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Resource Efficient Cities Implementing Advanced Smart City Solutions - READY

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READY behavioural campaign for energy efficiency and smart living solutions module & report, related to T8.9

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Dissemination level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission)	
RE	Restricted to a group specified by the consortium (including the	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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Scope of deliverable

This deliverable analyzes underlying factors affecting tenants' behavior regarding sorting of household waste and recycling. Attitude towards use of water, electricity, and environment in general is investigated to a limited extent based on a questionnaire survey. A comparative assessment of energy use at building level as well as water use at apartment level is analyzed. An information campaign to influence the tenant's behavior was implemented.

Context of deliverable

The deliverable is prepared in the context of a behavioural campaign to promote energy efficiency and smart living of tenants in the Alabastern demonstration areas in Växjö.

Perspective of deliverable

The perspective is to understand underlying factors affecting household behavior towards household waste recycling and implement a behaviour campaign. The analysis will help Växjöbostäder to implement solutions to overcome the challenges to waste management problem in Alabastern and similar areas in other parts of Växjö. Results will also provide learning experience to develop strategies to influence household behavior for a Sustainable and smart city.

Involved partners

UNI-SE (Lead)
VXH-SE
MUN-SE

Summary

The main focus of this task was to analyze household behaviour regarding waste recycling in Alabastern demonstration area of Växjö. Nevertheless, energy and water use was also briefly analyzed. Alabastern area is recognized as a socially challenged area, dominated by immigrants, mainly from some African and middle-eastern countries. It was a challenge, culturally and linguistically, to reach the tenants. After much effort, few people of similar social, cultural, and language background as the tenants were recruited in different phases of the project to interact with the tenants. They were trained varyingly, from several hours to one week, about the purpose of the project, benefits of waste recycling, and how to interact with the tenants. They conducted two focus group discussions, randomly interacted with people walking in the yard, visiting the recycling rooms, or gathered in nearby community hall, cafeteria and shops. They also visited each apartment to conduct a questionnaire survey and drive the information campaign. About 60-70 households participated in these activities.

Majority of these participating tenants reported that they are environmentally friendly, they take several actions to save energy and water, and they recycle household waste quite often. They mentioned that it was the "others", who do not engage in proper waste recycling. According to them, the main reasons for improper waste recycling in the area include lack of information in other languages than Swedish and English, lack of knowledge about benefits of recycling, carelessness (attitude), no driving licence or car to drive bulky waste to central recycling station of Växjö, insecurity among the ladies to enter the recycling room (that has no windows), children (sometime throw the garbage) do not have the key to the recycling room or cannot open the door as it is heavy, bad smell in the recycling room (lack of ventilation), people from nearby areas litter in Alabastern, and inadequate action by Växjöbostäder.

The participating tenants also suggested several solutions to the waste recycling problem. The *information* solutions include distribution of multilingual waste recycling brochures to every apartment,

multilingual signboards in the recycling rooms, regular information meetings organized by Växjöbostäder on different topics (e.g. energy, water, safety, environment, waste etc.), and education of children and adults. Suggested *Technical solutions include* Surveillance cameras in and around recycling rooms, arrange containers for bulky waste 2-3 times a year, easy to open doors and windows in the recycling room, redesigned recycling room so that it is possible to throw garbage in separate bins from outside, different colour garbage bags for different fractions of waste.

Considering that lack of information was a major reason for improper recycling of waste, an information campaign was conducted. The waste recycling guide was translated to Somalia and Arabic languages and distributed to each of the 313 apartments. The para-professional aides made door to door visit and discussed with 50 households. An information evening led by Växjöbostäder was also conducted. In the year 2019 Alabastern area generated about 363 kg colour glass, 228 kg clear glass, 299 kg plastic, 61 kg metal, 1307 kg cardboard, and 262 kg paper.

In this study energy and water consumption of different buildings in Alabastern was compared for the year 2019. Also, monthly and daily water use of 46 apartments was also conducted. Results showed that the average energy use of all 17 buildings for the year 2019 was ca 80 kWh/m^2BTA, which was 50% of the reference value. Hot water and cold water consumption was 0.0365 and 0.3989 m^3/m^2BTA, respectively. There were considerable variation temporally and among the apartments. Energy use for hot water and electricity varied by factor of 2 to 3 (all buildings), while hot water use varied by a factors of 25 among the analysed 46 apartments. The average and distribution of hot water use of the 46 apartments is higher than the same for all 313 apartments in Alabastern, but lower regarding cold water.

1. Background

The overall objective of the READY (Resource Efficient cities implementing ADvanced smart citY solutions) project, financed under the European Union's 7th Frame Work program, is to demonstrate an affordable, smart and integrated district with net zero carbon buildings in the cities Aarhus in Denmark and Växjö in Sweden. The 5.6 year project (2014-2020) has nine work packages (WPs), each having several tasks. The aim of the Task 8.9 under WP 8 (Business models, replication of developed solutions, training and dissemination) is to conduct a behavioural campaign to promote energy efficiency and smart living behavior among the tenants in the Alabastern demonstration area in Växjö. IKEA – Denmark was the original task leader for this task, but they opted out of the project. Hence, Linnaeus University (LNU) led this task in close coordination with Växjö municipality and the housing company Växjöbostäder. This task 8.9 continued from February 2018 to July 2020. At the first meeting of the task partners, Växjöbostäder suggested that household waste is a big problem in the Alabastern area and the behavioural campaign should focus on this aspect. Accordingly, the focus of task 8.9 is mainly on the behaviour regarding household waste management in the Alabastern area of Växjö city. However, the study includes some analysis of energy and water use based on data on monitoring and a questionnaire survey.

Waste management has been widely recognized as a global concern due to its great impacts on health, environment and economy (Saffron, Giusti, & Pheby, 2003). In 2003, the Swedish Government established the Environmental Protection Agency (EPA) to prepare a national waste plan (The Swedish Waste Management Association, 2018). The aim of the waste plan, which includes fine priorities, is to reduce the negative impacts of waste (The Swedish Waste Management Association, 2018). The first and most important priority within the waste plan is waste prevention, followed by reuse, material recycling, other kind of recycling such as biological treatment and finally disposal. According to Swedish Environmental Protection Agency (2015), waste quantity in Sweden may be double by 2030 if no attempt is made to change the trend.

1.1 The study area and household waste problem

Växjö is the capital of the Kronoberg province, located in the south of Sweden. Most households sort paper, cardboard, plastic, glass, food waste, metal, and rest material. Växjöbostäder has recycling rooms in its rental property, where tenants can leave these fractions in specific containers (*Image* 1). Entrepreneurs hired by Växjöbostäder collect recyclable fractions, while entrepreneurs hired by Växjö municipality collect food waste and rest of all fractions. There are also recycling stations in different parts of the city, where people can leave the recyclable material (*Image* 2). The city has a state of the art recycling station in Norremark (https://www.ssam.se/atervinning/atervinningscentraler.html), where people can leave all types of household waste including garden waste, household appliances and furniture, construction waste, and hazardous material.

Image 1: Recycling room (Miljöhus) of Växjöbostäder in Alabastern (photo taken by a project staff)

Image 2: Recycling stations in Växjö (Source: photo taken by a project staff)

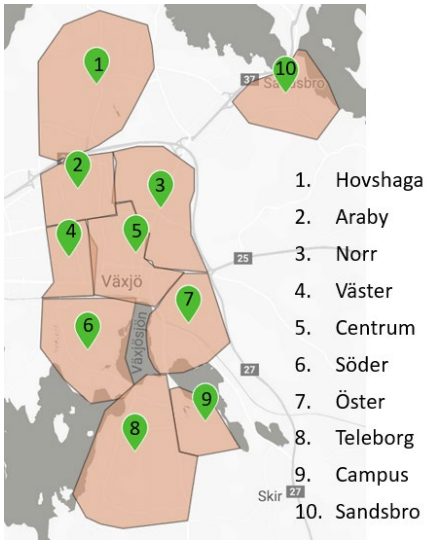


Figure 1: 10 Housing districts of Växjöbostäder

The READY project demonstration area "Alabastern" is located in the "Araby" housing district, where majority of the tenants are immigrants or refugees from Somalia, Syria, and some Arabian countries. The area has been known to be socially challenging with people having low level of education and employment. The 313 apartments in this area were thoroughly renovated during 2015- 2018 under the READY project (Växjöbostäder, 2019). However, according to Växjöbostäder, this area has difficulties in terms sorting and amount of waste generated. The tenants themselves also see this as a problem. Växjöbostäder conducts annual survey of the tenants to learn about the tenants' perception of various aspects of housing by the company. Data from the surveys conducted in the years 2016 and 2017 shows that about 45% of the respondents were unhappy about the waste-related problems in Alabastern.

Tenants of this sub-area failed mainly to sort their waste according to the waste separation guidelines. People left large size waste (e.g. furniture, mattress) just outside the buildings, left unsorted garbage bags both inside and outside the waste recycling rooms, and threw loose items such as cans and bottles in grass lawns (*Image 3*). According to Växjöbostäder the cost of gathering such items and keep the

Alabastern area clean in 2017[1] was 4.8 times greater than entire “Campus”, 2.3 times greater than “Centrum”, 1.1 times more than “Norr”, 1.2 times more than “Söder” housing districts.

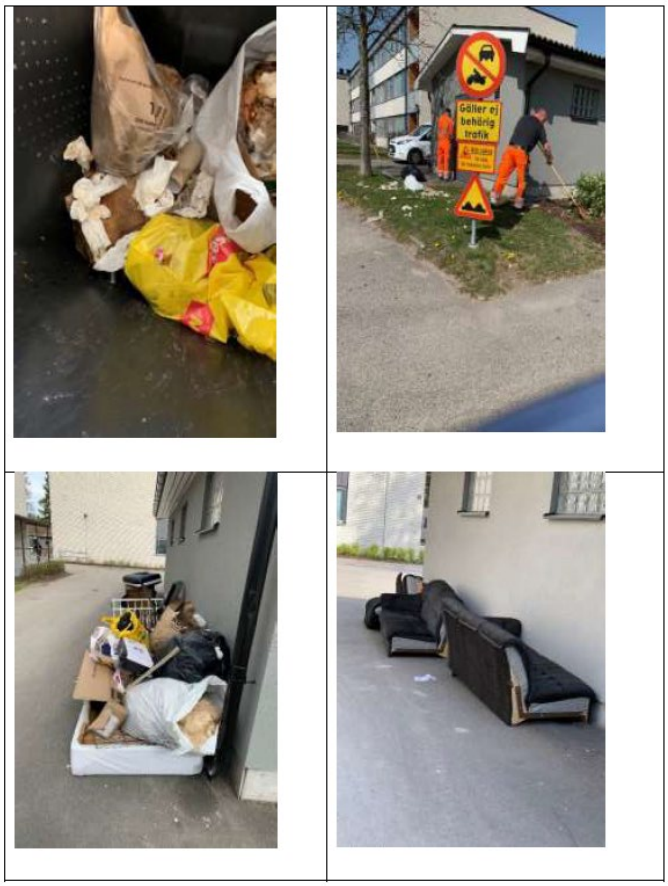


Image 3: Unsorted waste left at different places in Alabastern (source: photo taken by a project staff in different months in 2019)

1.2 Previous attempts to address waste-related problems

Växjöbostäder has undertaken several initiative in the past to solve the waste-related problems in Alabastern as following.

- Distribution of brochures to households in year 2016 that explained the tenants how to sort household waste, in Swedish and English language (April 2016); After that all new tenants are handed out the brochure.
- Installation of new sign boards in recycling rooms (miljöhus), which show different fraction of household waste be thrown in different containers, in Swedish and English (April 2016);
- Information regarding waste management and waste sorting on Växjöbostäder’s website in Swedish;
- Information regarding waste management and waste sorting in Växjöbostäder’s customer magazine, in Swedish;
- Short films on waste management and waste sorting in YouTube, in Swedish (Autumn 2014). At the same time “Environmental ambassadors” were trained to go around the area and inform the tenants about waste management.

[1] In 2017 the cost for cleaning and gathering waste in Alabastern sub-area was approximately 178,051 kr (Swedish crowns).

1.3 Objective

Despite several attempts for resolving waste-related problems in Alabastern sub-area, challenges regarding sorting and amount of waste persisted. Hence, the objective of Task 8.9 is to understand the underlying causes of the waste management problem and conduct a campaign to reduce the problem.

2. Method

An action research methodology was applied to conduct this study. In this approach researchers contribute directly with other partners to diagnose a problem and develop solutions in order to solve the problem. The following activities were conducted under the action research methodology.

