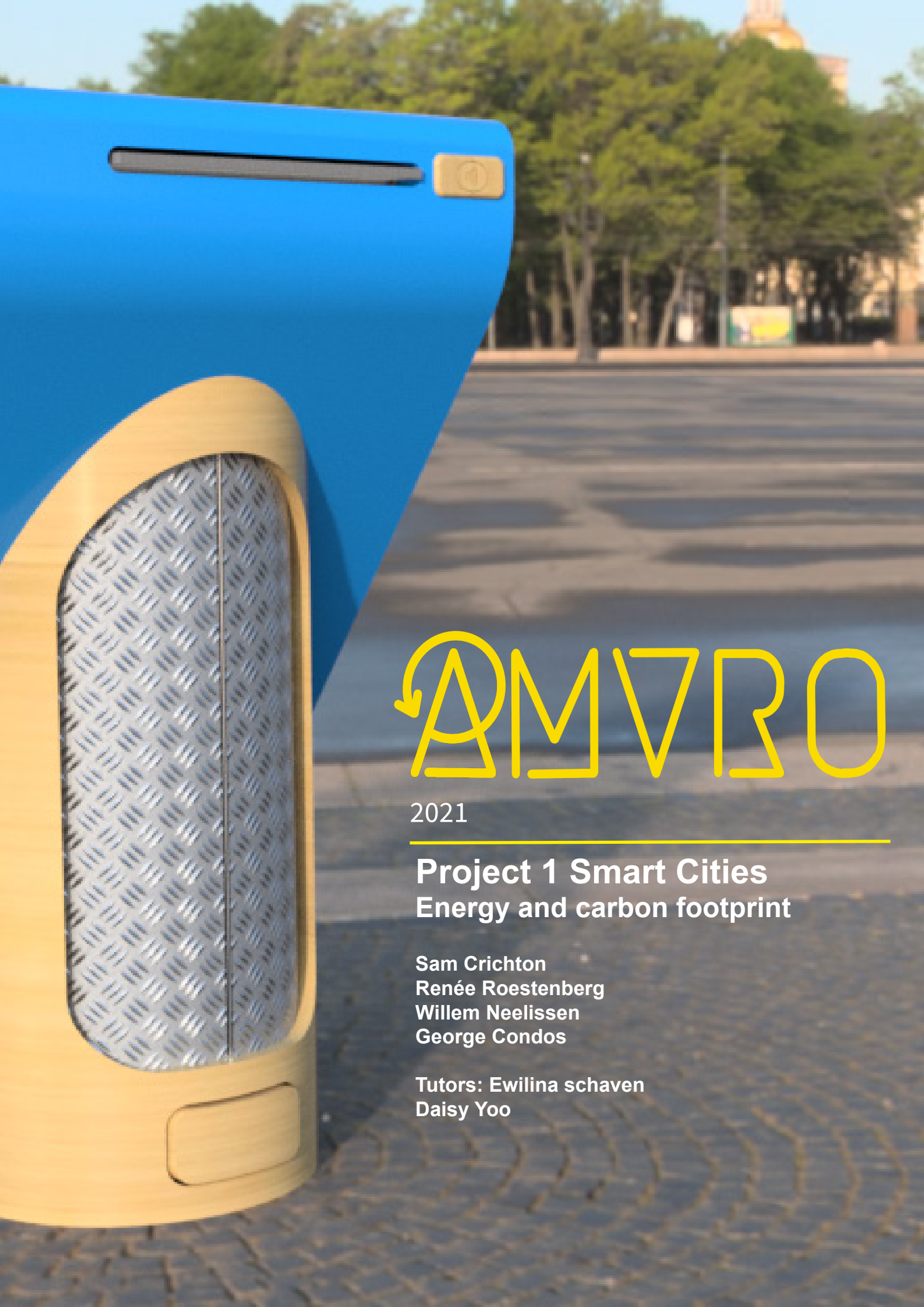

AMRO

2021

Project 1 Smart Cities
Energy and carbon footprint

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Introduction

Food waste accounts for around the 3rd largest carbon footprint globally (6%) when compared with national emissions and only China (21%) and the USA (13%) have larger total carbon footprint (Richie, 2020). This is a problem that needs to be addressed if we are to have a sustainable future. While many companies see food waste a problem we see it as an inevitable end-product. Instead of minimizing food waste completely, we concluded that there would always be a certain level of unavoidable food waste that could be converted into something useful.

When food waste decomposes naturally, it is digested by bacteria and biogas is released as part of this process. The biogas can be captured and used to make energy which is a process that has been implemented by several existing energy companies. Now, biogas facilities are using fresh produce such as maize for this process, which has a detrimental effect on the greenhouse effect. We propose that the solution should be to use food waste instead of these crops.

Currently food waste is thrown away together with the green waste such as garden trimmings and left to biodegrade naturally on a landfill. our aim is to encourage citizens to seperate and dispose of their food waste via our bin network. In this way food waste in cities can be collected and trenasfered to bioplants to be transformed into biogas. This way the biodegradation will be controlled and the gases which are formed can be captured and will be used instead of non-renewable gasses.

The main aim of this project is to successfully integrate a new system and product to allow for effective collection of this food waste in a smart city. We want to encourage people in Eindhoven to separate and distribute their food waste to a centralized system and create a sense of community in doing so. Similarly, we want people to feel more of a collective responsibility for the environment and to understand how working together can have a great positive impact.

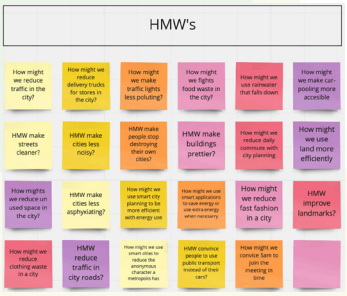
Our project will also allow communities to support their charity of course. This will be achieved through a voting system which the user can partake in the moment the bag with food waste is put in the Amvro smart bin. This will be funded with the collective profits made from the total biogas production in a smart city. This system is also necessary as a means of motivation. The idea of separation food waste has been tried before but mostly failed on user participation, we think that will Amvro this will not be an issue since there is a second layer of motivation which will attract users who were not likely to use the system otherwise since there seems to be no direct incentive. It will also make users who already would be eager to use such system be even more active, this will help a lot with spreading the concept mouth to mouth but will also get people talk about the issue of food waste itself.

Project Goal

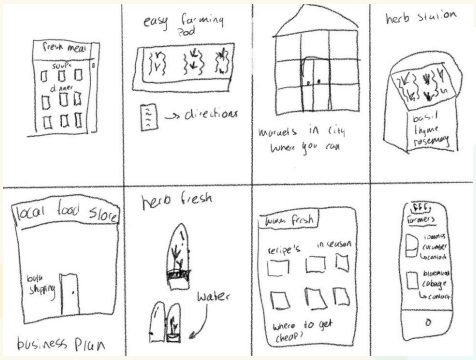
To make a product and system that increases feasibility of biogas use in future smart cities. We will focus on communities in the city of Eindhoven and how to make this system as user friendly as possible. The aim is to incorporate the idea of caring about food waste and caring for the environment using the sense of community, with the help of incentives from biogas production. We want everyone to be happy to use the system and related products and for it to fit seamlessly into today's society. It must help raise awareness about our impact on the environment and that with minimal effort and a well thought out system you can start to reduce this impact.

