concerns about the environment
What are your reason(s) for not sorting household trash? You may choose multiple answers.	I always sort household trash	Difficult or unpractical handling of trash	I always sort household trash	Difficult or unpractical handling of trash
Do you get leftovers after cooking?	No, never	Yes, occasionally	No, never	Yes, occasionally
If yes, what do you usually do with it?		Eat it the next day		Save and eat later

Have you tried to minimize food waste when cooking?	No, never	No, never	Yes, often	Yes, often
If yes, what have you done?				Only cook what I'm gonna eat
If not, what are the reason(s)? You may choose multiple answers.	I'm not aware of the problem			
Is there any unpleasantness or difficulties when dealing with food waste?	No, never	Yes, often	No, never	Yes, often
If yes, what is the problem?		it smells		smell, messy (without mill)

Appendix B Error Log BioBlend

Problem	Date	Detailed description	Solution
Water leakage, piping between garbage disposal and BioBlend.	2017-05-08	Water leakage from the area where the motor shaft of the BioBlend exits from the piping between the BioBlend and the garbage disposal. Plastic cap used to seal the area had fallen off during installation.	A hose with a brass seal and hose clamps used to seal the are more securely.
BioBlend motor won't start.	2017-05-08	The installation of the BioBlend put the motor shaft of the BioBlend under excessive tension due to bending.	A adjustable platform between the BioBlend and the floor were used in order to increase the accuracy of the positioning of the BioBlend
Constant error signal that the bin is full.	2017-05-10	The IR sensor used to detect if the bin is full always registered that the bin is full, causing the motor not to start. The led used to activate the IR-sensor seems too weak for the distance in the application, or ambient light is interfering.	The function to detect if the bin is full was bypassed by placing the led-light and the IR-sensor right next to each other, to ensure activation.
Automatic on/off does not work.	2017-05-10	The automatic on/off function of the BioBlend motor is not working.	Slightly opening and closing the bin is used to turn the BioBlend on and off by activating the bin open/closed sensor.
Water leakage from bin.	2017-05-15	The BioBlend was placed under a high load (several whole carrots were inserted at once). The garbage disposal processes food waste faster than the BioBlend, causing the BioBlend to get cogged. Water leaked out thru the bin onto the floor until the BioBlend had processes enough waste.	No technical solution. Informed the tenants that the BioBlend has a limited capacity, and that they need to be careful in their usage of the unit.
Water leakage/wet bio-waste content	2017-05-18	The water/bio-waste separation performance of the BioBlend is heavily reduced, causing the bin to fill up with large amounts of water.	Not solved.

Appendix C Interview Guidelines

This is a semi-structured interview, where the participants will be asked to elaborate on their thoughts.

Hi! This in an interview where we will discuss your experience with the BioBlend, now that you have had a few weeks to use it.

This interview will, with your consent, be recorded on audio. You will also be completely anonymous in the interview.

First, we are going to talk about how you have been using the BioBlend. How would you compare it to using brown paper bags, as is normal?

If we imagine a system where the BioBlend is used on its own in a kitchen and the problems associated with early prototypes have been resolved, we would have a system where a dry bio-waste mass is collected in a paper bag. This system would require manual disposal of the bag, as is the case with conventional systems today, but less frequent and with a reduced or eliminated risk of leaking bags. Would you be interested in such a system, and what are your thoughts around it?

The purpose of the BioBlend is to generate a product, the bio-waste, that's better suited for use in biogas digesters. Small-scale biogas digesters are in development, and combined with the BioBlend we can imagine a connected system where no manual disposal of the bio-waste would be required, and the bio-waste would be used directly to fuel the building. What are our thoughts on a system like this?

How would you compare the benefit for you of such a system, compared to if the bio-waste were used by the city?

Do you think that this perceived benefit would alter your habits regarding food waste disposal?

Do you have any additional thoughts on either the BioBlend that you have been using, or the technology in general?