- To understand the perception, attitude and behaviour of the tenants regarding energy, water and waste, a group of students from the LNU Masters program "Innovation through Business, Engineering and Design" conducted a combined mail-in/online questionnaire survey of the 300 households in Alabastern and surrounding area in March 2017 (after amendment regarding LNU to lead task 8.9 was sent to European Commission). However, only 16 households responded, even though there was a possibility to win a gift voucher of 250 SEK provided by Växjö Kommun. This low response rate was mainly due to special socio-economic and cultural situation of Alabastern, which made it difficult to communicate with the tenants.
- Multiple meetings were held between Växjöbostäder and LNU to gather information and gain in-depth knowledge regarding sorting and amount of waste in Alabastern. In some meetings Energikontor Sydost and Växjö kommun also participated. At the first meeting of these partners, Växjöbostäder suggested that waste management is an acute problem in Alabastern and it should be the main focus of the behavioural campaign. However, the experience from the questionnaire survey in 2017 showed that it was difficult to reach the tenants. Hence, we put a lot of effort to find ways to reach the tenants and communicate with them to understand their views of waste management problem in Alabastern.
- Linnaeus University established contact with the Växjö municipality's Medborgarkontoret (Citizen office), which is located adjacent to Alabastern. The office helps/guides the immigrants to establish in Växjö and communicate with them about their rights and obligations. Many staff are themselves immigrants and spoke Swedish, English, Somali, Arabic, Dari and Urdu languages. We held several discussion with a staff who himself migrated from Somalia to Växjö many years back and is very familiar with the tenants of Alabastern. According to him the main hinder in resolving waste-related problems was tenants' lack of knowledge regarding health, economic and environmental benefits of reducing waste and sorting them. Tenants had different language and culture, which created difficulties in delivering information and communicating with them. It was therefore, necessary to find an ambassador who could reach the tenants and communicate with them.
- We applied the concept of "para-professional aides" in this regard, which means recruiting and training people from a community to facilitate implementation of intervention measures planned to be implemented in the community. These aides are more educated and possess better communication skills than other members of the community, and therefore, are better placed to be trained about the intervention measures. Since, they belong to the community, it is relatively easy for them to reach and communicate with the community members. The staff from Medborgarkontoret took many weeks to suggest few such persons from Araby area (in which Alabastern is a sub-area) who could be employed as para-professional aides. We selected a woman who has immigrated from Somalia, fluent in Somalia and Swedish languages, and familiar with Arabic language, and happened to be a student of the master of sociology program at LNU. It was important to select a woman since household activities in general are woman-centric in the socio-cultural system of Alabastern. The recruitment process of the female candidate took few months and she worked part time for three months (October

– December 2018). She was trained (which included meetings with the project leader and self-reading) for about one week about the purpose of the project, benefits of waste recycling, waste management system of Växjöbostäder, and how to conduct interviews with the tenants. Since it was winter months in Växjö, she was given a LNU jacket to wear so that people would remember her as representing LNU and working on waste management project.

- The paraprofessional aide went around Alabastern to meet the tenants randomly, informed about the READY project and discussed about the waste management issue. She visited few apartments as well as talked to residents trolling in the area or present in the local community centre and cafeteria "Tallgården". She got a sitting place for 2-3 weeks at the Medborgarkontoret to meet tenants coming there for other purpose. The aim of this approach was to create a rapport with the community members and prepare condition for open discussion.
- The project leader, the paraprofessional aide, and a trainee student at Växjö municipality organized two focus group interviews of the tenants. The interviews with light refreshment took place on 11 December 2018 between 16 hr. to 18 hrs and 18 December 2018 between 18 hr. to 20 hrs at Tallgården. The interviewees of the first focus group interview included seven women who spoke Somali and only one woman who spoke Arabic, while the interviewees of the second focus group comprised seven women and two men who spoke Somali and only one woman who spoke Arabic. Most of the participants have children of older ages. The paraprofessional aide led the discussions in Somalian language, but the Arabic participant conversed in Arabian and Swedish language. The discussions were electronically recorded with the permission of the participants. The aide summarized the discussions in Swedish for the trainee student to write in paper.
- The woman paraprofessional aide quit the project at the end of December 2018 and the process to recruit a replacement started. We contacted the local employment office through the Medborgarkontoret and received few applications. An immigrant woman from Middle-east who lived in Växjö for several years and acquainted with Alabastern was recruited as a paraprofessional aide in April 2018 and she worked till November 2018. She regularly visited Alabastern, took photos, and interviewed tenants passing by the recycling rooms or trolling around the common area. The interviews included 30 men and 20 women of different nationalities, ages and level of educations. In addition, she conducted interviews by knocking on doors, where about 40 out of 258 tenants participated in the interviews. She also (i) participated in different activities for immigrants that took place in the Alabastern, such as language cafe, loud reading, and homework help, ii) discussed with owners of Arabic and Somalian stores in the area, and customers of the Tallgården café, and (iii) conducted interviews with waste collectors and sanitation workers employed by Växjöbostäder.
- An evening information meeting of the tenants was organized on 13 June 2019 at Tallgården café. Växjöbostäder led the meeting and presented about how to sort waste and the health, economic and environmental benefits of reducing waste and sorting it properly. The participants included 10 women and 20 men, and they had lot of questions and complains.
- Växjöbostäder's waste recycling guide in Swedish and English was translated to Somalia and Arabic languages and distributed to each household.
- A questionnaire on energy, water, and waste recycling behaviour of the tenants was created in Swedish, Somalia and Arabic languages and delivered to each apartment.
- In March 2020 three para-professional aides (two women and one man) from Somalia and Arabic origin and Alabastern neighbourhood were recruited and trained to visit each apartment to explain the waste recycling guide and conduct the questionnaire survey. The idea was to reach as many tenants as possible through snowball effect of personal contacts of the aides. About one hour was allotted to each household and the whole exercise lasted for two weeks. The aides visited the tenants according to the tenant's convenience including at late evening and weekends. About 50 households opened the door and participated in discussion about waste management. Only 20 households filled the questionnaire on the spot and 30 more responded later. The questionnaire with a prepaid returned envelop was dropped in the post box of the tenants who did not open the door. After one reminder 13 more responded. So

a total of 63 responded to the questionnaire survey, but all of them did not respond to all questions. Hence, we report number of observations (n) for each analysed questions. The composition of the respondents is outlined in Table 1. The composition of population in Araby district, where Alabastern neighbourhood is located, is also presented to verify that the people responding to the survey represented the population in the area, at least regarding gender and original nationality. The Araby area included all types of residential buildings, which include multifamily rented apartments, condominiums, and one- and two-family houses. The last two types of buildings are more likely to be owned by Swedish nationalities, therefore their share is somewhat higher in the Araby population. Since, the composition of respondents to our survey is rather similar to that of Araby, regarding gender and original nationality, it is likely that the respondents to our survey represented the population in Alabastern.

Variable		Alabastern (Gender and national origin, N=54; years living in Sweden, N=34)	Araby (neighbourhood where Alabastern is located; includes all types of residential buildings)
Gender	Man	52%	51%
	Woman	46%	49%
	Other	2%	Not available
National Origin	Swedish	37%	45%
	Somalia	17%	15%
	Arabic (Iraq, Syria, Yemen)	33%	30% (Iraq and Syria)
	Others	13%	10%
Years living in Sweden	1-5 year	12%	Not available
	5-10 year	18%	Not available
	>10 year	71%	Not available

Table 1: Composition of respondents to the questionnaire survey

- Time series data on waste generation from different housing districts of Växjöbostäder was collected from Växjöbostäder and analysed in MS-Excel. During this exercise it was noticed that specific measurements of waste generated from Alabastern did not exist. Hence, it was not possible to gauge the effect of intervention measures that would be implemented during the behaviour campaign.
- Energy and water use data for the year 2019 was compared for different buildings in Alabastern. Also, monthly and daily water use of 46 specific apartments was analyzed.

3. Results

3.1 Focus group discussions

The focus group discussions were steered within few predefined questions relevant to the waste management issue in Alabastern. Every participant had equal opportunity to present and discuss his/her opinion. The responses/quotes to the predefined questions (originally asked in Somali and Swedish languages) are summarized below.

Q. 1. What do you think when you hear the word waste management (in Swedish: Vad tänker ni när ni allmänt hör ordet sophantering?)

- That it is good for the environment and that you should sort correctly in different barrels.
- Do not mix food with anything else.
- You should separate different fractions of the garbage.
- You should sort, it's important.
- Food / batteries / plastic should be placed separately.
- Follow the rules and follow the pictures (signboards in recycling room).

Q. 2. What do you think when we say sustainability (in Swedish: Vad tänker ni på när vi säger hållbarhet?)

- That you can reuse certain things.
- Some things that you reuse is good for the environment, you should do it. Then other stuff is not good for the environment or things that you cannot recycle so many times, you can avoid those.
- For example, you should donate furniture to the Red Cross, which is good because then it is reused.

Q. 3. What do you know about the link between waste management and sustainability) (in Swedish: Vad vet ni om kopplingen mellan sophantering och hållbarhet?)

- You can recycle, e.g. cardboards, so you can use it several times
- In the past, I did not think it was important, but then I learned that waste could be reused, for example in transport, and now I think it is important.
- Some from Växjö Municipality have been here and told us why it is important; it is good for the economy and the environment.

Q. 4. What do you think about waste management in your area (in Swedish: Vad tänker ni om sophanteringen i området?)

- There are pictures in the environmental houses that show how to sort.
- Not everyone follows the rules that exist, many leave their waste outside the recycling room.
- It depends, it's a little different in every recycling room, some better than others.
- There are many who sort (waste) but it is those who do not do the right thing that makes it look bad, which means that those who do the right thing are not visible. Those who do not sort create problems for others.
- Some do their best, but not everyone does it and then of course it is boring. Some let the kids throw and then it doesn't end up right.
- You get angry and sad, there will be animals, birds when there is rubbish outside and then you will not be happy. We live here and it is not fun when there is garbage. It is in the morning you find that there is rubbish, so they leave those in the evenings and the animals come.

- There is rubbish, clothes and furniture in the (recycling) houses, it looks very bad and it is very sad.
- Sometimes people just leave garbage outside the recycling room.
- While moving during the renovation we received packing cartons as help. When you finished moving you had to leave the boxes under the stairs that Växjöbostäder would collect, but they are still not removed. Then it has become that people think it is okay to leave there other waste items also. So, there Växjöbostäder probably thought a little wrong, they should remove the cartons now and then.
- There is somewhat better in the recycling room after the renovation (in Alabastern area). Everything looks nice, there is a new playground, chairs, and so it is very nice but it does not mean that people throw garbage properly.
- It can be well sorted for a while now and then, but not so in other times.
- You never know what is in the bags that are in the containers, some things you can see are wrong but in the bags you do not know.
- Sometime there are furniture and other stuff in the corridor or staircases. People do not care if you tell them not to do so.
- Never seen someone threw wrongly but when you walk into the recycling room and see that it is wrong or dirty, you think "how do they think, we have special recycling room and keys and information, so why do they do this?"

Q. 5. Do you know why everyone does not follow the rules (in Swedish: Vet ni om varför alla inte följer reglerna?)

- Hard to say, the recycling rooms are nearby and I am sure they belong to the apartment, you do not want messy or something smelly in their apartment and therefore you should do it right (recycling), but everyone does not seem to care. Then there are those who are afraid of entering into the recycling room.
- They do not care, you do not want it with you so then you throw, but then it does not seem to matter what it looks like where you throw.
- In northern Sweden, they showed where recycling sites are located, where you recycle everything, there was a lot of talk about the benefits of sorting, it is probably important for more people to follow the rules.
- People who throw garbage or put rubbish outside the recycling room or in the corridors know that it is wrong, otherwise they would have done so during the day but they do not. They do it in the evening / night because they know it is wrong.
- In the past, the doors to the environmental houses were open, so you did not need to stress or skip throw properly if, for example, you have forgotten the key. Now it's locked.
- It's worse now than when doors were open. You notice the differences, it's a lot dirtier now than it was before.
- You send the children and they leave the stuff outside because they forgot to bring the key or do not want to use the key to go in (the recycling room), or that you send them with the key but it is lost when they come back, and then you do not give them the key anymore and let them put the stuff outside. It will not happen if you have it open.
- In some apartments it is crowded, may be 8 people in two rooms, and then it becomes more garbage.
- It is dirty and messy even in the laundry rooms, there is chaos and it smells bad. If it is dirty there, then you may not care about keeping the recycling rooms clean.
- There are cardboard boxes and similar from detergent packs in the laundry room, so no one cares about the rubbish.

Q. 6. Why are there some who are afraid of going in to the recycling room (in Swedish: Varför finns det vissa som inte vågar gå in i miljöhuset?)

- There may have been others who have already cluttered the room, it is dirty, and it smells really bad which means you do not want to go in, and then it becomes that you throw everything in the same way and leave immediately.
- It smells strong in there. There is a lot on the floor, if it was cleaned every now and then you might not see it as equally messy and then maybe people will do the right thing. When it is disgusting in there and it smells bad, you choose to throw everything in the same to get out of there as quickly as possible, even if you sort at home.

Q. 7. Who leaves the garbage and when (as you have seen)? (In Swedish: Vem är det som lämnar soporna och när (som ni sett))?

- It's hard to know which ones are throwing wrongly. If you meet someone who does wrong then you can sometimes point it out but then you can get an answer "why do you care?"
- You do not know who is wrong, but if you say something, you get some explanation like "I forgot the keys (for the recycling room) and I cannot go up again (to the apartment)" or "I hurry to the bus".
- You can't know exactly who, but when you see it, you start talking. There are certainly many who does (cluttering).

Q. 8. How do you handle your own household waste? (in Swedish: Hur hanterar ni ert egna hushållsavfall?)

- As they show in the pictures in the recycling room; food waste, cardboard boxes and plastic in different boxes. I sort so already at home so it gets right immediately.
- We sort garbage and food. Food should be in a special bag and then put in the container for food.
- We take care and do as per guidelines.
- There are signboards on how to do, different containers for different types of waste.
- Before when I lived with my family (parents) we all did wrong, I put everything in same bag and threw in a container. But, now I live myself in a newly renovated apartment and I want to do it right.
- Before I did throw, as she said, all in the same container. In my home country it is so, everything in the same but then I went to school here, they talked about costs and why to sort and so on, and now I have gotten better.
- I sort what one should. I took a course in school (community orientation), someone from Växjö municipality came, they had examples and they showed how to do so. Then I learned right.