Process

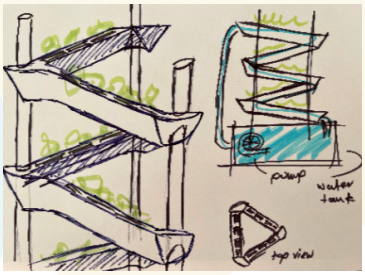
Initially we brainstormed and researched what we thought could have a large energy footprint and cause a large carbon footprint in a city.



We settled on the topic of food and the food industry which accounts for around 30% of global energy use and 25% of global carbon footprint [7]. This was an area that had a broad scope with many different challenges that we could try to take on. The idea was to pick a broad interesting topic and then dive deeper into something more specific later.



After choosing this area we conducted a design sprint focussing on the area of food so that we could become familiar with the topic and see how a project might pan out if we chose it. We looked at the production cycle of food in the preliminary stages and when ready for consumption as well as the carbon footprint and energy use associated with this. Eventually our design sprint resulted in the solution of “hydroponics at home” which could be incorporated into a smart city to reduce the impact of conventionally farmed crops which had a high carbon footprint by the time they reached supermarket shelves.



The design sprint and follow-up research were important steps in formulating a good and concise design brief for the project. The research we had conducted allowed us to set more specific constraints and have a better understanding of the energy use and carbon footprint of food.

Once we had finished the design sprint, we evaluated our hydroponics system and whether it would have a positive impact on the energy use and carbon footprint of a smart city. During our research we discovered that food waste is the main contributor [8] to carbon footprint and energy use and that a hydroponics system only solves a small part of the underlying issue. We also saw that the market for products at home – that aim to reduce food waste – was very saturated, with a plethora of products that solved many of the issues we had previously discussed including examples of a home hydroponics system. After considering all these aspects we decided to change the direction of our project and focus solely on the final component of the food industry; the management of food waste.

Design brief

We are going to design a product or system that reduces the energy use and carbon footprint of food in a smart city. This can be at any stage of the production of food but must make use of ‘real world data’ that is collected in a smart city.

The final solution must include a physical product with digital integration that makes use of ‘real world data’. The outcome must have an aesthetically pleasing modern design that is eye-catching. The product should raise awareness about the carbon and energy footprint of food for the user so that they can be more conscious of the impact of food use. It should also create a sense of community feeling when using the product/system

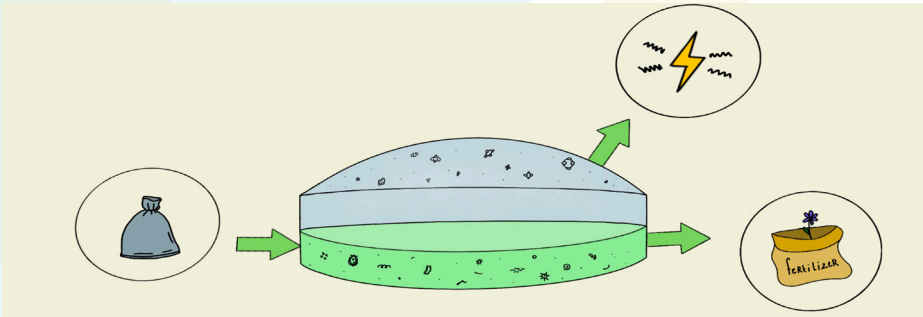
The solution must be applicable to HEDC’s. It must also be made in a sustainable way such that the resultant carbon footprint is shown to be negligible.

The progress report for this project is due on April the 1st and the Demonstration day will happen on the 7th of June.

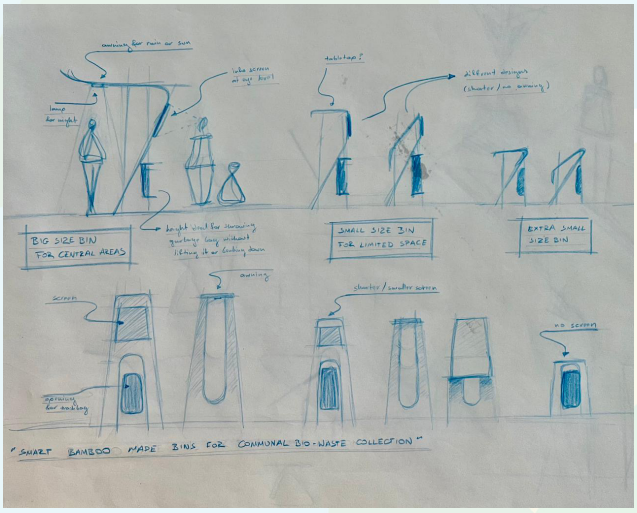
It was surprising to find the lack of solutions for unavoidable and inevitable food waste and how this by-product was often just expelled to landfill, rather than being used as a potential resource. This was an opportunity for us to devise a solution whilst seeing food waste as a resource rather than just something we would like to reduce. Of course, we would not like to encourage food waste, this became an important part of our user research later in the project.

We shifted from trying to reduce carbon and energy footprint of food prior to food consumption, to doing the same with food waste. This meant we had to change the way we viewed food waste. We saw it as an opportunity and not a dilemma. We researched diverse ways in which it could be used as a resource. We looked at fertilizer, compost, and ways that some specific foods can be recycled or used. Eventually through further research in this field we came across the concept of a biodigester which had been widely used to produce 'home fuel' in Indian suburbs around Delhi [17]. This process used animal dung which naturally releases biogas that can be burned and used as cooking fuel. This research was a couple of years outdated and we soon found that the process had been streamlined and that it was far more effective to use food waste in place of animal dung. The much higher calory content of food waste meant that it produced far more biogas which also burned better [9]. We also discovered that an added benefit of biogas is fertilizer which is a natural by-product [10].

We found this to be an exceptionally good idea and that it was quite confusing that the system had not been adopted by highly developed nations that also have a lot of food waste. The system has been widely suggested to be a key component of future circular economies which will be a key part of how future smart cities will function [11]. This way all the food waste in a city would be used to collect biogas.



This system has not yet been adopted anywhere and this has a lot to do with the fact that any system to collect this food waste might not be reliable enough and no system like this has been tested. The reasons biogas has not been implemented in cities up till now is because there are several significant barriers to entry [12]. These include technical barriers, economic barriers, institutional barriers, market barriers, socio-cultural barriers, and the comparison of barriers for developing and developed nations. We decided to focus on the socio-cultural barriers as well as designing some of the technical requirements which includes infrastructure.



We began the iteration process with different concepts for a bin that would be used to collect the food waste at home or even a home Bio degasser [16] (used to make biogas for personal use) which aimed to make the switch to separating food waste easier for users. But after reflecting on this decision and seeing its shortcomings such as: prohibitive cost as every household needs a bin or degasser, bad smells, no space in everyone's home and the risk that not everyone would want such a thing in their house. This is where we made the design decision to switch to a communal bin that could be installed and maintained by the local municipality. This would mean users could voluntarily use the bins which is a system that already works in the Netherlands.