With that, I thank you for your participation in this study. The BioBlend will be removed from the kitchen in the following week, and the sink will be restored to its previous condition.

Appendix D Interview Transcript No. 1

Interview with resident no. 1.

A = Interviewer, I = interviewee.

2017-05-24

A: My idea is for this to be a semi-structured interview, and I'll start with the usual disclaimer that this will be recorded and you will be treated anonymously in this process.

I: That's OK.

A: If we start with the BioBlend as you have been using it, how would you compare it to the regular brown paper bags that are common?

I: It's more complicated as it is now, since there has been so much trouble with the BioBlend.

A: Is this primarily due to the problems that have been?

I: I'm spoiled to have one of these (garbage disposal) at home that's connected to the drain. So, I feed the disposal, and someone else will take care of them for me. So, I'll save a lot of steps right there. You won't have to carry the garbage down and it's simple and clean. You just put the garbage down the drain and then it's gone, there's no mess. And with the BioBlend, you first must make sure that you're doing it correctly, since there have been a lot of trouble. Like with the rubber gasket that prevents the water from going everywhere that's been coming loose.

A: Oh?

I: Yeah, I think it's possible that it wasn't installed properly, but in any case. There have been a lot of trouble trying to make the BioBlend work and so forth. And that's a matter of design. If we look past this, the BioBlend creates a lot of extra steps, since you must feed into the drain, and then you have to remove the bag, waste will spill and things get sticky. And if you don't have the paper bag that you added, you would have to clean the bin. So, as it is now, this creates more work. It's more work to use the BioBlend than to just use the brown paper bags and throw them in the compost. What I'm saying is that, if you want a summary of this, if there is an increased work there must be some kind of benefit for me, otherwise it's not worth it. And as I understand it, your idea is that you can produce your own biogas with this, and then you can drive your car to work on that, as an example.

[02:50]

A: Yes, as an example.

I: Yeah, cause then you get another effect, but I can say that there have been a few times where I have been close to calling you and ask you to come and get this junk, I don't want it anymore, since it doesn't fit and all of this. So, if I'm being critical, I would never accept this at home. As it is now. That's it. We only do this for you to get something to research.

[03:17]

A: So, even if you disregard the problems that we have had with the BioBlend, it's still a system that involves more work, compared to brown paper bags?

I: Yes.

A: If we imagine some alternative applications. Do you have a central vacuum cleaner?

I: No.

A: But you're familiar with the concept.

I: I am.

A: Imagine the same concept on this unit, you'll have a large BioBlend, if you live in a house it might be placed in the basement or similar, and this means that you're able to use a garbage disposal in Gothenburg, where that's not normally allowed. It'll also require emptying much less frequent than the current unit, say once a month or once every six month. Somewhere around the frequency of a central vacuum cleaner. What are your thoughts around a concept like this?

[04:30]

I: Well, I want to say that there must be an economic incentive to do this. Somewhere there must be a profit that I see. So, if I won't have to empty the unit it's obviously easier than the paper bags. Well… if you are to understand my values here… this is not about me not wanting to improve the environment, it's about me thinking that you place too much value on small things and ignore the important ones. If you understand what I'm saying? You do what is simple, sorting to the compost. Well… look at it like this: home in Stockholm, what we feed to the garbage disposal won't cost the housing cooperative, which is me, anything. So we are saving money by doing this. This means that the housing cooperative have considered this a big enough of a saving to install the garbage disposals for us. We don't have to pay privately for them. So that's a win for us. And I know that this is being flushed to the city and turned to biogas for the buses, which is good for the environment. And at the same time, I save some work. But if I am to do a bunch of extra steps to save something somewhere, and at the same time nobody cares that the boats out on the earth spews out huge amounts of sulfur dioxides. Because that's difficult to solve. Then my willingness to help with the improvement of the environment just isn't as large. Do you understand what I'm saying?

I: Yeah, I understand what you're saying.