Q. 9. Who in your family goes out to throw the garbage?

- It's different, the one that's there when it's time to throw.
- Children, dad, mom; the one who is going out first can simply take and throw the garbage.
- Sort at home and then explain the children so that they can look at the pictures in the recycling room. But, you cannot be sure that they (children) have done completely right but you have done what you can.

Q. 10. How do you handle furniture that you need to throw (in Swedish: Hur gör ni med möbler som ni behöver slänga?)

- There is a place where you throw furniture, but you must have a car to get there, have seen how others just put their furniture outside their building.
- Everyone does not have a car or driving license, it is difficult to get to the place where you can throw away old furniture and stuff if you do not have your own car or driving license.
- I just moved away from home so I didn't have to throw anything.
- I don't know what to do with the furniture but there is certainly a place where you can leave them.

Q. 11. Where did you get the information on how to sort?

- In school (adult education for immigrants).
- It is clear on the signboards that hang in the recycling rooms, they have both pictures and text about which fraction to be thrown in which container. If you can't speak the language, you can look at the pictures.
- From Växjöbostäder, but people do not understand (the content), and they do not care if it is about some boring thing as waste, you just throw the document in dustbin.
- Someone who is taking a training program on cleaning (or local maintenance) tells us that you can go there for a course to learn how to sort properly.

Q. 12. How often do you talk to each other about waste management (in Swedish: Hur ofta pratar man om sophanteringen med varandra?)

- Yes you talk a lot, especially when something is wrong. Sometimes when you go out and there is someone there, then you talk to each other and ask like "why? How can they do this”?
- Yes, everything is newly-renovated, and then it is obvious that you talk about it, now that it is so nice. Of course, you talk about the negative.
- Quite often. If you are in the laundry room that is next door and see how dirty it is, you can talk about it, as well as see how it looks. It is not good for us, for the area or for the health because there are birds and things like that.
- I have never seen anyone throw garbage outside the recycling room, just furniture. You do not see as much as those who have their laundry room nearby, so you do not talk as much.
- There is a woman in the area who also lives here, she goes and collects and throws the garbage. Once I asked if it is her garbage and then she said no but that she takes care of it because otherwise birds will come.
- It is clear that you talk about how it is, you transpire a little with each other.

Q. 13. How can waste management be improved (in Swedish: Hur kan sophanteringen förbättras?)

Install surveillance camera

- Install camera, then you see who does this, it must have consequences. If there is a camera, everyone will know it and talk about it, which will make more people do the right thing. Warnings for camera in the area, for example, if you drive a car and they warn that there will be a camera. Then you slow down the speed.
- Install camera
- Although there is already a camera, right? We don't know but we have heard about it and if there is none then it is not a good idea (to install a camera). It would cost so much.

Designated place or containers for furniture

— There is a lot of furniture near stairwells, which could be avoided if there was a place in the area where you could leave them.
— There are many who know where to throw, e.g. clothes and furniture, but may be a container or something like that is needed to facilitate. There are many who do not have a car and then it becomes very difficult to transport furniture or similar heavy items to a recycling station. Must be simple!
— The most important thing is probably a place for furniture. It is so carefully described how to sort other things that if you choose not to do so, then you do not care at all.
— There is a place (in Växjö) for old furniture, but a solution for the area is needed. Some send their children to go out with the furniture and they just put somewhere.
— Help should be available to move your old furniture there (place in Växjö) or nearby, there may be someone else who may need something, it will be reused then.

More information and in multiple languages

— It is simple already, but it may have to be made even easier, they have no knowledge.
— The simplest thing is probably to *knock the door* and say that every now and then we will meet, during a time that most people can, e.g. 18 hr -19 hr. When asked if they sort their waste they will probably lie and say that they are doing right, but if they get information directly from someone then maybe they take it seriously and do it right.
— A lot of information is needed. Send out information (e.g. *multilingual brochures*) so everyone understands. Some have been told how to do from *school*, others not and then they come to the recycling room and see that it is already dirty, and so you continue to dirty it because others have already done it.
— *Lectures* are very important, you have to get in touch with as many people as possible.
— Several people send their children, they often throw everything in one. So you also have to *inform the children*. Then if you send the children to throw, upon return ask them where they threw. Tell the kids that it is not good to throw in wrong places or containers.
— In school, social orientation is good. They tell a lot and it's great, but everyone doesn't care. It would be better if information was in *Arabic* and *Somali*.
— Maybe there should be information in *several languages*, for example, you can take something home and hang on the wall.
— The signboards are in Swedish. It would certainly have helped if they existed in several other languages, such as *English, Somali* and *Arabic*.
— When we moved in, a letter came home in which the information was in *several languages*.
— Yes, it would certainly have helped if it had been in *several languages* since there are women who are at home and do not understand Swedish.
— Yes and then there are actually illiterate people in the area, they do not understand at all but in their *mother tongue* they may be able to understand a little if they recognize something.
— You can look at the newly renovated apartments where there are signs on the walls that bicycles and strollers should not stand in the corridors but still today there are bicycles and strollers in the corridors. I don't think they understand and then they don't care. They do not want to read, but if it maybe in the *mother tongue* you go there and read because then you become interested, you think aha I understand this, wonder what it says.
— We want to understand, but it's not so easy and everyone doesn't understand.
— It might also be important to have in *Somali* for children to understand, then they can in turn explain to their mother, she is often forgotten actually.
— Children may learn but unless the mother can, the child may do something else than what he/she has learned.
— You help each other in the family, typically if the children know more Swedish than the parents, then they get to read, then they help each other.

— The Medborgarkontoret (Citizens' Office) is also helpful, where you can go if you do not understand or need to ask something.
— Sometimes it can be difficult for the children to translate to the parents and then it can be big mistakes, so it is good to be able to go to the Medborgarkontoret.
— You can tell others to do it right way, but not everyone dares to do it, and the one you say may not care about sorting properly.
— Sometime you try to help others, but there are language barriers.

Employ someone for regular control

— Employ someone who can be in the area regularly and check the recycling rooms; if you see someone is keeping an eye, then you do not dare to do wrong things.
— We ourselves cannot do something, may be someone should be employed.
— There are many unemployed people in the area, may be one such person can get the job to take care of the recycling rooms.
— There are people who litter inside and outside of the recycling room; may be there should be someone to check the rooms now. It becomes very dirty because there is a long time gap before the rooms are cleaned.

Competition

— There might be a competition, where you look at food waste in different areas, and then based on some measurement you judge which one is best. Food waste is biogas and you have that for the buses, so those who win may get a free bus ride for a week.

Study visits

— There are other cities where new people can go and look at such a place where you should throw, for example, furniture, and then they can show you around and explain. That might be a good way.

Redesigned recycling rooms

— A recycling room with slots for waste fractions to be deposited from outside is good (e.g. *Image 4*). Then you do not have to go into the house. It is easier and you avoid both dirt and smell. If there are gaps, you just have to look at what should be thrown in which door, open it and throw it. If you have bigger things you may need to go into the room but it is not that often.

Image 4: Example of alternate design recycling room

3.2 Personal interviews and observation

The second paraprofessional aide interviewed many tenants in the area made observations of the area through regular visits. A summary of the interviews as well as her observations is summarized below.

Recycling problem in the area

- There exist several problems in the Alabastern area, one of them is the waste recycling problem.
- About 10%-15% of the household waste is properly sorted.
- Recycling rooms are dirty, garbage bags on the floor, unsorted and mixed garbage in same container, and things (e.g. furniture) that should not be in the recycling room.
- Household waste thrown outside recycling rooms.
- Household waste thrown in small bins (meant for very small fractions) outside the buildings
- Signboards are either in Swedish or multilingual, but the text in other languages very small and unclear from distance (*Image 5*).

Image 5: Signboard in a Recycling room about food waste

- Things thrown wrongly become a source of irritation.
- Careless with food waste, paper bag is rarely used.
- Household waste mixed in the same garbage bag and thrown in any container, often in the first container next to the door.
- Most people said that they usually sort the garbage (but interviewee's own interpretation from the way they talked was that they did not)
- Few interviewees mentioned that they did not know how to sort waste because they have recently arrived in Sweden. One mentioned that (s)he knew how to sort, but did not have time about these things.
- Women ask children to throw the garbage without giving key to the recycling room, who then leave the garbage outside the recycling room.
- There are people who could not read or write, i.e. there is communication problem. One said that the municipality should take part of responsibility in two ways:
    - To take care of more about what they read at school as a newcomer to Sweden, not only is the language enough, but they must be educated with the laws of society.
    - The municipality contributes mostly families with low support, so they could not rent elsewhere (this area is cheaper than the others); so there are people from the same background concentrated in one area and that exacerbates the problem

Proposed solutions

Information

- Distribute multilingual brochures to every apartment. It should explain with pictures how to handle and sort household waste.
- Clear and multilingual signboards in the recycling rooms
- Regular information meetings organized by Växjöbostäder on different topics (e.g. energy, water, safely, environment, waste etc.). This will provide an opportunity for the tenants to share their knowledge, practice and experience to others, who in turn can motivate others.
- Educate children and adults in school.

Technical

- Surveillance cameras in and around recycling rooms
- Sensors in containers so that they can be emptied when full
- Doors that are simple to open
- Windows in the recycling room improve safety and ventilation.
- Try to have redesigned recycling room, where it is possible to throw garbage in separate bins from outside.
- Garbage bags in different colours for different fractions of waste

3.3 Questionnaire survey

3.3.1 Awareness and attitude towards environment

Majority of the respondents consider themselves to be aware of environmental issues in general and the causes of environmental problem, but a lesser proportion are aware of solutions to those problems (*Figure* 2). Responding to another question, about 55% of the 57 respondents reported that, compared to others, they are doing enough or more than enough towards the environment.

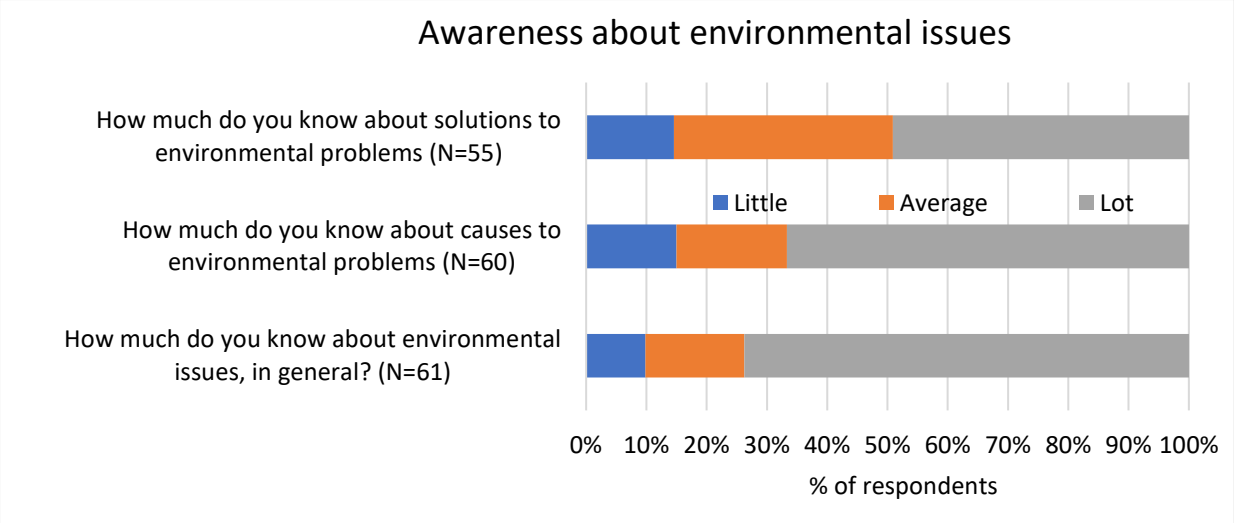


Figure 2: Awareness about environmental problems

We posed a series of statements on attitude towards environment to which the respondents could respond in a 5-point likert scale (1= do not agree at all, 5=completely agree). The responses were reorganized to three categories by merging points 1 and 2 to one category (disagree) and points 4 and 5 to third category (Agree). Results presented in *Figure 3* shows that about 70% agree that they do

what is best for the environment even if costs money and time. On the other hand, about 30% have a negative attitude as they think that many statements about environment are exaggerated, they do not want to pay higher taxes for the environment or feel that there is no point of protecting environment if no one else is doing it.