The challenge now was to design a bin that was better than the existing ones, with better incentives for use, a clear positive environmental impact, a more user-friendly design and a way to educate people about the benefits of Biogas as a renewable source of energy. At this point we decided to find out more information about the current limitations of bins [13] in the Netherlands through secondary literature searches and through primary user research in the form of an interview. From the interviews specifically we gained vital insights on what the general public wanted from communal bins. We made summaries (view summary sources) that included important findings, general feelings of the interviewer and insights that could be implemented in an app or website.

We combined this primary and secondary research to inform our decisions on the design of the bin and insights for anything additional such as an app or website. After reviewing various aspects, we began iterations for the bin design and thought about how an app could be implemented. Each team member brought their unique design ideas to the table and pitched to the rest of the team about why their design should be used. We reviewed our distinctive design styles and settled on a combination between sustainable functionality and something that was slightly new and interesting to attract attention of potential users.

Our bin design went through several iterations before we came to a design that we were happy with. The final design was chosen with user friendly design as a top priority and thus we tried to cut down on any unnecessary steps in the process of using the bin. The bin included a bag dispenser, foot activated door and solar panels to ensure any electrical functions of the bin utilized renewable energy.

Now that we had an initial concept of a final design, we began the process of thinking of additional material that could be used to ensure user participation and motivate the general public to use our bin and to separate their food waste. This required us to take a step back and revisit the interview responses and previous literature research [12] [14]. We decided to implement an optional app and website to ensure that participants could find out more about why the bin will help the environment and why it benefits them to use our bin. This is something that was mentioned by several participants of the interview (view summary sources) as being a useful source of motivation for using the bin system. The app could also be used to show a map with locations of our bins and statistics about what percentage of your community waste is being recycled. It was important to consider that some participants of the interview were not happy with the idea of "another app" and we decided we wanted to make the app and website optional. This means that people can still use the bin without having to download an app or sign up for an account on a website. This is a crucial aspect of making the bin as user friendly as possible and making using the bin an 'after thought' rather than something you must seriously consider and adapt your routine to. Again, this is part of the process to do with overcoming the social-cultural barriers that have prevented a Biogas system from being implemented in today's cities. At this point our bin incorporated better assurance of increased user participation and the infrastructure required to collect the food waste that will be used in Biogas production.

We also considered the idea of a reward system, and this was something we asked users about in the interviews and how we might be able to implement this without causing people to waste more food. We also conducted research around this topic and stumbled upon the idea of using charitable donations as an incentive. Which is motivation on moral grounds and does not actually provide the user with monetary value. This concept has been successfully implemented by Waitrose supermarket in the UK [15], where if a user goes to Waitrose for their shopping, they have an influence on what charities are donated to by Waitrose. That way Waitrose allow their customers to determine how to give back to the community and it provides them with value. We decided to implement this reward system into our bin system because it gives value to the user without incentivising them to waste more food. To implement this donation choice, we incorporated an NFC functionality to the bin so that when you scan it with your phone, a screen pops up allowing you to make a choice on what charity our bin company will donate to. Your vote only has a weight of 1 credit for each week that you use the bin. Therefore, you cannot just throw away more waste to increase the number of votes you have. Initially a donation of 3000 euros will be distributed amongst the different charities depending on the ratio of votes for that month.

We produced a name for our company that was appropriate to what we were trying to achieve. We settled on AMVRO which is short for the Greek term Amvrosia which translates to 'food of the gods.' We chose this name because when implemented properly food waste could mean a future of far greener and cleaner cities.

Waitrose
Community
Matters

AMVRO

Iterations

INTRODUCTION

When the concept, of reducing carbon emissions with the help of biogas produces from food-waste, was found, we went on and started ideating.

PRODUCT ANALYSIS

Through an analysis of existing products, we found that home biogas production products already exist. However, even though the technology is advanced enough to be affordable for a certain wealthier part of the population its cost is still accessible for the majority of the population. Additionally, in dense metropolitan areas living space is limited and such a home cultivation product could not fit. [18]

Due to these barriers the participation in replacing traditional energy sources with biogases is exceptionally low. The average recycling rate of the Netherlands is 50% and to make the project more feasible we want to bring that number to 100 as close as possible.[19] Therefore, a system that fits all makes city-level food waste collection and biogas production possible. Therefore, our concept became a public bin network for food waste.

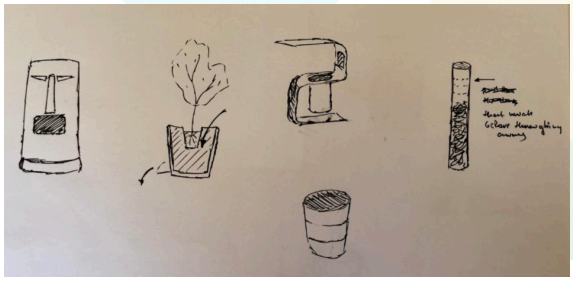
INTERVIEWS

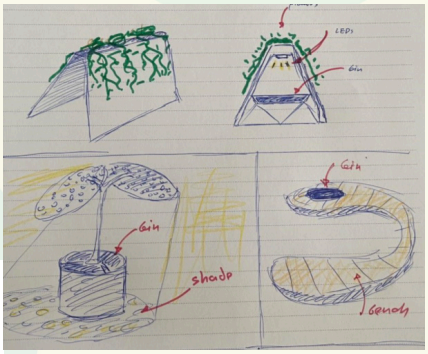
Our first step in designing the bin system was to identify what could be improved on a current system of similar function. In order to give an answer to that question we resorted to interviewing actual users of any kind of bins that exist in public spaces.

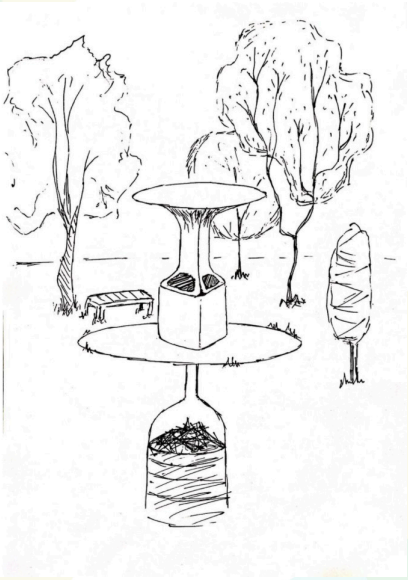
Through the interviews a digital interface in the form of an app or a display on the bin was born. This is because we found out that in order for our new bin system to be used there must be visible incentives. “By providing incentives to users this would make them more interested and likely to buy into the scheme and what it is trying to achieve.” reads one of the summary interviews. Also, the app needs to contain practical information, like maps with bin locations and whether they are full or not. “Unclear what bin there are available and where they are”