[06:58]

I: Yes, and this might be because I'm old, and have been around for such a long time. If you are to believe everything we should start eating vegetarian as an example. It's difficult to teach an old dog to sit. I'm aware of the problem, and then I'll defend that in different ways. But in the end, I must feel that I'm saving something on this, otherwise I'm not on board.

[07:30]

A: Yes, well… I agree on that. The idea with this is that we are trying to see if it's possible to use this to make the sorting simpler. Because this is one of the ways we can make people do it.

I: Yeah… and it's a question about information as well. I mean, you must tell me that if I do something, things will get this good, right? Sure, sure, I'll do this thing. But if I can't see the profit, then I'll just see it as work. I think it's kind of ridiculous that you can't flush it right down the drain, I mean, what's the difference in flushing food that has gone thru a garbage disposal and food that has gone thru a human? I'm a little bit sceptic as to why you can't flush it straight down the drain. Is this an idea someone has, or is this based on facts about the sewer in Gothenburg not being able to process it?

A: Well, I'm not entirely certain on how it looks, but it varies from city to city, and my understanding is that it's, sometimes, related to the tilt of the sewer system.

I: Yes, but do you think that it's different from Gothenburg to Stockholm?

A: That I don't know.

I: No, I'm just saying that I don't understand. I'm not saying that it isn't so, but I don't understand. What is the difference in flushing out something in the sewer from Farsta to Henriksdahl versus doing the same from Chalmers to Ryaverken. Just… I don't know.

[09:15]

A: No, I'm not sure about the difference there. But still, that's the situation we're in, and we have to work with the conditions that we have here in Gothenburg.

I: Yeah, sure. But otherwise, if it had been like that, it depends on what level you're at. If you are in an apartment building, and it's flushed out for biogas then that's great. Then it's on such a scale that I… it's easier since I won't have to take the bag out. Then there's no problem, right? And… there's probably some sort of gain from the energy, right? So I like that. And if you are a bit more interested you can have a unit that produce biogas for your own house also, and of course, that might have been interesting…

A: Yes, well, the original intent with the BioBlend is to produce a product that is better suited for biogas production. Well… you said earlier that you think it's a positive thing that the city produces biogas for buses. Well, do you see any difference between that and if the biogas is used directly by the building you live in, whether it's a house or an apartment building?

[11:16]

I: Well, if you can do it at a small scale, that that good since it would be possible to do it on places where they don't have the possibility to take care of it centrally, right? In the future, we might even have a self-supporting house? That's great if it's possible.

A: Do you think that this would affect… the value you see in the sorting of the bio waste…

I: Absolutely.

A: Is closer to you, so to speak?

I: Well, I have had a house that was heated by oil once upon a time.

A: Hah. And I gather that was expensive?

I: Heh. You want to know what a cubic meter of oil costs? It's not even funny. And now that we are talking about energy, I don't know if you have thought about this, if it's interesting to you. But how energy is transported have changed a bit. There used to be more or less a monopoly. But nowadays, anyone can sell energy, but the energy must be transported to the house, right? And those that own the infrastructure take a large fee for that, right? You can't just buy from Vattenfall and then have it transported on Vattenfalls infrastructure all the way, you have to get what's connected to your house. So this means that we have companies that make a lot of money on this. And speaking of environment… look at Vattenfall that think it's OK to deal with brown coal in Germany. At the same time as they make a lot of money there, they lose a lot of money on us. If we look at Germany, the development of solar cells increased by a lot. The problem is that in Sweden, the sun isn't enough, right? Well…. It's a matter of scale, I think it depends on how much of what we eat can be turned into biogas and how far that goes towards heating a house. But it's a step in the right direction. And it's a source of energy that works even when it's cold outside.

[14:00]

A: yes, well, it's quite independent of outside factors, so to speak. Do you have any other general thoughts, any ideas about how to apply the technology, outside of the home? Do you think that it's best suited for individual kitchens, centralized in the building or something else?