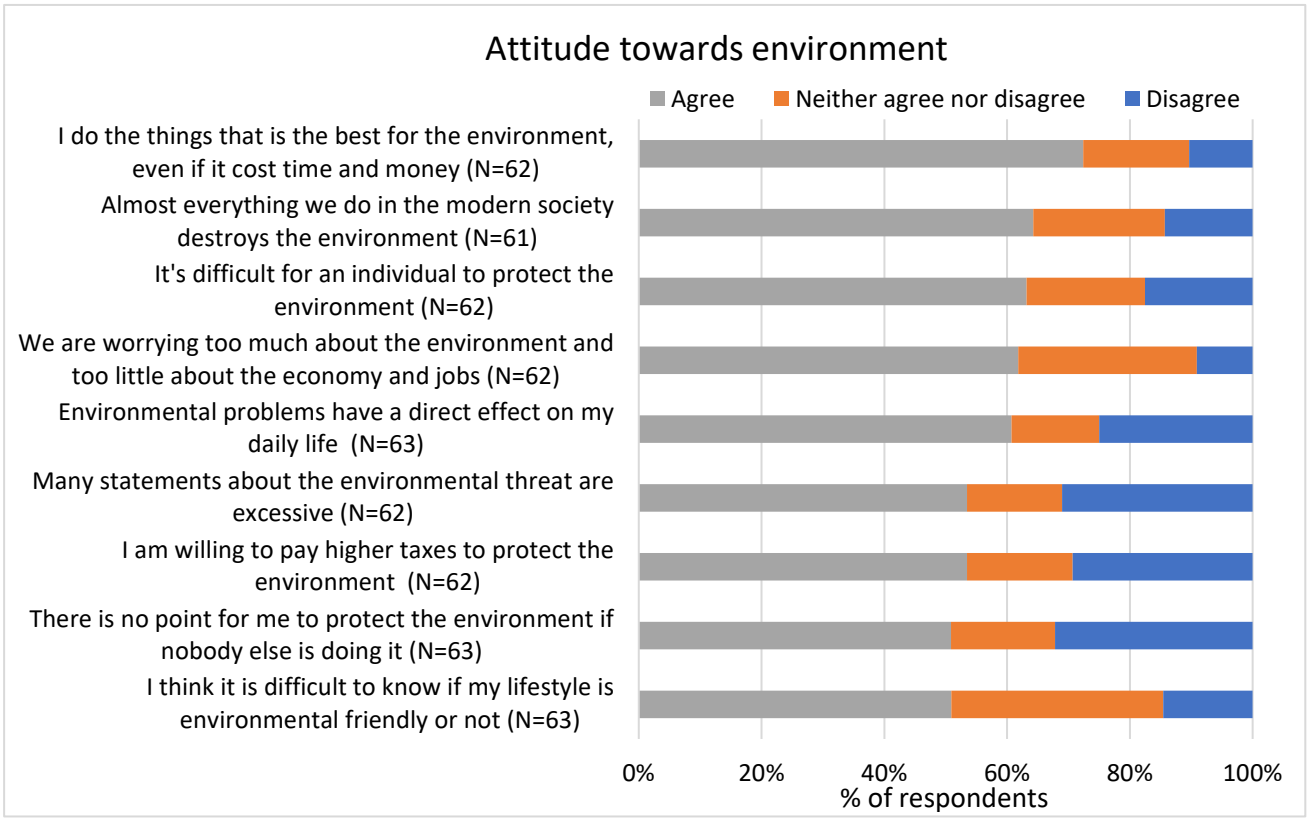


Figure 3: Attitude towards environment

The respondents were asked to mention how they would like to be informed about environmental issues and behavior. A majority preferred digital display followed by meetings by Växjöbostäder and brochures (*Figure 4*).

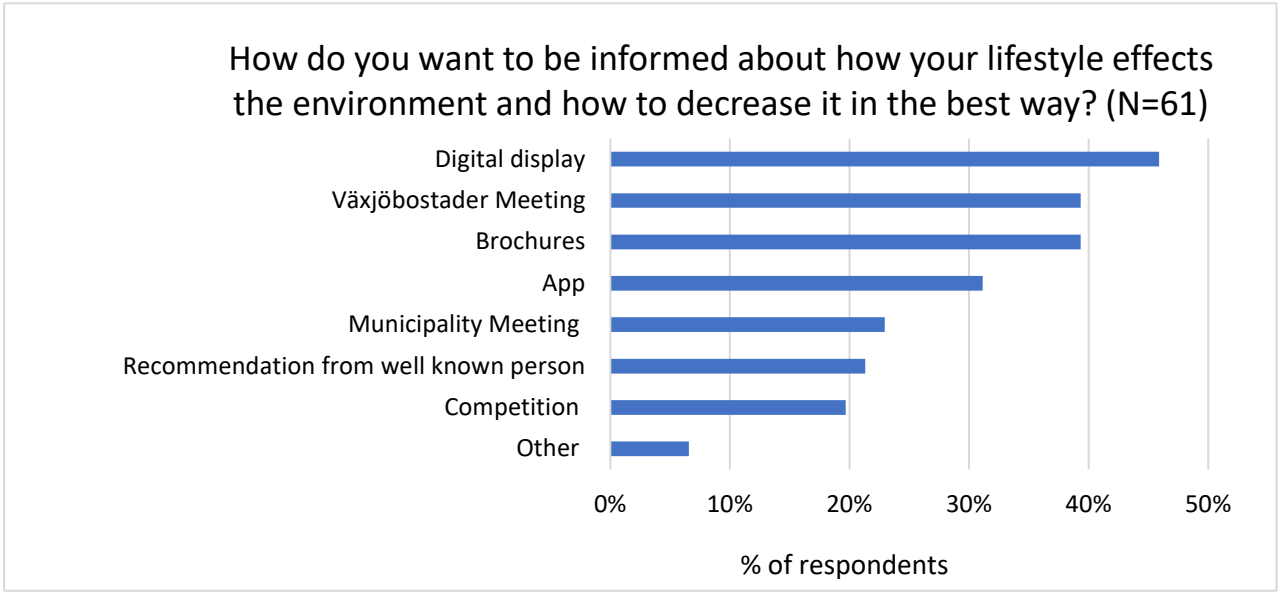


Figure 4: Respondents' preferred mode of information regarding environmental issues and behavior

3.3.2 Waste recycling

Figure 5 shows that about 80% of the respondents reported that they often sorted all fractions of household waste. About 7% to 10% never sorted at least one fraction of the waste, but it was not possible to identify those households due to anonymity of the survey. More people sorted paper and furniture than plastic or metal.

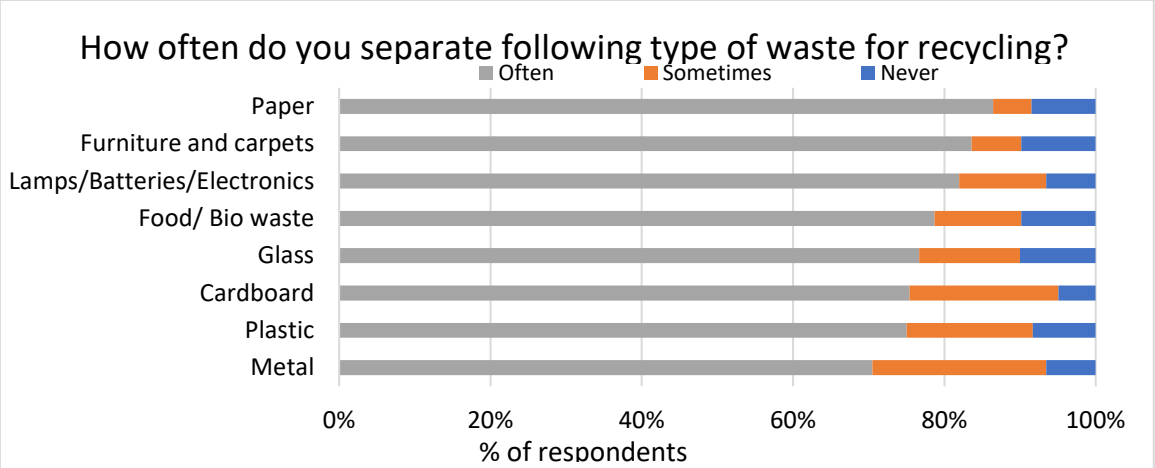


Figure 5: How often the respondents recycled their household waste?

Figure 6 shows that a majority of the respondents consider "others", e.g. people in surrounding area and inadequate action by Växjöbostäder, as responsible for the waste recycling problem in Alabastern area. Still, there are about 20-25% who blame themselves, e.g. lack of time or interest to recycle. About 50% cited unavailability of car or driving license as an issue, while 40% reported lack of space in the apartment as a limitation.

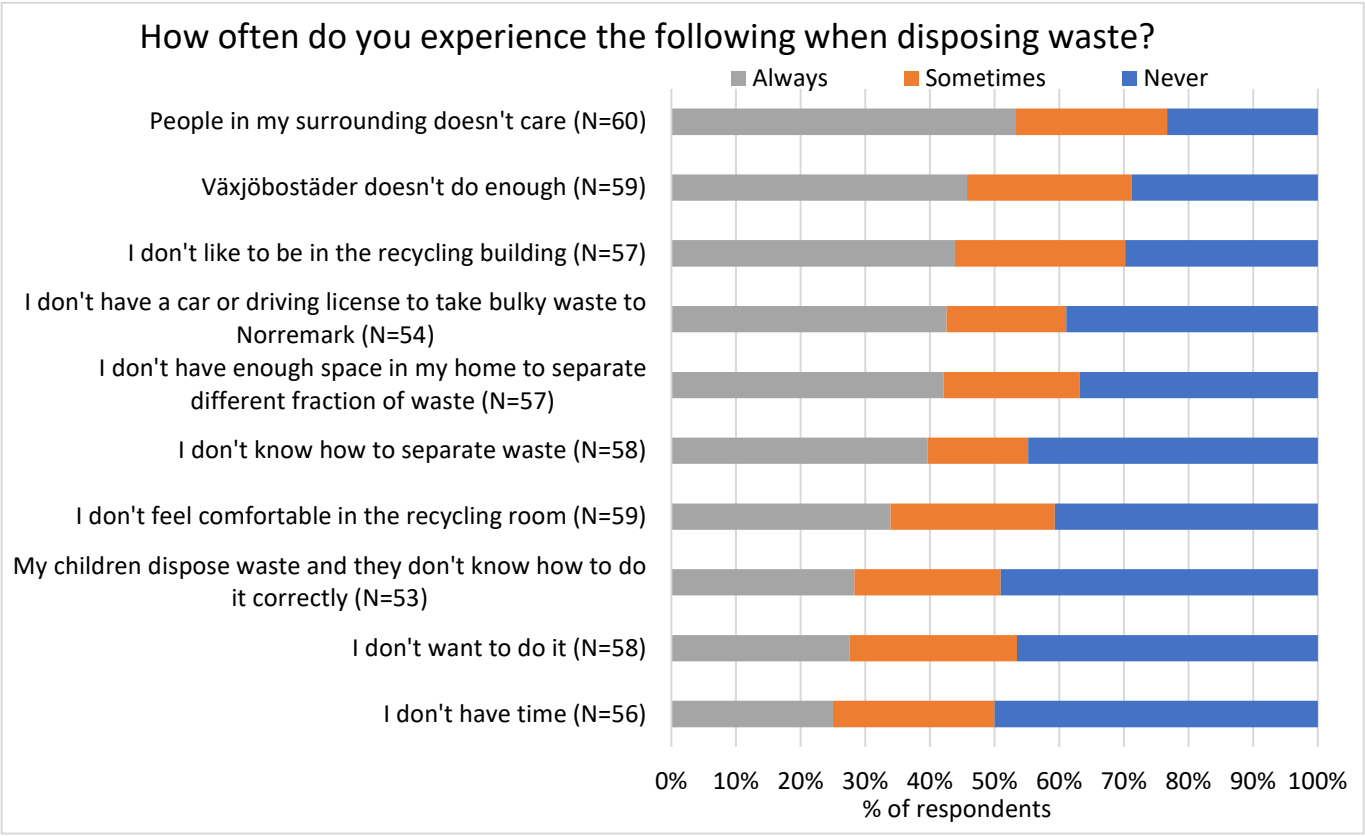


Figure 6: How often the respondents experienced different factors while disposing household waste?

Figure 7 shows that majority of respondents want Växjöbostäder to take the initiative to improve waste recycling problem in Alabastern. They suggest surveillance cameras in and surrounding recycling rooms, arrange a containers 2-3 times a year for people to throw their bulky waste, and employ someone to have a regular control of the area.