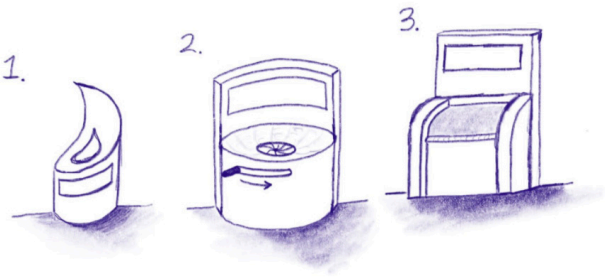
INITIAL BIN DESIGN SKETCHES

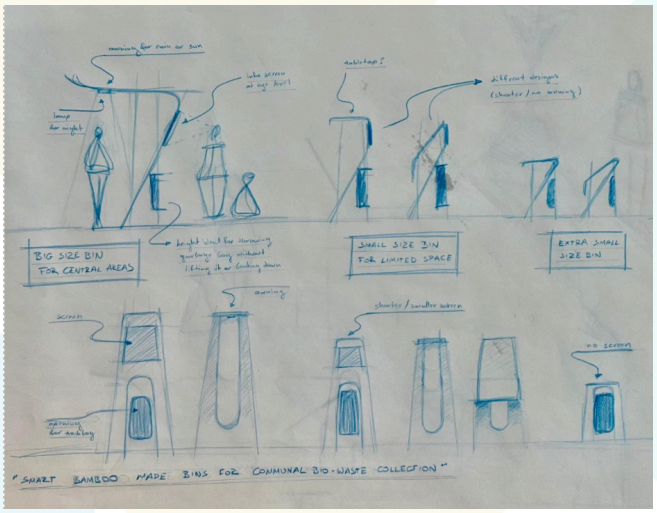
Meanwhile, all members of our team were exploring possible visual styles for the bin, through crazy 8's. As the design language and how good the bin looks is subjective we let this process up to us to determine what we liked.











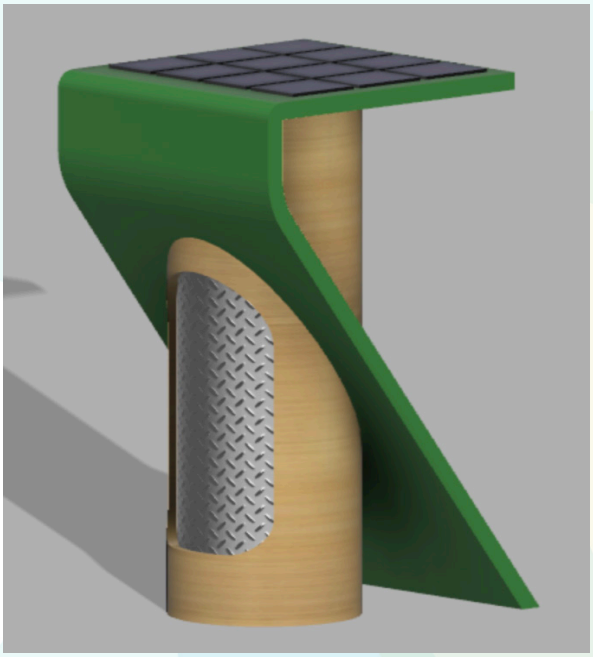
LANDING ON A FIRST MAJOR BIN DESIGN

Afterwards, when the interviews were over and the key aspects of the design, that are mentioned above, were set we came up with our first final design. As it can been seen in the sketche at the right, this first final design is comprised of three iterations of a similar design with variation in size.

From there, we started working on a digital prototype based on the bigger size design of the previous figure. This bin variation includes a sunshade to be used by passers-by on the back and a surface on the front dedicated to an informative screen.

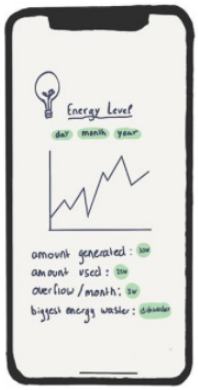
USER TESTING

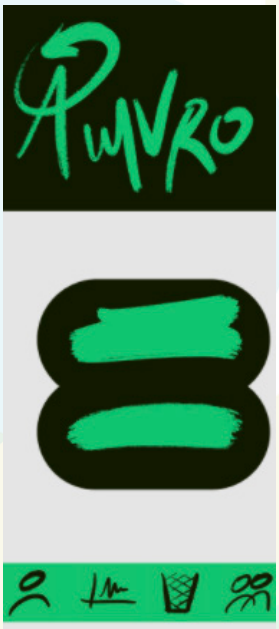
To test and experience the bin design in real life an AR model was constructed. This helped in comparing the bin with real objects and humans. From feedback that we gathered, from people that we showed the AR model to, we spotted some flaws on this design. It was too big thus obtrusive, something that was against our set constraint of designing a non-intrusive bin. The sunshade feature was also unnecessary and a reason of the bin being too big.



DESINING APP AND FUNCTIONALITY

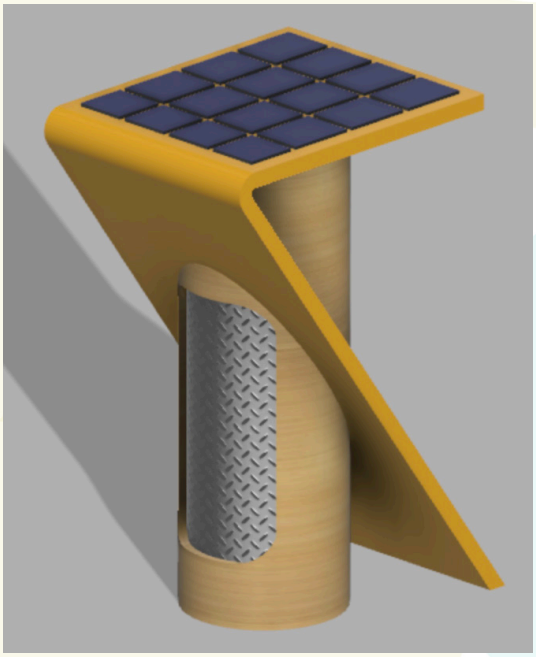
By removing every informative visuals from the bin the app became an integral part of the bin system. Four pages were created for the app based on the interviews and the functionalities that were removed form the bin.