I: When you say the BioBlend, what do you mean then?

A: I'm talking about the principle of the BioBlend that you have.

I: Well, the idea is that if you grind something directly, it's easier to transport that product, and then you can transport it in a pipe that's already there, then it's really simple, as opposed to using a truck. To there has to be some sort of transportation. I mean, you can calculate the cost of transporting all of that and compare it to using the pipe. And you'll see that it won't work, right? You have to use the pipes, otherwise it's pointless. I used to transport garbage here in Gothenburg, a long time ago. So I know a bit about how it works. This is a very large educational problem, and the point is that you have to explain to people why they should do something. If not, they will do what easy. And that is usually what they are used to.

[16:50]

A: Well, part of moving the use of the bio waste closer to the user is that it's a way to make the benefit clearer, at least to some user groups.

I: Yeah. But, as it is, have you calculated how much energy a house could gain from this?

A: It has been done, but I haven't looked into it yet.

I: No, because that's the critical part. And the problem is that all of this equipment costs money and requires energy. And that's a strain on our resources on the planet, too? Oh, as it seems then again in Stockholm, the city gets a lot of energy, and then it earns money on something that cost them money before. "We'll take care of the sewage, then we'll clean it and we'll let it out in the water." "Oh, we have to take care of the sewage, waow, we make biogas of it so we can sell it to the bus companies who run the buses in the city. Waah... we make money." So ... at the same time, they get the homeowners and to take care of the costs to install the waste bin, for what they think then is "waow, we save money because we do not have to pay the shipment of garbage." So they also save money on this, the city may make an investment to make a biogas plant central, but it will pay for selling the biogas, and it's cheaper than just cleaning and sending out. Otherwise they would have used the waste, the sludge that remained, they would have used trucks to drive and dump it somewhere, because they have to take care of that too. It has been a problem, but there has been an attempt to try to take care of the sludge, but the problem is that the waste contains so much heavy metals and dirt, so it does not work for example in a trading garden to fertilize. That ... I do not know if you've heard about it, but it was tried here in Gothenburg, so there were a lot of trading gardens that went to hell because they could not sell their plants or vegetables because they were poisonous. I think it was before you were born.

[19:35]

A: Heh, well, it might have been so.

I: You see the deal, right? If we look at me again, and the facts that I have [inaudible murmuring], if you are to install BioBlends in every house, that's a strain on the earth's resources. Much more so that installing one large in the city. Well, that's my thinking.

- END OF INTERVIEW

Appendix E Interview Transcript No. 2

Interview with resident no. 2.

A = Interviewer, I = interviewee.

2017-06-05

A: Yes, just for the sake of recording, I thought to say that we play in it, if it is OK with you, and you will be treated completely anonymously in this interview.

I: Yes.

A: Well, my idea is for this to be somewhat semi-structured, so we'll do some open-ended questions. How much have you been using the BioBlend?

I: It's been a little bit each day. Often I've shoved my waste to the other side, and [resident no.1] have been operating the BioBlend.

A: Yes, I know that he has been quite involved in this.

I: Yes. But it's been close to daily.

A: Alright. That's good. If you just compare the way you have been using it to regular paper bags, how would you rate it?

I: I like that the waste gets so compressed. So instead of having to run down with the paper bags every or every second day, well… you did the emptying, right?

A: Yes, I did that three times a week. But that was more than necessary, the bags were seldom even half full.

I: Yes, exactly. So, it is true that you will not have to go as often. It becomes comfortable that way. Then ... I do not know. I usually have problems with flies and this ... not just the BioBlend, but it's usually banana flies with the usual compost bags. I think if it's isolated in the way of the BioBlend then it might be easier to avoid that problem.

[02:26]

A: Yes, it gets harder for them [fruit flies] to enter. I haven't thought about that, but that's a good point.

I: But, overall, if the BioBlend hadn't protruded as much, it would have been great.