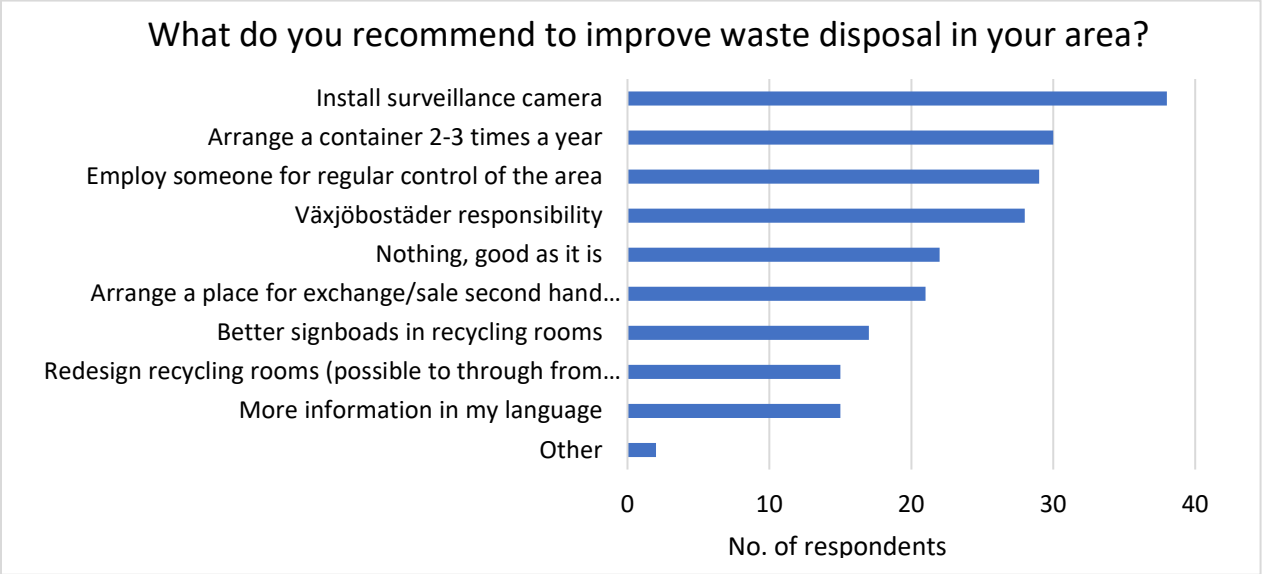


Figure 7: Respondents' suggestion for improved waste management in the area

3.3.3 Electricity use

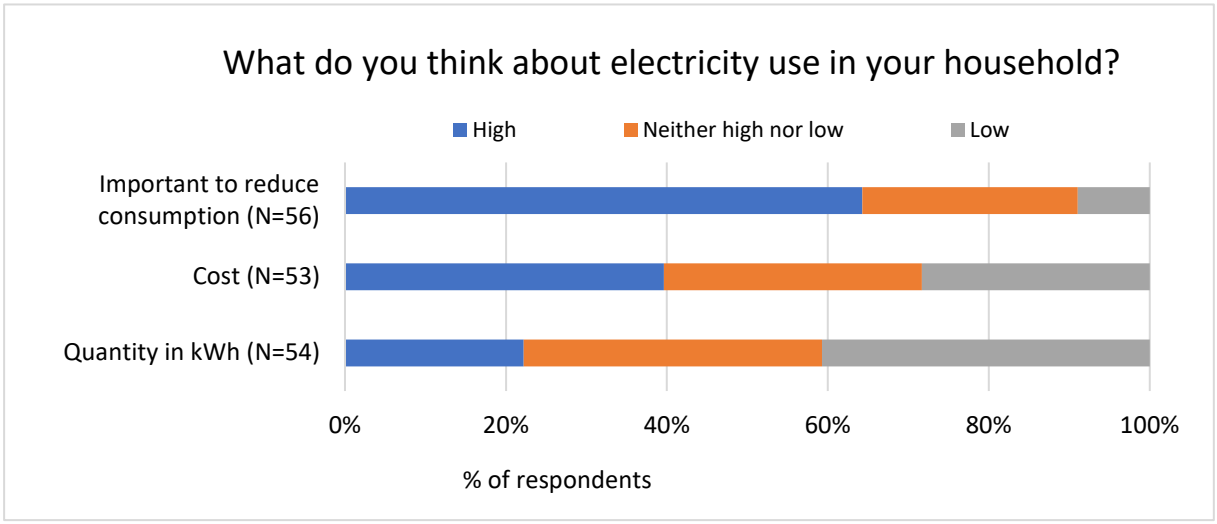


Figure 8: Attitude towards electricity use

Figure 8 shows that about 80% of the respondents consider that the quantity of electricity (kWh) they use is low or average. About 20% think they use a high amount of electricity, but a double so many (40%) consider that the cost of electricity is high. High cost of electricity might influence people to reduce consumption, but it seems other factors (e.g. care for environment) might also influence because about 70% consider that it is important to reduce electricity use. Respondent take variety of

actions to reduce electricity use; most popular is to cook with lids, and turn off lights and devices when not in use (Figure 9).

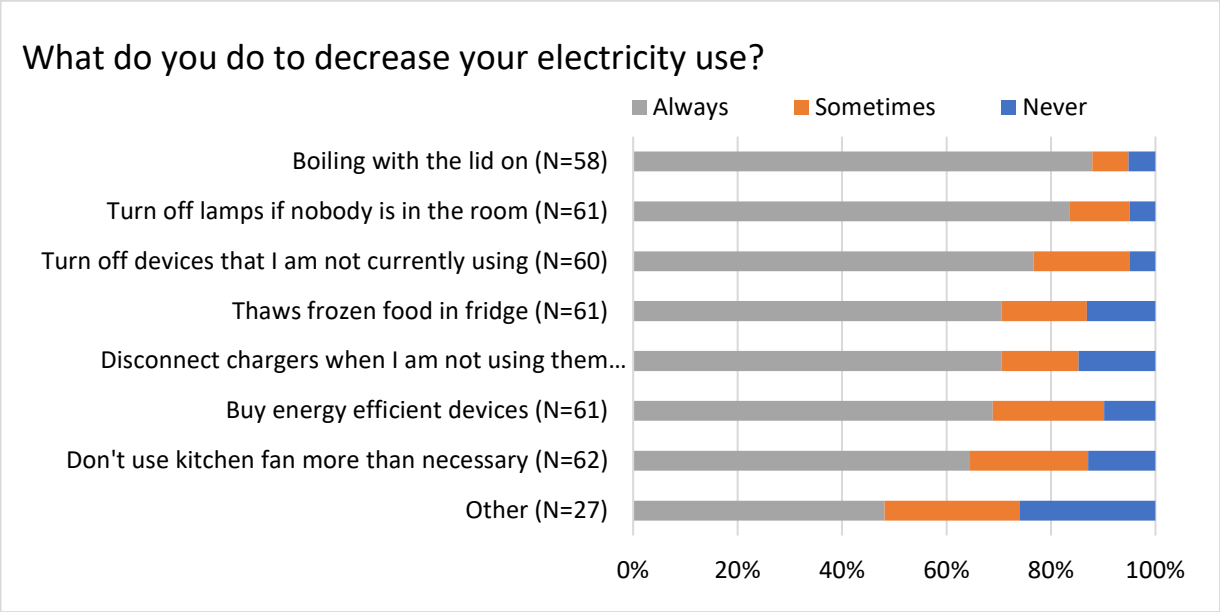


Figure 9: Actions respondents take to reduce electricity use

3.3.4 Indoor comfort

Increased insulation and airtightness of the buildings due to renovation should reduce cold draft, but may result in overheating in summer time. *Figure 10* shows that respondent do not feel overheating problem in summer time, but about 40% feel warmer (warm or very warm) indoor climate in winter months. This may be one reason why about 80% of respondent open windows many times a week in winter months (Figure 11), which results in heat loss.

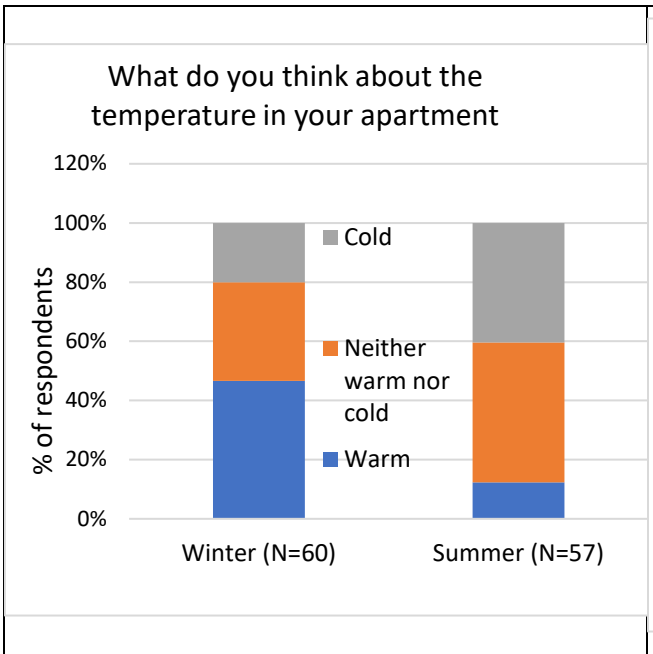


Figure 10: Respondents' perception of indoor temperature

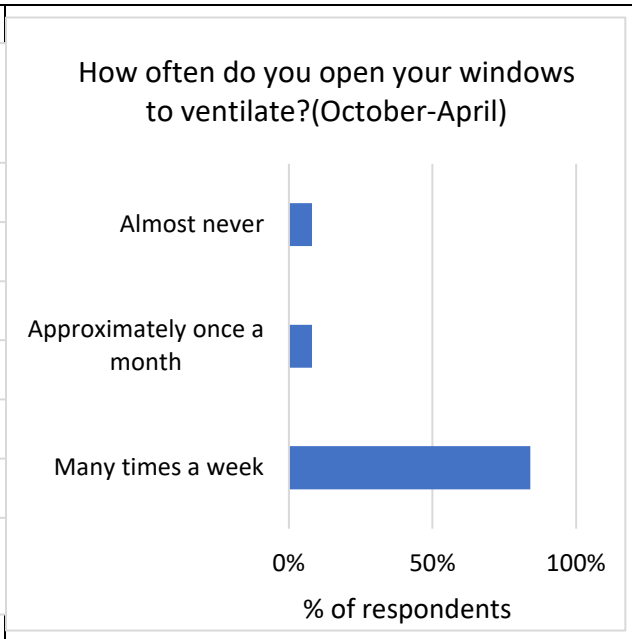


Figure 11: How often respondents open windows during winter months

3.3.5 Water use

Figure 12 shows that about 20% of the respondents think that their household water use is high (includes very high), while about 45% consider the cost is high (or very high). A majority consider it important to reduce water consumption (*Figure 13*), especially hot (or warm) water, may be because of its cost to the household. A large majority take variety of actions to reduce water use (*Figure 14*).

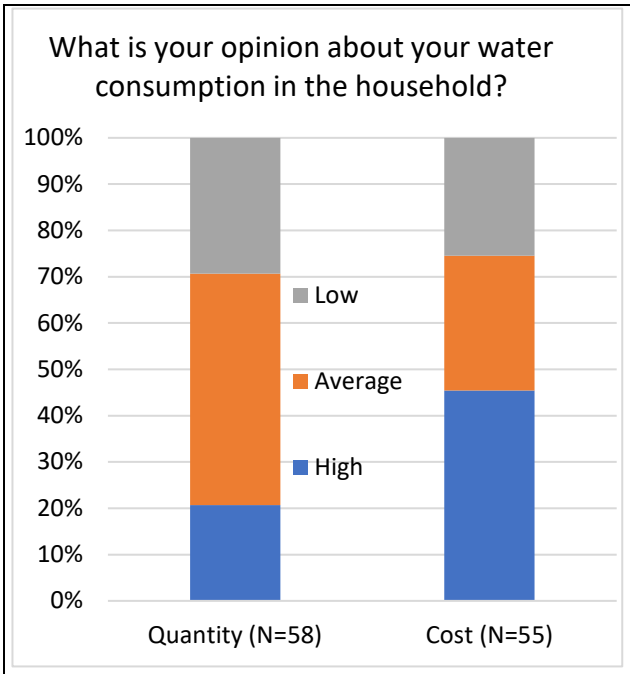


Figure 12; Respondents' opinion about quantity and cost of their water use

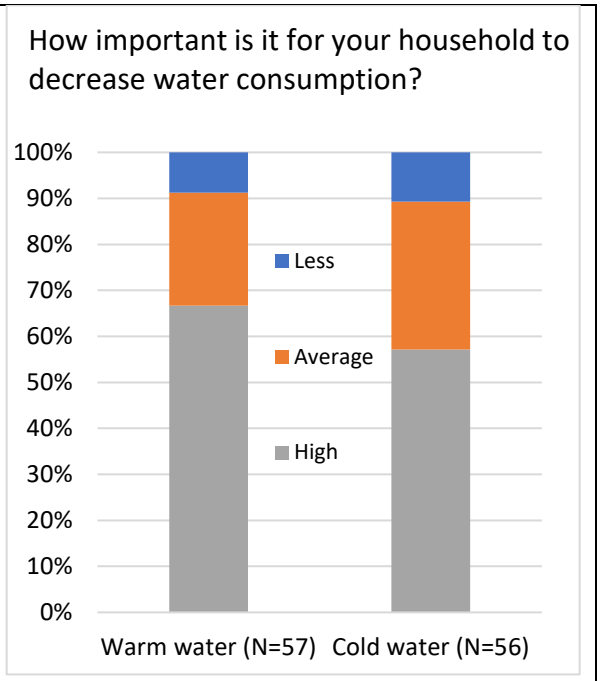


Figure 13: How important it is for the respondents to reduce their water consumption

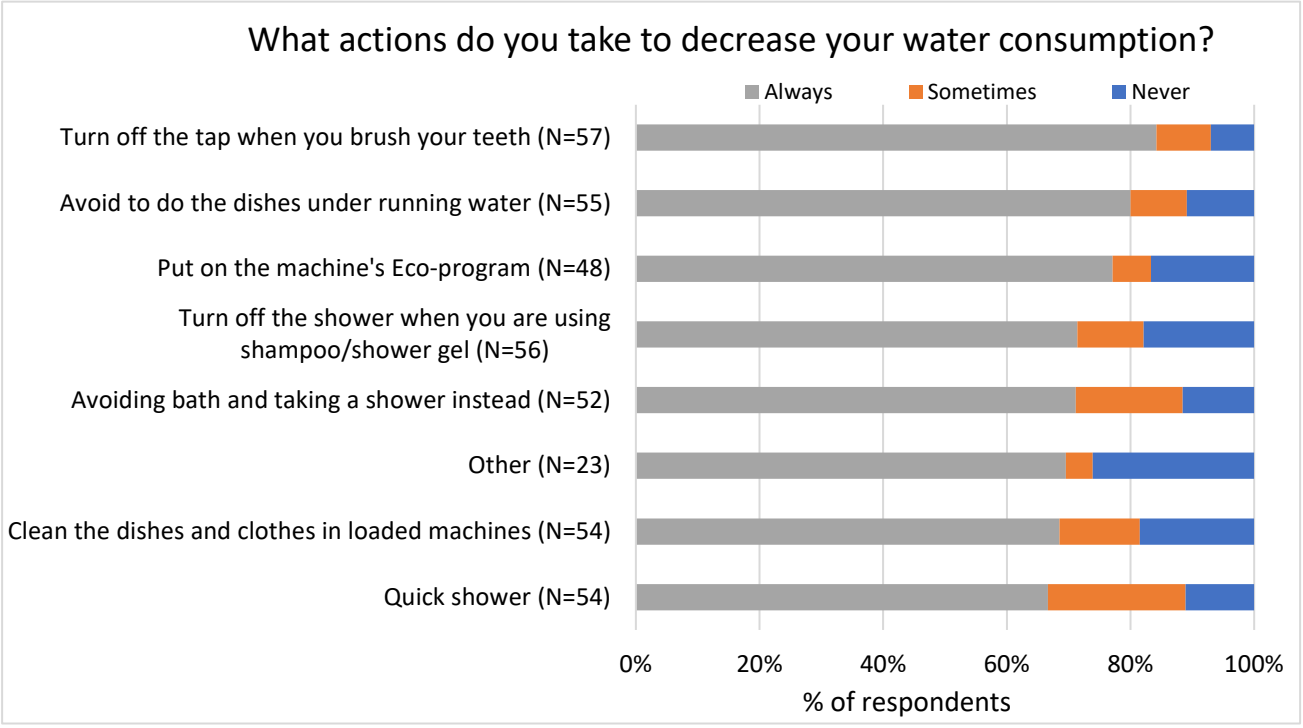


Figure 14: Actions taken by the respondents to reduce their household water use

4. Behaviour Campaign

4.1 Evening Information meeting

Växjöbostäder (VB) and LNU organized an evening information meeting for the tenants in June 2019. VB showed a video film as well talked about how to sort the garbage (in Swedish), but there were questions from the tenants not only about the environment or waste but on all aspects and problems they experienced.