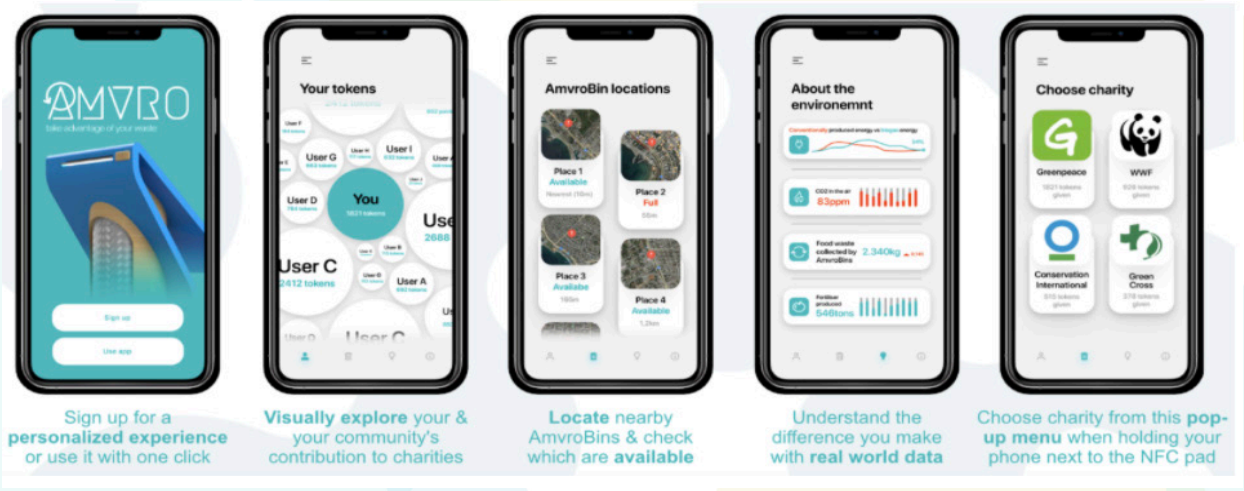
REDESIGNING BIN

The display idea was also ditched, after discussion with our tutors. This is because we realised that a screen panel on the bin would drastically increase its price and its power consumption. Instead, everything on the screen can be viewed on the users' smartphones, leading to a new feature on our design, that is the NFC pad for easy pairing with a phone.



The first page is the incentive of receiving back when using the bin. To prevent gamification and excessive food waste just to receive awards we based our tokens system on an existing one. This system is used by Waitrose supermarkets and is based on giving back to charities. The way it works is that after use one chooses to give the tokens collected to one of the charities. At the end of every month each charity receives a percentage of the money collected by the fertilizer, made from food waste and sold to farmers, based on the tokens they received by people.

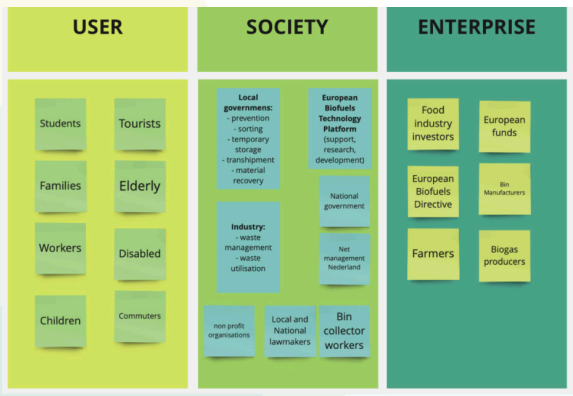
The second page includes maps with bin placements and information on how full the bins are and whether they are available. The third page includes maps to locate bins and information about how full they are and whether they are available. The final page contains more general information about the bin system, how it is working and how it can be used.



BIN PLACEMENT and COST

By examining the bin's price and power consumption we started questioning the cost of existing bin systems and how we could make ours competitive with existing ones. To solve this, we came in contact with an architect and an expert in urban planning, Bogdanos Takis, and a mechanical engineer and energy inspector, Maria Mageirou. The experts made us realise how complicated deciding bin placements is and what an extensive and long study this requires. So, our solution was to adapt our design to fit alongside existing bins and existing infrastructure, like underground containers.

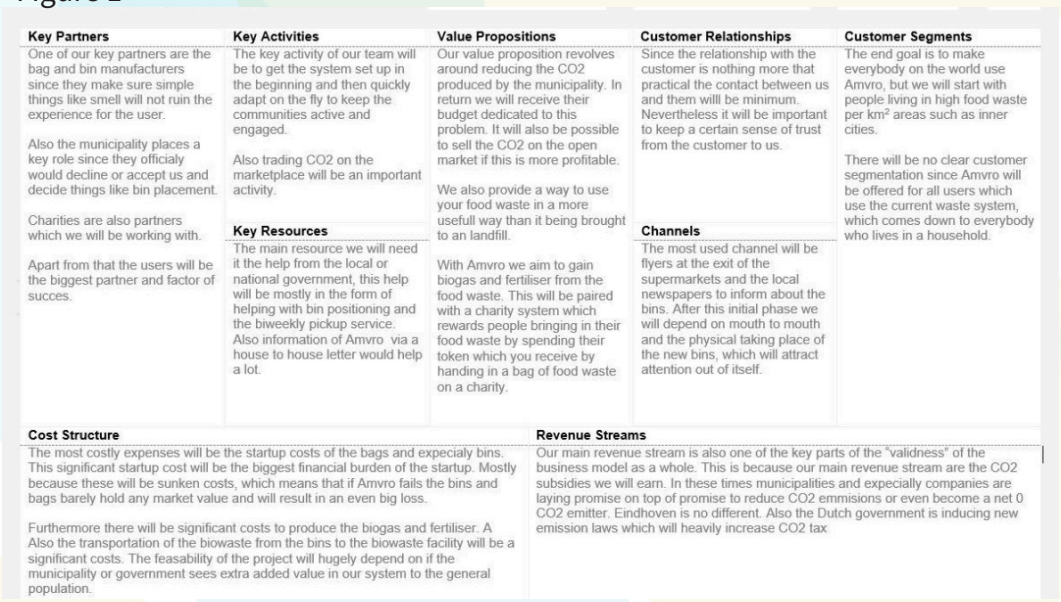
Through a business model we also gave emphasis to the cost of the bin leading to more changes in the design such as not including screens and placing low-cost solar panels for the few electronics on the bin like the NFC pad.



Economic feasability study

For the business model we did not want to solely look at the benefits and costs and compare them but also do a case study on what impact Amvro will have if implemented correctly. Nevetheless we made a business model canvas to make sure we get the complete picture of what Amvro will give and what will be needed for it to operate, this is listed in Figure 1

Figure 1



Key Partners

One of our key partners are the bag and bin manufacturers since they make sure simple things like smell will not ruin the experience for the user.

Also the municipality places a key role since they officialy would decline or accept us and decide things like bin placement.

Charities are also partners which we will be working with.

Apart from that the users will be the biggest partner and factor of succes.

Key Activities

The key activity of our team will be to get the system set up in the beginning and then quickly adapt on the fly to keep the communities active and engaged.

Also trading CO2 on the marketplace will be an important activity.

Key Resources

The main resource we will need it the help from the local or national government, this help will be mostly in the form of helping with bin positioning and the biweekly pickup service. Also information of Amvro via a house to house letter would help a lot.

Value Propositions

Our value proposition revolves around reducing the CO2 produced by the municipality. In return we will receive their budget dedicated to this problem. It will also be possible to sell the CO2 on the open market if this is more profitable.

We also provide a way to use your food waste in a more usefull way than it being brought to an landfill.

With Amvro we aim to gain biogas and fertiliser from the food waste. This will be paired with a charity system which rewards people bringing in their food waste by spending their token which you receive by handing in a bag of food waste on a charity.

Customer Relationships

Since the relationship with the customer is nothing more that practical the contact between us and them willl be minimum. Nevertheless it will be important to keep a certain sense of trust from the customer to us.

Channels

The most used channel will be flyers at the exit of the supermarkets and the local newspapers to inform about the bins. After this initial phase we will depend on mouth to mouth and the physical taking place of the new bins, which will attract attention out of itself.