A: Yes, if you consider the concept more than the execution, so to speak? There have been quite a lot of problems with it. Also, from what I've gathered, the BioBlend worked quite well in the beginning, but lately the bio-waste has been quite wet?

I: Yeah.

A: Did you have that problem in the beginning?

I: I can't… I don't know. But in the beginning, it looked quite dry as far as I can remember. But later it started to be wet. At least from what I saw, when [resident no.1] introduced us to it and when I tested it myself.

[03:57]

A: That's what I also felt that the first time it was good, but the other times there was a lot of water in the container. You talked about the fact that you did not have to empty it as often, and one thought was... what I want to do is to investigate different use cases for the concept, rather than investigating how to optimize it in its current environment. So, one possibility is a more centralized system, kind of like a central vacuum cleaner. If it's in a house you might have it in the basement and if it's an apartment building the building has a centralized one. But then it may be at that level so you empty it once a month or once in the half-year. It will be more difficult to empty it then, but it will be more maintenance-free between emptying. What do you think about such a concept?

[05:02]

I: Well… in the end it's still about using the waste? Here at home I thought the idea was for us to use the waste to maybe use as manure or something else. But in a concept like that, a large centralized one, you can't do that.

A: No, in a scenario like that the idea is more that the BioBlend is used to simplify the sorting process for the user, and later… the garbage truck might come and take care of it, and that infrastructure will do that.

[05:58]

I: Yes, but of course. That would work, but in my head, I had a different idea.

A: Well. The compression of the bio waste is just a side effect of the BioBlend, since what it does is to separate the water to get a more usable product for biogas production.

I: Well, OK.

A: So the original idea is that you get something that you can connect to a biogas digester, so that you can produce your own biogas. So that's another possible application, and that was what we originally wanted to test, but it wasn't technically possible. Also, the current rules around that made it difficult. But the idea was to directly connect the BioBlend to a biogas digester, and use your own waste to heat the building. Do you see any difference in something like that, compared to if the city is using the biogas? Because what we do is essentially to move the biogas production from Ryaverken to your own building.

[07:30]

I: Hmm. Well, this was not my understanding of this project. I wasn't on the introduction.

A: No, we didn't talk about this on the introduction, since we had a few different thoughts on how to do this. We wanted to see if such a system could affect your behavior, but we didn't find a way to do it, so all we can do is to try to talk to you about different scenarios and your thoughts around that.

I: Ah. Well… I just have to process this now…

A: No worries, I understand. Take your time.

I: So…. The question was if it would be possible to create a more centralized unit?

A: No. Look at it like this: Instead of allowing the city of Gothenburg to use the waste to produce biogas, you will yourself produce biogas in your home. And that gas is used direcly by the house. So, you move the process home. Do you think that this would affect your view about bio-waste sorting, or affect the benefit you see in it?

[09:04]

I: Yes, I think that it becomes very useful since you get so close to your energy source. And that alone does a lot, I think. Partly because you get an understanding of the energy, and I think that you would be more inclined towards sorting if you see the direct benefit from your waste. It's really hard to see the direct benefit from what we throw in the garbage room right now, and therefore I think this would be a good thing.

A: Okay. So, you see both a physiological and a physical advantage…. Oh, sorry. I think I misunderstood what you said in the beginning somewhat.

I: Well... I see it more as… I get a closeness to it. I get to feel that, alright, this can create energy at home. And thus, I'm thinking more about the value in this, and therefore I will do it more. You get a better understanding, and I think that it makes you want to sort more, and maybe you choose to read up on it. I think it triggers you, at least students.

[11:30]

A: The idea is also, for the system that I have tried to describe, the if you get it to function properly, you would basically use it as a garbage disposal. Then the BioBlend will do the rest of the work, and the waste will go straight to a biogas digester. So you are basically using a garbage disposal then, quite simple. But if this, for one reason or another, doesn't work flawlessly and the system would require some kind of added work with the BioBlend, where do you think that the tradeoff for that lies? I know it's a very open question, and it might be difficult, but how much work do you think is too much?