- Doors of some recycling rooms have been broken, VB informed that they were replaced.
- It is difficult to open the heavy doors of recycling rooms.
- People bring their waste from other area and throw in the Alabastern area.
- Course waste e.g. furniture, old electrical products, even garbage bags, are left out and not picked for a long time, sometimes more than a week.
- People usually leave old household items in front of the recycling room during the night so no one can see them.
- The problem is with those who do not have a car or a driving license or those with a disability, how can they handle their old things?
- VB has not informed the tenants that they can enter the recycling room after 23 hr in the night. It was not allowed in the past. VB has included it in the personal information to be sent to all tenants in the neighborhood soon.
- Many of those who make mistakes are not present. So how do they know what is right and what is wrong, how they are informed?
- VB and the tenants have different views on whether VB has or has not informed the tenants about previous complaints.
- Children leave waste, but parents do not give them key
- There will be some suggestions on how to reduce the waste problems that VB and LNU should investigate
    - VB fix a car with a trailer once or twice a month for a low fee, and it can help many who are unable to hand over their items to the recycling center.
    - VB arranges similar meetings in different languages for those who do not know Swedish so well
    - For all residents who see someone doing wrong, they must talk and tell immediately, so everyone must take responsibility for the area.
    - VB can arrange space and time so that it becomes possible for tenants to exchange / sell their old furniture and goods.
    - VB can use surveillance camera to identify those who are causing waste problems and impose a penalty

4.2 Information in native language and home visits

The Alabastern area is dominated by tenants from Somalia and Arabic origin and the respondents to our surveys reported that lack of information in their native languages was one of the barriers to proper recycling of waste. Therefore, we translated the waste recycling guide of Växjöbostäder to Somali and Arabic languages (*Image 6*). The three paraprofessional aides personally delivered the guide to 50 apartments and talked to the households that it was important that they recycled properly (*Image 7*). The recycling guide was left in the post box of the rest of the apartments.

Image 6: Waste management guide in multiple languages

Image 7: Paraprofessional aides discussing with tenants about waste recycling guide

5. Monitoring

5.1 Waste

Data on waste generated in Växjö was collected from Växjöbostäder for the year 2016 to Mid-2020. *Figure 15* shows recycled waste generated in all housing districts of Växjöbostäder, while *Figure 16* shows the same for Alabastern area. Following observations could be made from both the figures.

- The total waste produced in Växjö and in Alabastern remains almost constant over time.
- The share of plastic, metal and clear glass remain almost constant, while the quantity of cardboard, paper, and colour glass has marginally reduced in Växjö as well as in Alabastern.
- Cardboards and paper (newspaper, magazine etc) are the larger fractions in Växjö as a whole, while in Alabastern cardboards represent the largest fraction. One explanation for the lower share of paper in Alabastern might be that people mix them with cardboards or with other types of waste. It may also be that many households in Alabastern area do not use Swedish magazines and newspapers due to language barrier.

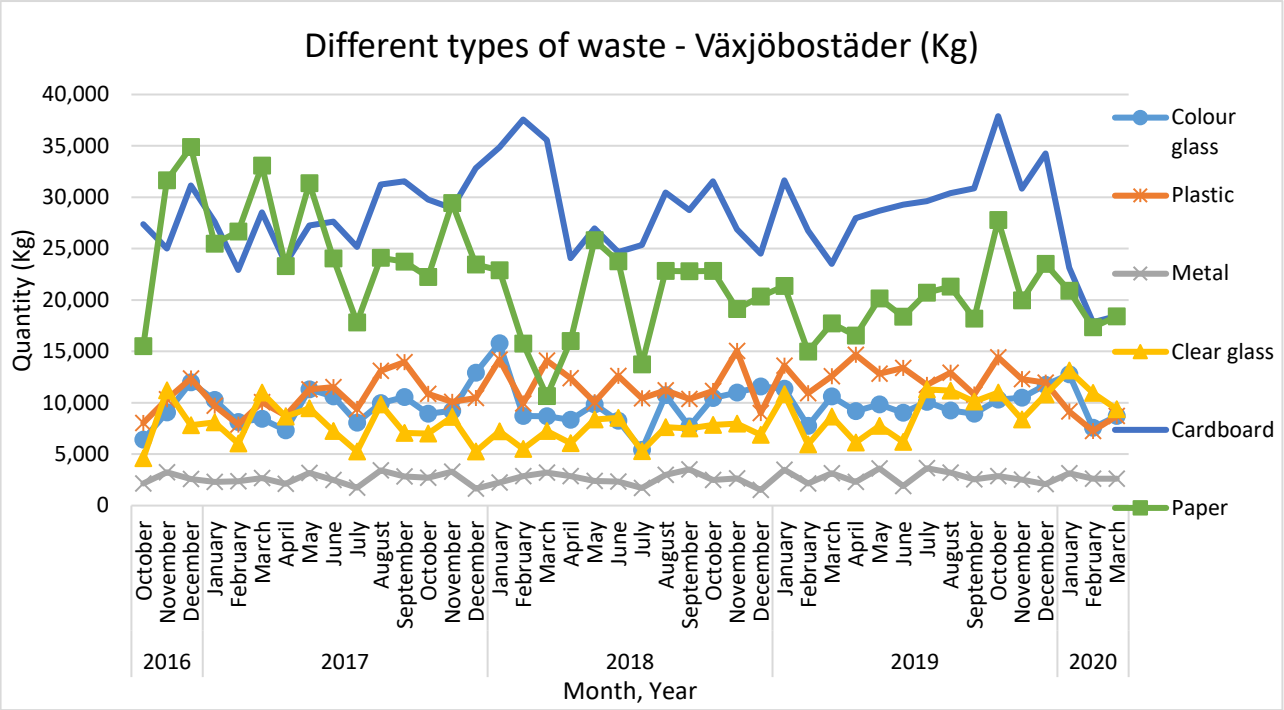


Figure 15: Weight of different fraction of recycled waste (except food waste) generated in all housing districts of Växjöbostäder

While analyzing the data for the recycled waste it was noticed that the statistic on **proportion** of waste generated from different areas of Växjö was constant over time. The share for all types of waste was 32% for the district Norr, 30% for Söder, 28% for Centrum and 10% for campus district. Växjöbostäder clarified that the total weight (kg) of different fractions of waste is measured at the final point of disposal and is reported by the entrepreneurs to Växjöbostäder. This total amount is distributed proportionally to different housing areas depending on the number and volume of waste containers in those areas.

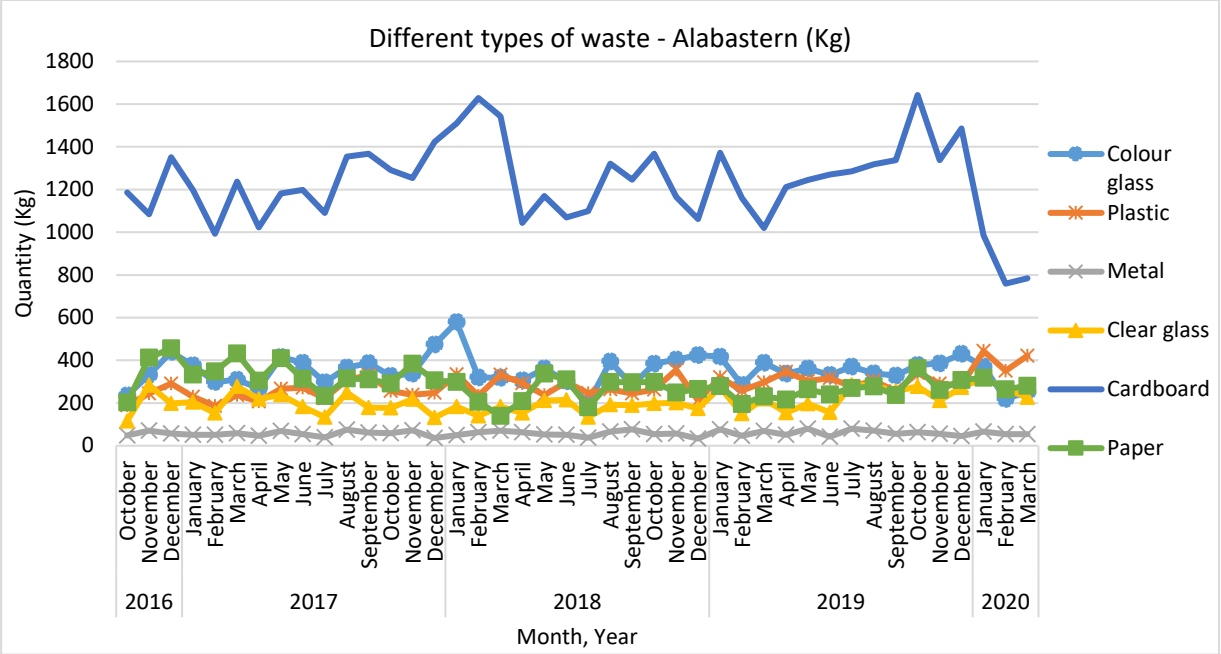


Figure 16: Weight of different fraction of recycled waste (except food waste) generated in Alabastern area

Figure 17 shows payments made to two entrepreneurs to collect bulky waste from Alabastern area. Bulky waste are those that are heavier than what is allowed for a person to lift under the Swedish law for work environment and/or bigger than that can be thrown in a container or hazardous substances. The entrepreneur 1 collect such bulky waste from outside of the recycling rooms for a variable fee depending on the quantity of such waste collected, while the entrepreneur 2 has a fixed price contract for collecting at regular intervals bulky waste thrown inside the recycling rooms.

It can be seen from *Figure 17* that the cost of collecting bulky waste thrown outside the recycling rooms has reduced from 2017 July-August till April 2020. According to Växjöbostäder, the reduction was mainly because Växjöbostäder fixed doors and locks with codes in recycling room. Large size garbage such as carpets and other small size garbage that were thrown outside were thrown in containers in recycle room. This means the cost shifted from entrepreneur 1 to 2. That more people through waste in the recycling rooms rather than outside is an indication of changed behavior. There is a slight increase in cost of bulky waste collection in spring 2020, may be because there was more waste generation as most people stayed home due to Corona pandemonium.

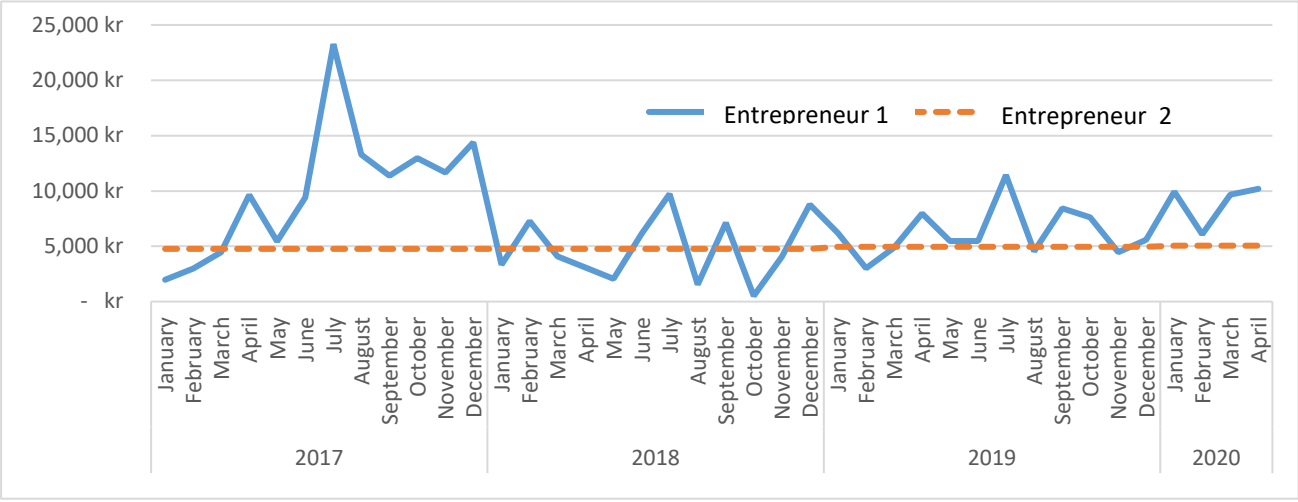


Figure 17: Fees paid to entrepreneurs 1 and 2 to collect bulky waste generated in Alabastern

5.2 Measured energy use

In *Figure 18*, we have compared the measured (metered) energy use per square meter gross floor area (BTA) of each demonstration building in Alabastern for the year 2019 versus the estimated reference value before renovation. The metered energy use for space heating is temperature corrected with degree days for the years 1991-2010. The energy use for space heating includes this temperature corrected space heating plus heat loss from hot water circulation (not temperature corrected). Total energy for a building includes energy for space heating, energy use hot water and electricity for facility (e.g. lighting in common areas, ventilation). Electricity for laundry and outside lighting is excluded. Facility electricity data for Nydalavägen 22 was unavailable for the period January-August 2019 and therefore, data for a similar building Nydalavägen 16 was used. Similarly, energy data for the month of January 2019 for Nydalavägen 20 is that of Nydalavägen 18. Data for Nydalavägen 12 was incomplete and therefore, not reported.