Customer Segments

The end goal is to make everybody on the world use Amvro, but we will start with people living in high food waste per km² areas such as inner cities.

There will be no clear customer segmentation since Amvro will be offered for all users which use the current waste system, which comes down to everybody who lives in a household.

Cost Structure

The most costly expenses will be the startup costs of the bags and expecialy bins. This significant startup cost will be the biggest financial burden of the startup. Mostly because these will be sunken costs, which means that if Amvro fails the bins and bags barely hold any market value and will result in an even big loss.

Furthermore there will be significant costs to produce the biogas and fertiliser. A Also the transportation of the biowaste from the bins to the biowaste facility will be a significant costs. The feasability of the project will hugely depend on if the municipality or government sees extra added value in our system to the general population.

Revenue Streams

Our main revenue stream is also one of the key parts of the "validness" of the business model as a whole. This is because our main revenue stream are the CO2 subsidies we will earn. In these times municipalities and expecially companies are laying promise on top of promise to reduce CO2 emmisions or even become a net 0 CO2 emitter. Eindhoven is no different. Also the Dutch government is inducing new emission laws which will heavily increase CO2 tax

In this case study we will take Eindhoven in consideration since Eindhoven has made significant promises to reduce their CO2 emissions.

If we estimate that 50% of Eindhoven actively participates, which means that they put all their food waste in the Amvro bins. This would mean that we will have 50% of 220.000 people use Amvro which gives 110.000 users.

An average Dutch citizen wastes arounds 50 kilograms of food every year [1]. So in total the Amvro system will process about 50 * 110.000 = 5.500.000 kilograms of food waste every year. This is equal to 458.333 kilograms per month or 15.068 kilograms per day.

According to [2], 1 kilogram of food waste costs on average 2.5 kilograms of CO2, of course the food is not recycled in the way that new food does not have to be made but the biogas created can substitute gasses which would otherwise have to be mined from below the surface and release CO2 that otherwise would have not reached the atmosphere. Following this logic this would result in 1.500.000 * 2,5 = 11.000.000 kilograms of CO2.

Following the CO2 calculator [3] we can calculate that 11.000.000 kilograms of CO2 or 11.000 tons of CO2saved in comparison would equate to 55.000.000 kilometers driven by a normal passenger car.

Currently the CO2 market price per ton is about €7,30 per ton according to figure 2 of [4] and will be insufficient to fully fund Amvro. We can directly convert our 11.000 tons of saved CO2 in our case study to euros since the European union allows the direct trading of CO2 per ton. So in the case of a company's emissions being too high above the threshold set they will have to directly buy back their CO2 emissions at market price. This proved to work correctly but unfortunately for Amvro the CO2 price per ton is quite low as you can see in Figure 2.

But the Dutch government came in clutch and proposed a new carbon tax low which has just been accepted by the senate. This new law imposes lots of new implications including a new minimum market price for CO2 per ton, thus making it less of a market price and more of regulated price. The price they agreed for 2021 is €30 per ton and this will rise up to €120 per ton in 2030.

This has major implications for Amvro. We went from a measly €7,3 * 11.000 = €80.300 to at least €30 * 11.000 = €330.000. Here the "at least is really important since this number will increase over 4.17x the coming 9 years. This would mean over 1.3 million euros. Of course we cannot legitimately use this last calculations since the laws and legislation changes quite quickly because of added attention the last few years. Also the added factor of "big money" entering the game with lobbyist will add pressure. But nevertheless the price of emissions seems to rise either way.

We do have to add that due to the current pandemic there is talk of relieving companies of pressure in these difficult times. This release of pressure may possible come in the form of increasing the permitted threshold of CO2 emissions which do not have to be bought back. Also a lowering of the CO2 tax in general is possible. Mind that this is not proved by initial sources but could rather be regarded as "hallway talk". [5]

BIN PRICE

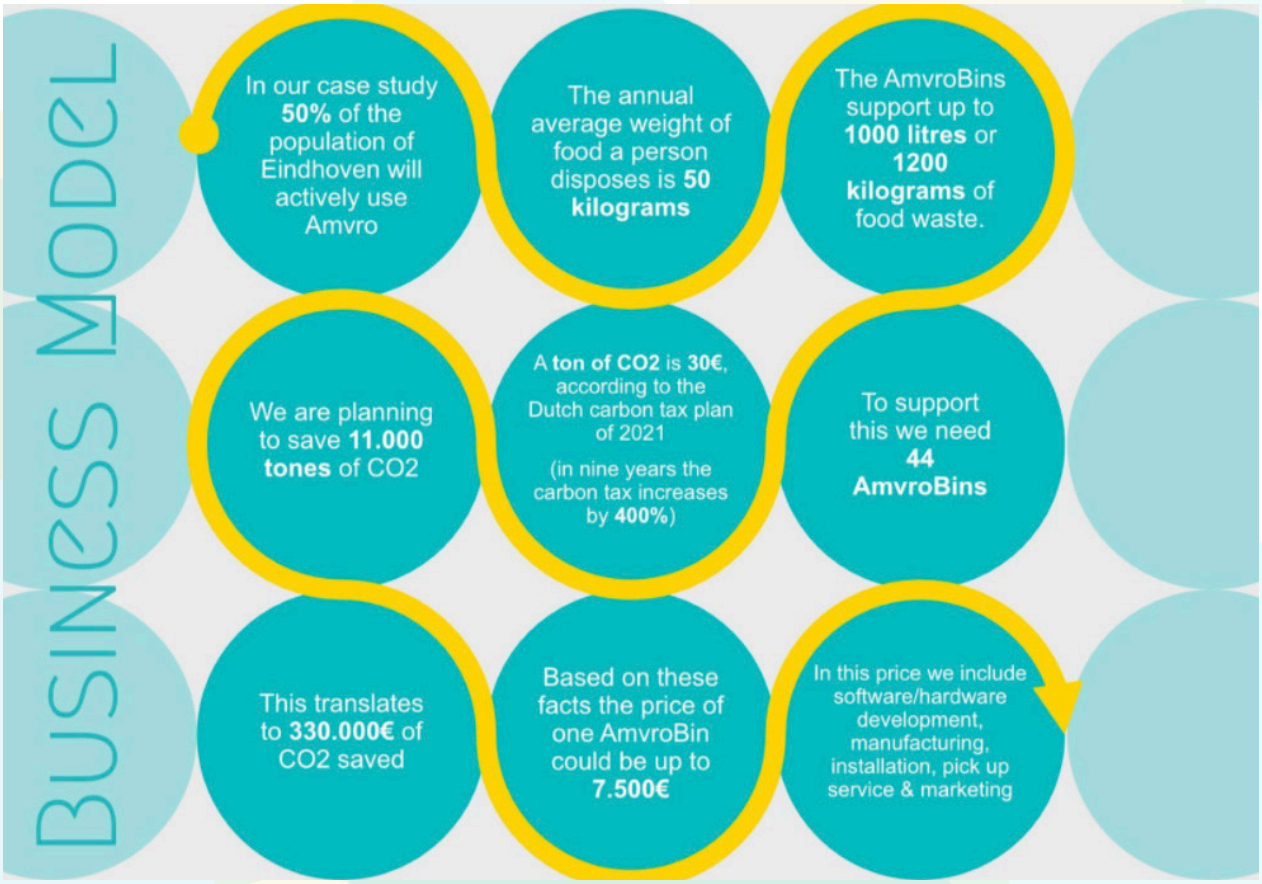
Currently it is difficult to say how much a municipality would spend for Amvro. There are certain sources which specify a price of €20.000 to €50.000 per underground bin, this excludes all other costs like maintenance and the pickup system. But these prices are paid for more directly necessary system, like green and general waste. For the sake of ease we will assume that the municipality would not help us in any way financially. We will need to keep a good relationship for bin placements and possible help with the pickup system.