[12:25]

I: Well… it's really difficult to say… I don't know if I should look at it from an economic point of view or from a time point of view?

A: Well, it's both about economics and time, really. Let's say that you can save a few hundred SEK each month on energy production, but instead of just throwing the brown paper bag away, you might get some extra work occasionally. Maybe you must clean the digester once every second week or so. Somewhere there lies the tradeoff, what do you think is OK?

I: Well, it's very open. I'm a person who have to test thing before I can know what's OK. But… it's difficult to generalize. But… every second week wouldn't be a problem, depending on how much work there is.

A: No, well, of course.

I: And what would the effect be? Would it smell a lot, would it be hard to reach, or would it be something that you dread to do? It's difficult to say, but if you can save some money, and you have an interest for recycling, then I think that it would work. I mean, I think people would do it.

[14:55]

A: Do you think that an interest for recycling is a requirement for being interested in a unit like this?

I: … not really. But if you had to do more than just throwing it and taking out the thrash you might need an interest, or understand this energy that you get. You have to see the tradeoff.

A: So, do you think that if it's only a positive to have the unit, anyone would want it, but if there's a downside to it as well, the situation is more sensitive?

[16:03]

I: Yeah... with comfort and such, I guess it's always so. But I don't know how much extra work would be the limit.

A: No, I just wanted to hear some open thought of yours. When we talk about a system where you produce your own biogas, we are talking about the BioBlend in its most developed stage. Let's assume that we make it a bit more simple, and you use the BioBlend the way you have been using it, but as a way to be able to install garbage disposals where they aren't normally allowed, like in Gothenburg or Malmö. You can't have a garbage disposal on the drain in most parts of Sweden.

I: Okay.

[17:10]

A: Well, what do you think of using the garbage disposal?

I: It has been simple. It's just to push things down, turn on the water, and then it manages by itself. Well, if you look past the details with the bin, turning on the power and such.

A: Well, that's problems related to it being an early prototype.

I: Exactly. So, it has been very simple.

A: Has this affected how much food waste you have been throwing away?

I: …no…

A: You might be the kind of person who already separates all of your food waste?

I: Yeah, I am. But we have these conflicting things, before I used to lay aside some stuff for the hens. And then this came along, and I started putting it in the BioBlend instead. But still just regular food waste. So when I cook, the waste goes in the BioBlend instead of to the hens.

A: For you there is no difference. And this might be difficult, because I'll ask you to speculate about other people's behavior, but do you thing that the average person would be more likely to sort his or her food waste with the BioBlend?

[19:10]

I: Yes, absolutely. Or it feels like it at least. Some in the kitchen hasn't done so much sorting, because they find it too much work. But with the BioBlend they find it easier, and they do it. So it activated them to start to think more about food waste, instead of just throwing it in the regular garbage. Because… as I said about the fruit flies and such, it's easy to get that when you use the brown bags. This [the BioBlend] activates an interest since it's so simple, just down the drain and flush some water, so that's what people did.

[20:20]

A: It's interesting that you have seen a change in behavior in people who doesn't usually sort waste.

I: Exactly, so it helps a lot.

[irrelevant conversation]

I: No, so I'll usually just put all the food waste in the sink with the dishes, and then separate it later. But with the BioBlend I separated the waste directly.

A: So, you scrape off the food instead of washing it off?

I: No… more like, since I work on the other side of the kitchen, you adapted to having the BioBlend. If I had the BioBlend on my side this wouldn't have happened. But I don't know what my thinking with this was…. Anyway.

[irrelevant conversation]

I: I still liked it. But with the maintenance, since it was a prototype, it was a little bothersome.

A: He [resident no.1] focused more on the execution of the prototype, rather than the concept…

I: Yes, but I liked it, because you could see that it activated people who wouldn't normally sort the waste. They thought about what might and might not go into the BioBlend.