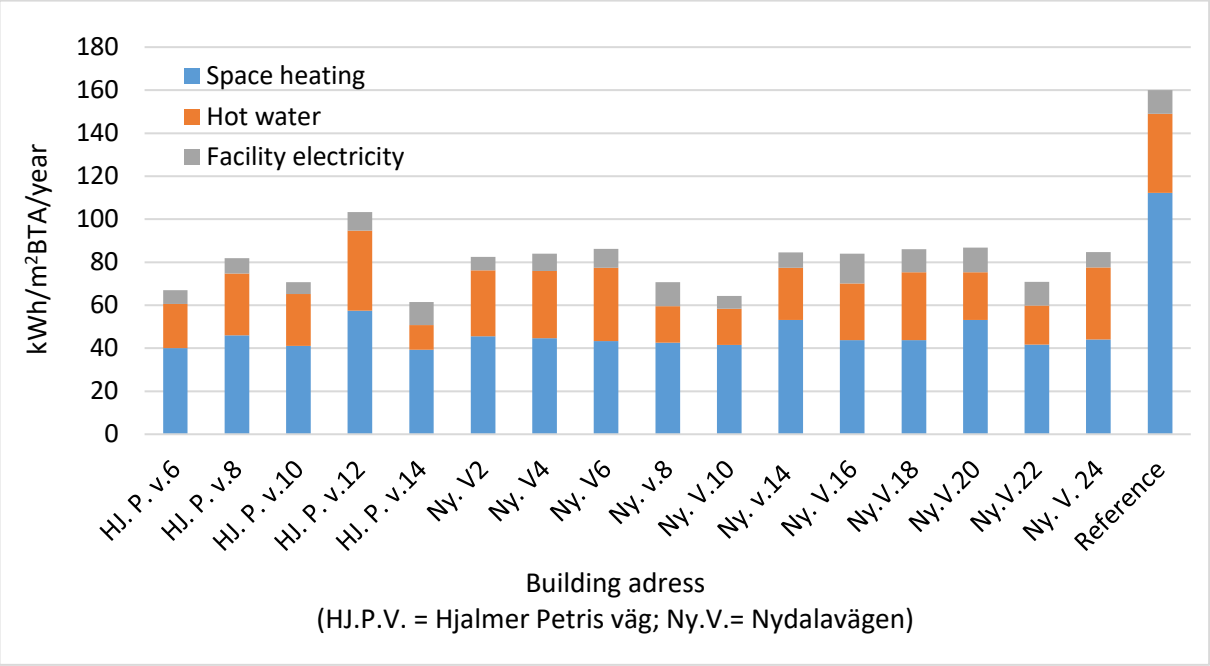


Figure 18: Measured energy use in different buildings in Alabastern

It can be seen that space heating constitute about 50% of the total energy use. Energy for space heating varies from 39 kWh/m^2 BTA/year to 57 kWh/m^2 BTA/year, while hot water and facility electricity use varies by factor 2 to 3 between the buildings (*Table 2*). Such variation could be due to variation in size of apartments in different buildings, number of occupants, and household behavior.

Type of energy use	**Buildings with *lowest* use**	**Buildings with *highest* use**
Space heating (temp. corrected) + hot water circulation loss	Hjalmar Petris Väg 14 (39 kWh/m^2 BTA/year)	Hjalmar Petris Väg 12 (57 kWh/m^2 BTA/year)
Hot water	Hjalmar Petris Väg 14 (12 kWh/m^2 BTA/year)	Nydalavägen 6 and 24 (34 kWh/m^2 BTA/year)
Facility electricity	Hjalmar Petris Väg 10 (5 kWh/m^2 BTA/year)	Nydalavägen 16 (14 kWh/m^2 BTA/year)
Total	Hjalmar Petris Väg 14 (62 kWh/m^2 BTA/year)	Hjalmar Petris Väg 12 (103 kWh/m^2 BTA/year)

Table 2: Buildings with highest and lowest space heating, hot water and facility electricity kWh/m^{2}BTA/year

5.2 Hot and cold water consumption

5.2.1 Monthly analysis

This section analyzes hot (warm) and cold water consumption by using box plots. The objective is to determine if there are visible trends in hot and cold water consumption in different months of the year as well as in week days. The analysis also aims to understand if different apartments have similar or different behavior throughout the year. A boxplot is a standardized way of displaying the statistical distribution of data based on five numbers including: minimum value, first quartile (lower), median, third quartile (upper), and maximum value. Boxplots are useful as they show the signs of skewness and the dispersion of the data set. The middle line of the box represents the median or the middle number of a data set (e.g. monthly water use in different apartments), i.e. 50% of the observations lie below and above this point. For example, in *Figure 19* the median value is 0.046 m^3/m^2 BTA (gross floor area) in the month of January 2019, which shows that 50% of the apartments use less than this amount of hot water, while 50% of the apartments use more. The bottom line of the boxplot, also known as the first quartile, represents the middle number between the smallest number (of the dataset excluding the outliers; see later for explanation") and the median of the dataset, i.e. 25% of the observations lie below this point. The top line of the boxplot which is known as the third quartile represents the median of the top half of the data set, i.e. 75% of the observations lie below this point or 25% of the observations lie above this point (excluding the outliers). The whiskers (vertical lines) extend from the ends of the box to the smallest number excluding outliers (e.g. 0.000 m^3/m^2 BTA in January 2019 in *Figure 19*) and maximum value (0.15 m^3/m^2 BTA) excluding outliers. Outliers are data points that fall outside 1.5 times the interquartile range (IQR=quartile 3 - quartile 1) above the upper quartile and below the lower quartile (Q1 - 1.5 * IQR or Q3 + 1.5 * IQR)). Outliers may indicate a problem with the measurement or the data recording and therefore it is justified to remove these values. Since such values are rare, their removal will not have a statistical impact on results. All outliers are removed in the analysis presented by this section. The maximum values with a * symbol in boxplots below are outliers and they have been removed from the analysis. But, they show that there are apartments that are using such high amount of water). Since the number of apartments in this analysis was 46, each quartile contains 11 or 12 apartments. An "X" symbol in a boxplot shows the average value of the data set, e.g. values for hot water use in January month in *Figure 19* or values for apartment a1 in *Figure 19*.

Figure 19 illustrates the data distribution for monthly hot water consumption. This figure shows that in January, February and March first quartile is lower than other months. It means that in these 3 months hot water consumption of households in the first quartile (lower 25%) is less than households that fall into first quartiles in other months. In addition, from April to October we see that the boxes are not balanced. It shows that hot water consumption of upper 50 % of the households has larger variability compared to the buildings with 50% lower hot water consumption. Overall, *Figure 19* shows that there is not a considerable variation in consuming hot water between different months, but in each month hot water consumption considerably varies between different buildings. For example, in February, 3rd quartile is almost 7 times larger than 1st quartile which shows that in this month there are 11-12 households (upper 25%) who consume hot water around 7 times more than the lower 11-12 households (lower 25%). The outlier value 0.289 for February shows that one apartment is using more than 25 times more water than the one using lowest amount of water use in that month. *Figure 19* also shows average hot water consumption of 46 studied apartments versus all 313 apartments in Alabastern. This comparison shows that average (and monthly spread of) hot water consumption is higher in the 46 households compared to the entire Alabastern households.

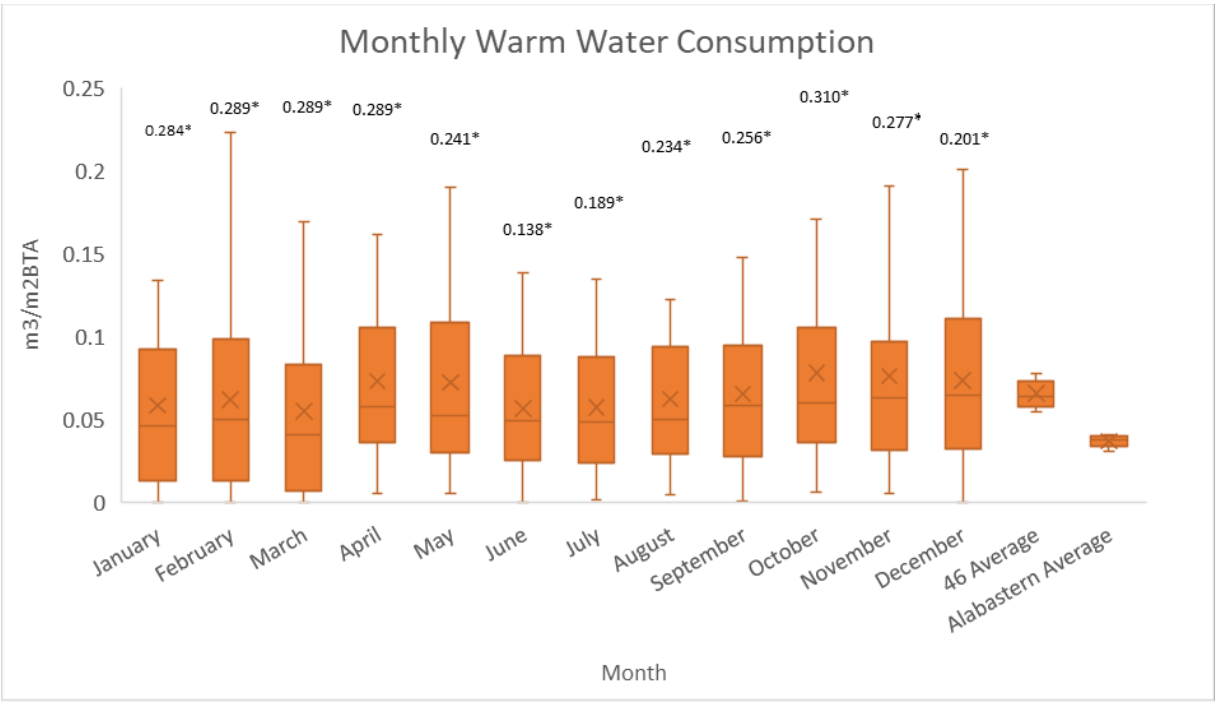


Figure 19: Box plot of monthly hot water consumption in different apartments (* shows outliers on upper side)

Figure 20 displays the Box plot of monthly cold water consumption. Overall, the figure shows that Cold water consumption increases slightly during summer months. Similar to hot water we can observe that the variation between consumption of different buildings is considerable. For instance the tall box in month of July shows that different households have notable different behavior in cold water consumption in this month. Similar to *Figure 19*, *Figure 20* also presents a comparison between cold water consumption in the 46 studied households and the entire Alabastern households. Unlike hot water consumption, it is observed that cold water consumption is lower in the studied 46 households.

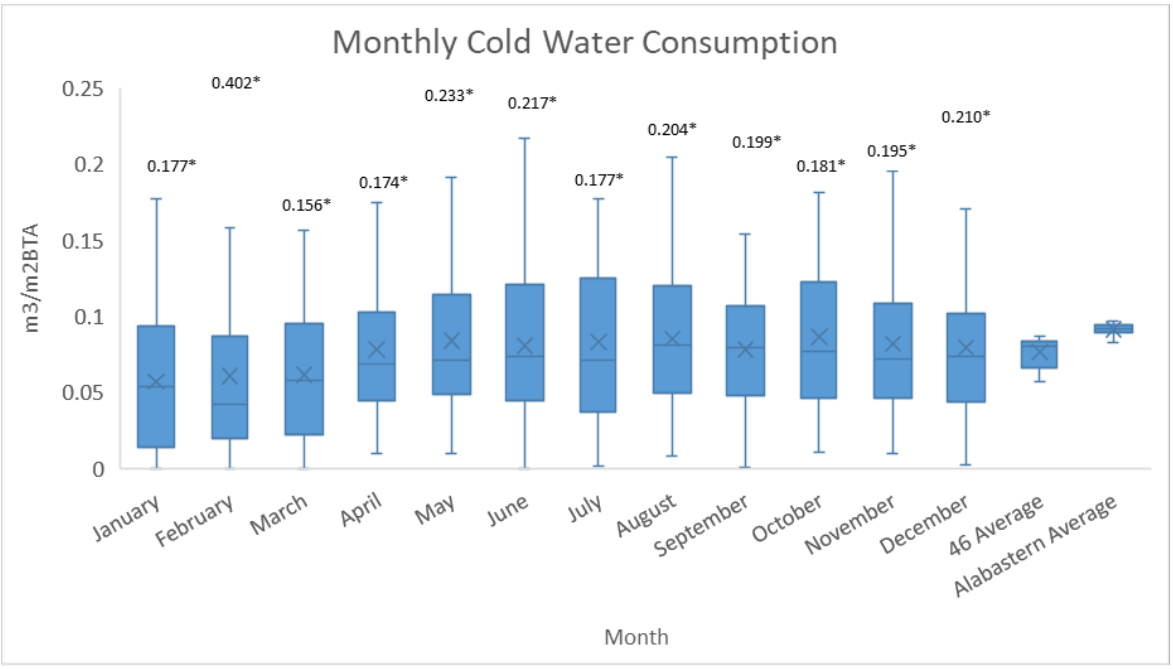


Figure 20: Box plot of monthly cold water consumption (* shows outliers on upper side)

5.2.2 Daily analysis

Figure 21 and *Figure 22* show the distribution of hot and cold water consumptions respectively. Comparing these two figures show that hot and cold water consumptions do not change significantly in different week days. However 3rd quartiles on Sunday, Saturday, and Friday is higher which shows that there are more number of households that consume more water on these three days compared to the rest of the week. In addition, the analysis shows that variability of daily cold and hot water consumption in the studied households is considerable. For example on Sundays 3rd quartile (0.00350 m^3/m^2 BTA) is more than 5 times larger than the first quartile (0.00063 m^3/m^2 BTA). It shows that there are11-12 households (25% above the third quartile), which consume more than 5 times hot water than the 11-12 households (25% below the first quartile) with lower hot water consumption. Relatively similar behavior is observed in other days of the week for hot and cold water consumption.