If we assume that the project launches in 2021 with the 110.000 active users we need to process the previously calculated 5.500.000 kilograms of waste per year. That is 105.000 kilograms per week and if we want the Amvro bins to be emptied twice per week that would result in 53.000 kilogram per pickup session. We agreed to biweekly pickup sessions because of the smell the starting of the natural biodegrading may possible cause and the loss of the gasses which are already released in the process and are therefore not collected and used.

The Amvro bin's underground section has the standard underground bin size of 1m height, 1m length and 1m in depth. This will result in 1000 liters of storage. A 1000 liters of food waste in general weighs around 1200 kilograms according to [6].

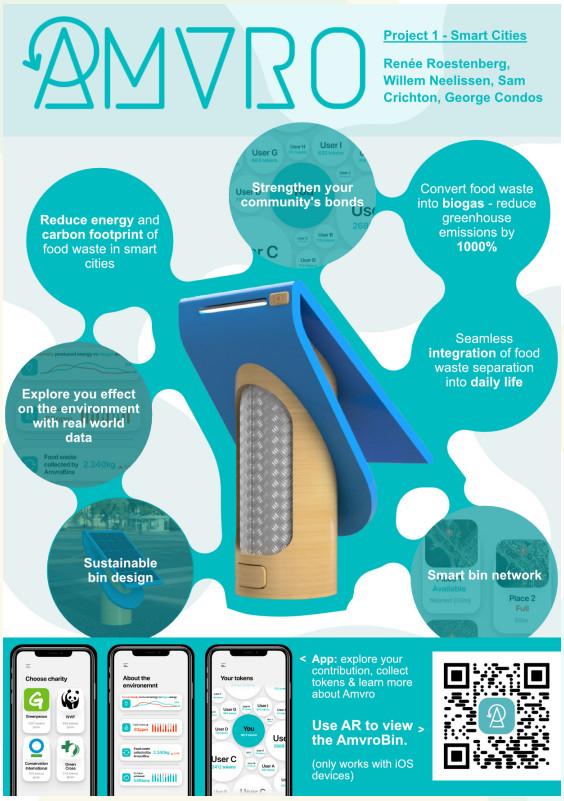
Using these calculations we can account for 53.000/1200 = 44 bins. In 2021 this would result in €330.000 / 44 = €7.500 per bin for breakeven. Take in account that this price can fluctuate heavily due to the CO2 price per ton and also that this price must also include costs for the biweekly pickup, maintenance, software development, marketing and installation.

This is also visualized in a poster for a quick look at the numbers in Figure 3.

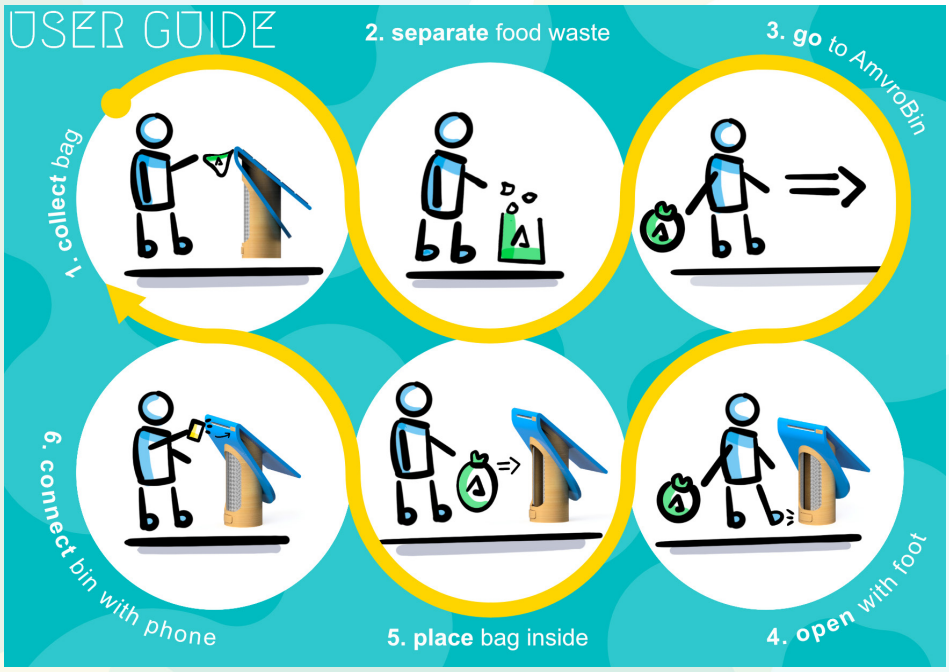


Overall results

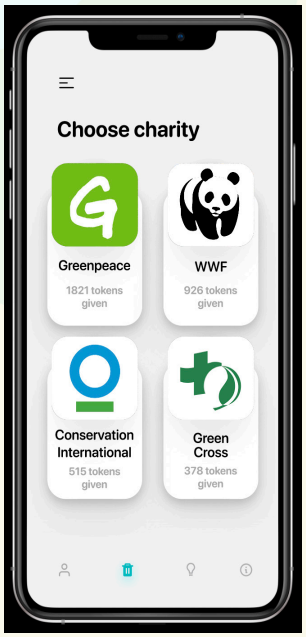
The Amvro bin system consists of 2 main components; the physical bin and the app and website which support the system. The bin is designed primarily with the user in mind, with the secondary benefits of being 100% sustainable and building on the existing Dutch municipality bin infrastructure. The app and website are designed to inspire user participation and to provide the necessary background information that we hope will motivate people to use our bin. The website is also crucial to be able to convince municipalities to adopt our bin system which is where our business model and economic feasibility study are very important.



The user can pick up their biodegradable bin bag at the Amvro bin, free of charge and at any time. After taking the bag home they can fill it up with their food waste and hand it in at their nearest Amvro bin. When handing it in they can open the bin with their foot using the button on the bottom of the bin. It is hands free which makes it easy and more hygienic. When the user puts in their bin bag the door closes automatically. A red light will start to blink. If they hold their phone against it they will be sent to our app or website via Near Field Communication technology. They can then choose a charity to their liking and Amvro will donate a portion of their profits to these charities by the end of the month.