A: How have you experienced the usage of the actual garbage disposal?

I: It was… we didn't have a tool to push things down the hole, so that's something one could develop. We used the dish brush. Using the disposal, since we had some leakages, was kind of like baby siting it. So actually, if you could just turn it on and leave it it would have been great. But now you were kind of looking to make sure everything was fine.

[26:25]

A: But you didn't experience any discomfort with the mill?

I: No, no. I didn't.

A: Good. Because that's sometimes an issue, some people find them uncomfortable.

I: Well, I can understand that. But… I didn't really understand how it was constructed. It separated at the side? I'm thinking, there's a hole here, and I I put my hand down there, would anything happen?

A: Oh!

I: Because it felt like the milling process was at the end?

A: Not really…

I: Or?

[27:18]

A: No, that's not the case. The big unit directly under the sink is the garbage disposal. So that's the mill. The see thru box then separates the milled food from the water. So… directly down the hole is not good for your fingers.

I: Oh! Okay. Well, that's a little discomforting.

A: Ah.

I: Haha, then it's uncomfortable, I just didn't know.

A: Well, you shouldn't put your fingers down there.

I: Well, no. Obviously.

A: There's a conical grinder down there, so at least it's not knives. But it's still a bit hazardous to put your fingers down there.

I: Well… I still liked having it. But… maybe some kind of security would have been nice? Now it was only this floppy black rubber thing.

A: [Resident no.1] mentioned that the rubber gasket slid down a few times. Did you see that?

I: Oh. No, I never saw that.

A: Okay. Well, he just said it passing by…

I: Okay. No, I never saw that. As I said, my usage of it [the BioBlend] was that I threw over the waste, and occasionally I used it. It was mostly [resident no.1] who operated it, he told us that we should put the waste in that sink, and he could grind it in the evening. So when I used it, when I had cooked and felt like using it immediately, everything went well. And it was very convenient to just throw everything on the other side and just let [resident no.1] do the work, hehe. But yes, my experience with it was good.

A: Okay, okay. Well, thanks for your participation, and for putting up with such an early prototype.

I: It…. It was interesting,

A: Well, good!

- END OF INTERWIEV

Appendix F Coding of Interviews

Data	Personal values	Comfort & ease of use	Goals - environment	Goals - economics	Behavior & habits	Knowledge & information	Alternative methods	Difficulties	Prototype
Q: If we start with the BioBlend as you have been using it, how would you compare it to the regular brown paper bags that are common? A: It's more complicated as it is now, since there has been so much trouble with the BioBlend.		X			X			X	X
I'm spoiled to have one of these (garbage disposal) at home that's connected to the drain. So, I feed the disposal, and someone else will take care of them for me. So, I'll save a lot of steps right there. You won't have to carry the garbage down and it's simple and clean. You just put the garbage down the drain and then it's gone, there's no mess. And with the BioBlend, you first must make sure that you're doing it correctly, since there have been a lot of trouble.		X			X			X	X
BioBlend creates a lot of extra steps, since you must feed into the drain, and then you have to remove the bag, waste will spill and things get sticky. And if you don't have the paper bag that you added, you would have to clean the bin. So, as it is now, this creates more work. It's more work to use the BioBlend than to just use the brown paper bags and throw them in the compost.		X			X		X		
If there is an increased work there must be some kind of benefit for me, otherwise it's not worth it.	X	X							
There have been a few times where I have been close to calling you and ask you to come and get this junk, I don't want it anymore, since it doesn't fit and all of this. So, if I'm being critical, I would never accept this at home. As it is now.		X						X	X
Somewhere there must be a profit that I see. So, if I won't have to empty the unit it's obviously easier than the paper bags.	X	X					X		