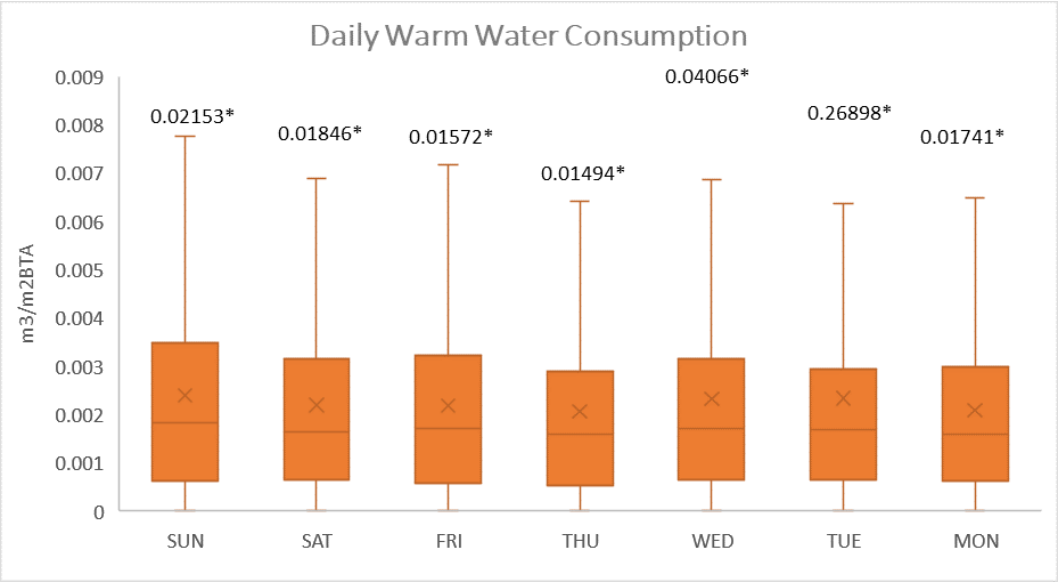


Figure 21: Box plot of daily hot water consumption (* shows outliers on upper side)

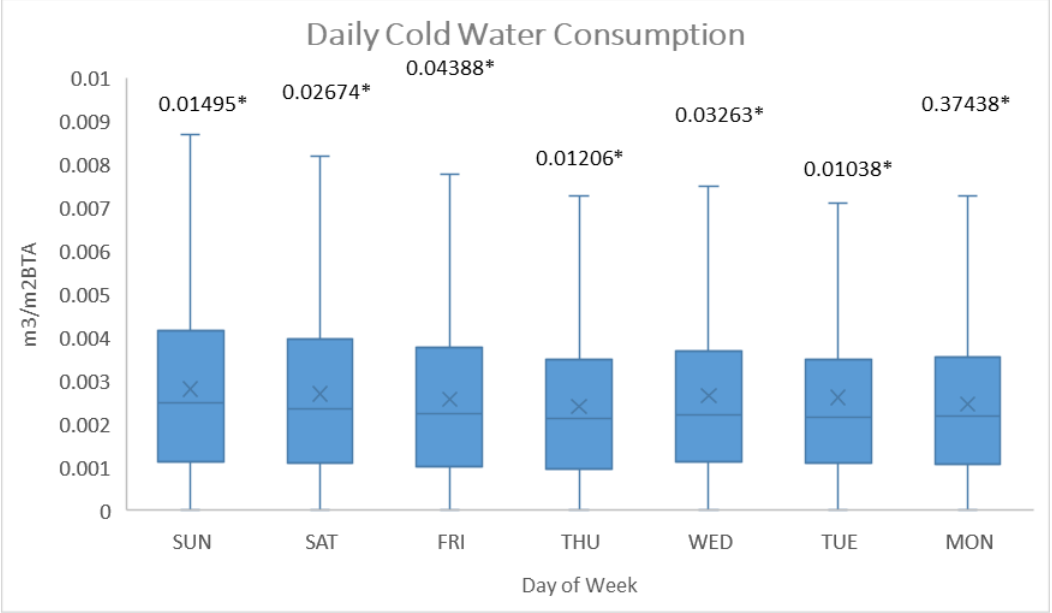
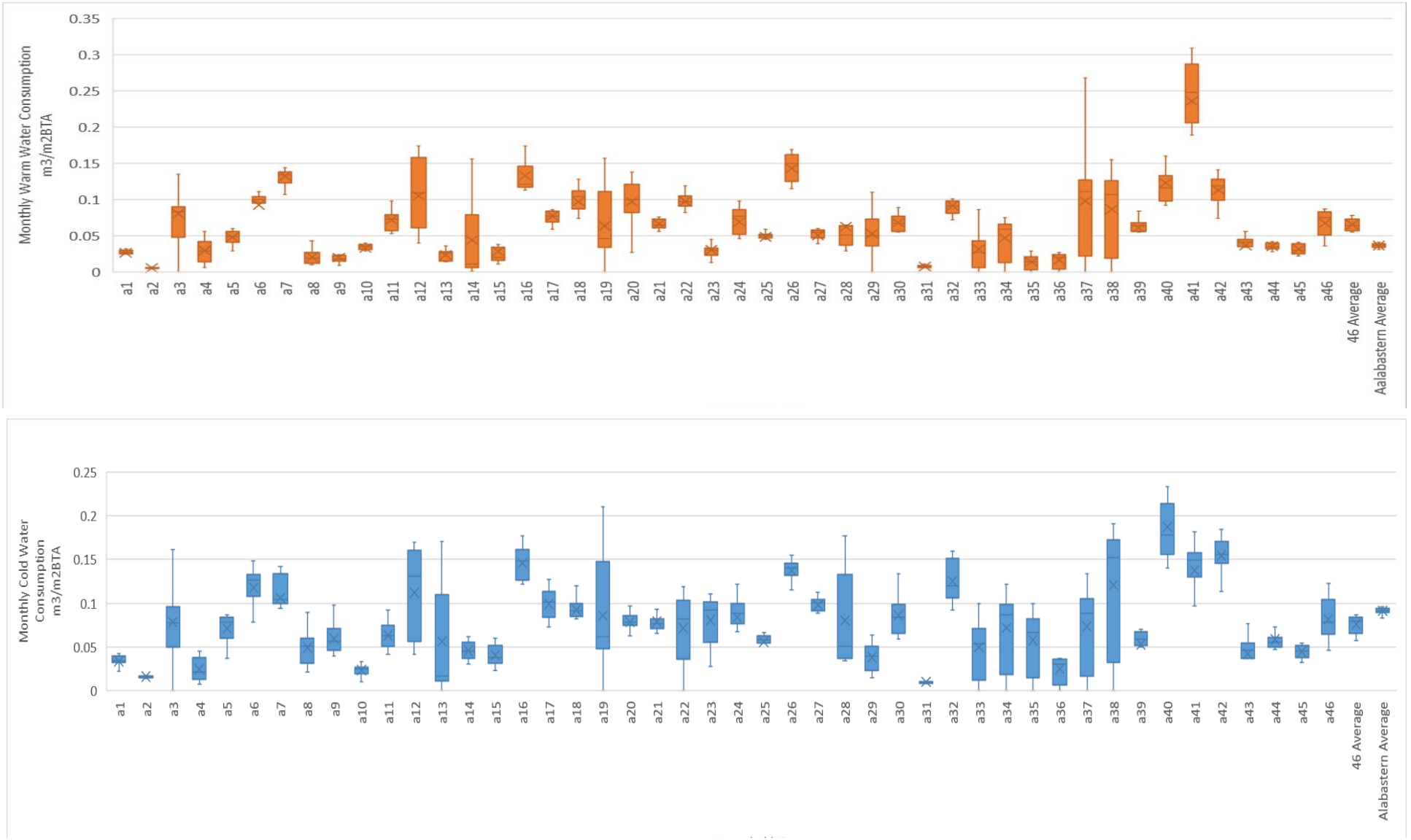


Figure 22: Box plot of daily cold water consumption (* shows outlier on upper side)

5.2.3 Individual household analysis

Figure 23 illustrates the distribution of monthly (12 months) hot and cold water consumption for 46 apartments (with identification numbers a1 to a46), their average, and average of all 313 apartments in Alabastern. Results show that in a number of apartments hot and cold water consumption varies significantly in different months of the year while for some other apartments there is very little fluctuation. For example, in apartments a12, a13, a19, a28, a37, a38 cold water consumption varies considerably in different months (apartments with tall boxes). Figure 23 also shows that hot water consumption in apartments a16, a26, a41 is higher than average for all 46 apartments, while apartments a35, a36, a44 and a45 consume hot water less than the average. There is a variation of factor 25 between the apartment using lowest (a2) and highest (a41) amount of water. Finally*, Figure 23* shows that the average of 46 households consume less cold water compared to the average of entire Alabastern households while their hot water consumption is higher than the average of entire Alabastern households.

Figure 23: Monthly cold and hot water consumption in different apartments (a1 to a46), average of 46 apartments and average of all 313 apartments in Alabastern



Conclusion

Alabastern area is recognized as a socially challenged area, dominated by immigrants, mainly from some African and middle-east countries. It was a challenge, culturally and linguistically, to reach the tenants to gather primary data on their attitudes and behavior towards waste recycling, and energy and water use. To collect data and implement the behavior campaign, people of similar social, cultural, and language background as the tenants were recruited in different phases of the project. The concept "para professional aide" was used to which means recruiting and training people from a community to facilitate implementation of intervention measures planned to be implemented in the community. These aides conducted two focus group discussions, randomly interacted with people walking in the yard, visiting the recycling rooms, or gathered in nearby community hall, cafeteria and shops. They also visited each apartment to conduct a questionnaire survey and drive the information campaign.

Majority of these participating tenants reported that they are environmentally friendly, they take several actions to save energy (e.g. switch of lights when not in use) and water (e.g. taking short showers rather than long baths), and they recycle household waste quite often. They mentioned that it was the "others", who do not engage in proper waste recycling and a source of irritation for many. According to them, the main reasons for improper waste recycling behaviour include lack of information in other languages than Swedish and English, lack of knowledge about benefits of recycling, carelessness (attitude), no driving licence or car to drive bulky waste to central recycling station of Växjö, insecurity among the ladies to enter the recycling room (that has no windows), children (sometime throw the garbage) do not have the key to the recycling room or cannot open the door as it is heavy, bad smell in the recycling room (lack of ventilation), people from nearby areas litter in Alabastern, and Växjöbostäder takes inadequate responsibility.

The participating tenants also suggested several solutions to the waste recycling problem. The *information* solutions include distribution of multilingual waste recycling brochures to every apartment, multilingual signboards in the recycling rooms, regular information meetings organized by Växjöbostäder on different topics (e.g. energy, water, safely, environment, waste etc.), and education of children and adults. Suggested *Technical solutions include* Surveillance cameras in and around recycling rooms, arrange containers for bulky waste 2-3 times a year, easy to open doors and windows in the recycling room, redesigned recycling room so that it is possible to throw garbage in separate bins from outside, different colour garbage bags for different fractions of waste.

Considering that lack of information was a major reason for improper recycling of waste, an information campaign was conducted. The waste recycling guide was translated to Somalia and Arabic languages and distributed to each of the 313 apartments. The para-professional aides made door to door visit and discussed with 50 households. An information evening led by Växjöbostäder was also conducted. However, it was difficult to measure the impact of these measures due to lack of monitoring systems for each fraction of household waste. In the year 2019 Alabastern area generated about 363 kg colour glass, 228 kg clear glass, 299 kg plastic, 61 kg metal, 1307 kg cardboard, and 262 kg paper.

In this study energy and water consumption of different buildings in Alabastern was compared for the year 2019. Also, monthly and daily water use of 46 apartments was also conducted. Results showed that the average energy use of all 17 buildings for the year 2019 was ca 80 kWh/m^2BTA, which was 50% of the reference value. Hot water and cold water consumption was 0.0365 and 0.3989 m^3/m^2BTA, respectively. However, there were considerable variation temporally and among the apartments. Energy use for hot water and electricity varied by factor of 2 to 3 (all buildings), while hot water use varied by a factors of 25 among the analysed 46 apartments. The average and distribution of hot water use of the 46 apartments is higher than the same for all 313 apartments in Alabastern, but lower regarding cold water.