But in the end, I must feel that I'm saving something on this, otherwise I'm not on board.	X		X		
Yeah… and it's a question about information as well. I mean, you must tell me that if I do something, things will get this good, right? Sure, sure, I'll do this thing. But if I can't see the profit, then I'll just see it as work.	X		X	X	
Q. Yes, well, the original intent with the BioBlend is to produce a product that is better suited for biogas production. Well… you said earlier that you think it's a positive thing that the city produces biogas for buses. Well, do you see any difference between that and if the biogas is used directly by the building you live in, whether it's a house or an apartment building?A: Well, if you can do it at a small scale, that that good since it would be possible to do it on places where they don't have the possibility to take care of it centrally, right? In the future, we might even have a self-supporting house? That's great if it's possible.	X	X		X	
It's a matter of scale, I think it depends on how much of what we eat can be turned into biogas and how far that goes towards heating a house. But it's a step in the right direction. And it's a source of energy that works even when it's cold outside.		X			
This is a very large educational problem, and the point is that you have to explain to people why they should do something. If not, they will do what easy. And that is usually what they are used to.		X		X	
You see the deal, right? If we look at me again, and the facts that I have [inaudible murmuring], if you are to install BioBlends in every house, that's a strain on the earth's resources. Much more so that installing one large in the city. Well, that's my thinking.	X	X			
Q: If you just compare the way you have been using it to regular paper bags, how would you rate it? A: I like that the waste gets so compressed. So instead of having to run down with the paper bags every or every second day, well… you did the emptying, right? Q: Yes, I did that three times a week. But that was more than necessary, the bags were seldom even half full. A: Yes, exactly				X	X

It is true that you will not have to go as often. It becomes comfortable that way.		X		X		
I usually have problems with flies and this ... not just the BioBlend, but it's usually banana flies with the usual compost bags. I think if it's isolated in the way of the BioBlend then it might be easier to avoid that problem.		X				
But in the beginning, it looked quite dry as far as I can remember. But later it started to be wet. At least from what I saw, when [resident no.1] introduced us to it and when I tested it myself.					X	X
Well… in the end it's still about using the waste? Here at home I thought the idea was for us to use the waste to maybe use as manure or something else. But in a concept like that, a large centralized one, you can't do that.	X		X			
Yes, I think that it becomes very useful since you get so close to your energy source. And that alone does a lot, I think. Partly because you get an understanding of the energy, and I think that you would be more inclined towards sorting if you see the direct benefit from your waste. It's really hard to see the direct benefit from what we throw in the garbage room right now, and therefore I think this would be a good thing.	X		X		X	
I get a closeness to it. I get to feel that, alright, this can create energy at home. And thus, I'm thinking more about the value in this, and therefore I will do it more. You get a better understanding, and I think that it makes you want to sort more, and maybe you choose to read up on it. I think it triggers you, at least students.	X		X	X	X	
Q: Do you think that an interest for recycling is a requirement for being interested in a unit like this? A: … not really. But if you had to do more than just throwing it and taking out the thrash you might need an interest, or understand this energy that you get. You have to see the tradeoff.	X	X	X		X	
Q: So, do you think that if it's only a positive to have the unit, anyone would want it, but if there's a downside to it as well, the situation is more sensitive? A: Yeah... with comfort and such, I guess it's always so.		X	X	X		

Q: Well, what do you think of using the garbage disposal? A: It has been simple. It's just to push things down, turn on the water, and then it manages by itself. Well, if you look past the details with the bin, turning on the power and such.		X					X
Yes, absolutely. Or it feels like it at least. Some in the kitchen hasn't done so much sorting, because they find it too much work. But with the BioBlend they find it easier, and they do it. So it activated them to start to think more about food waste, instead of just throwing it in the regular garbage.		X		X	X	X	
Because… as I said about the fruit flies and such, it's easy to get that when you use the brown bags. This [the BioBlend] activates an interest since it's so simple, just down the drain and flush some water, so that's what people did.	X	X		X			
Yes, but I liked it, because you could see that it activated people who wouldn't normally sort the waste. They thought about what might and might not go into the BioBlend.	X	X		X	X		