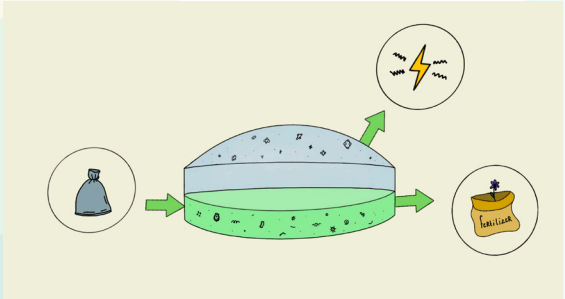


Our app can be downloaded but is not required to use our system. If the app is not installed on the user's phone he will be sent to a web-app which is a direct replica of our app and still allows them to pick a charity that they wish to donate to. When the user doesn't have the app installed, he will be given the option to also download the app. When using our app, they can choose to sign up to personal statistics on how recycling with Amvro helps the environment and allows users to compare with the 'city average' encouraging them to reduce their food waste. When the user chooses to not sign up, the app will still be fully functional so that we do not force users to download an app to use the bin.



Without an account they can only see what their community is doing for the environment. Next to statistical feedback there is more to see on our app. Information on where our Amvro bins are and whether they are full or not. As well as information on the charities of that month and how these charities allow you to give back to your local community. It is impossible for a user to pick multiple charities per week and that way if you waste more food, it doesn't mean that you can donate more to charity. Every month the user can choose one charity, after that month a portion of the profit of Amvro will be divided per the ratio of votes from users. So, if charity 1 got 20% of the tokens that month, Amvro will donate 20% the charity fund for that month. This way we prevent people from putting in extra bags so they can donate more.

After the waste is collected at the Amvro bin we transport it to the biogas plant using the existing waste collection vehicles. Our bins have the same collection structure as a standard general waste bin. After it being moved the waste gets put into the biogas plant. The biogas that is produced gets burnt to make energy, this being a green and carbon neutral energy. This energy will then be sold to the NET (Dutch National Energy Grid). Next to energy a high-quality fertilizer is also produced from the biowaste. This being leftover composed food waste. It will be packed up and sold to local farmers for a fair price.



Conclusion

The overarching outcome is that we achieved almost all objectives we set earlier in the project. We only had to compromise on specific small ideas or concepts. The only thing we all can agree on is that we focused too much on the result of the project and too little on our individual learning. This led to a great result but a mutual feeling of leaving a big part of learning potential behind. But apart from missing out on these personal learning goals we do feel that we made a great project.

Another essential goal of our project was to ensure that our bins system overcomes at least one of the barriers to entry that is currently preventing Biogas from being implemented in modern cities. We focused on the socio-cultural challenges more specifically related to user participation to ensure that the whole system is feasible. With user participation above 50% the system would start to be profitable in a city like Eindhoven and our economic feasibility study shows that our bins would make this a possibility especially when you consider the new Dutch CO2 tax plan which will increase taxes on each ton of CO2 carbon footprint to 125 euros. Thus, we are happy that the Amvro bins system could successfully be implemented into a city such as Eindhoven and drastically reduce the carbon footprint of food waste as well as giving the city a primary source of renewable energy.

A main point we lucked during the four months project one lasted was defining clear roles within the team. From the very beginning we all concentrated and worked simultaneously on the same part. As this offered the ease to participate in every aspect of the project, there was mutual consent in every decision taken. However, a major drawback of this was that at the same time we could have done and accomplished more.

Additionally, we had not set goals from the start regarding the expertise areas. This caused us to focus on two areas without even realizing it and not three, until the second half of our design process where we did incorporate a 3rd. This was a problem that can be probably attributed to a major issue. This issue is that we encountered project 1 as a real-world challenge that had to be solved realistically. This is not true though as the true purpose of the course is to get experience and learn more on the various expertise areas.

Overall, we believe that we all experienced the three areas of expertise that we focused on. As a team we worked great together and included the others while making something we are more experienced at. Thus, some got more acquainted with creating, designing and prototyping digitally while others learned a lot about user centered design or business models.

Reflections

Renée Roestenberg

I learned a lot about the design process and how that should be constructed. I am really glad I know how to do a design sprint because I feel like that helped us so much and I look forward on doing more in my future projects. As this was my first project almost all of the ideating methods were new to me. But I feel like I learned very well when I should use what method. Also, documentation is key, being organized and having a summary of every week is really important. I felt like me and my group became way better in this during the end of the project.

I also learned to put myself out there by taking on tasks I do not feel comfortable with. I for instance put a goal in my PDP to work with premiere pro and learn animating even though I never had done it before. So, when we needed to make a video, I said that I was going to do it. Eventually it turned out great and I am really proud of it. This also made me come to the realization that the projects are about the learning and not about the end product. You can have a great end product that looks amazing and is super realistic but you do exactly the things you were already good in. Or you form the project to realize the goals you have put down for yourself. Which is way better for your personal development. I am going into my next project with this attitude and put myself out there even more.

What my role was during this project is that I keep the focus on what is important. Sometimes we tend to doze off or fail to feel the pressure of a deadline. In those moments I try to keep things clear and organized and divide specific tasks. I came to the conclusion that I don't like inefficiency and so I strive to make me and my group work as efficient as possible.

Sam Crichton

What I learned:
During Project 1 I have learned different soft and hard skills and tried to improve on what I had done in the 'From idea to design' course. In past projects I have not organized as well or used design methods as effectively as we did in this project. The benefits of this methodology were clear to see and something I will make to incorporate in any future projects. We used the design sprint method to good effect - something we initially overlooked as being useful - but this gave our project a clear direction and allowed us to ideate many different good ideas rather than just picking the first best idea and sticking to it. From here we were able to ideate further and come up with different approaches to our chosen problem of food waste. This led to more concise and relevant research and personally I improved in this area the most. I learned how to take concepts from existing designs and use them to ideate new or better ideas through the means of a product analysis and literature research. something I initially struggled with, but this is something I was proud of achieving

Making relevant research clear for someone who knew nothing of the topic was something I initially struggled with, but this is something I was proud of achieving by the end of the project. This has helped me improve my implementation of the User and Society expertise area especially aspects involving UX design research. I learned how to write an effective design brief and how to keep it broad but also specific enough to ensure we had the necessary constraints to incite creative problem solving. I also learned that it is important to take a step out of my comfort zone to get more out of the project, as I feel like I was quite safe in the way I approached this course and did not challenge myself enough.

What is my role:

For this project I wanted to contribute more to organization and the research, I learned these are two crucial aspects of any design project following the evaluation of my shortcomings in 'From idea to design'. I have scheduled and organized most meetings this quarter and tried to help keep the project going at the right pace, this was not always successful on my part, but I am happy with the progress I have made. In terms of the research, I contributed the use of product analysis of existing products to give us further insights and I wrote the final brief using everything we learned from the design sprint, and this gave us a good foundation to build on. I also improved my research skills when comparing the interview responses with literature research to find an appropriate rewards system for our bin. Often, I was devil's advocate when it came to any final design ideas as well as my own, this was helpful towards the end of the ideation process, but I think it is important to realize that when beginning the ideation process, it is good to keep an open mind and not be too critical. As a group I feel we all contributed a good sense of urgency and commitment to achieving a high-quality outcome as well as creating a safe space where we could all express our ideas and concerns freely.

Significant learning outcomes from project 1:

- I leaned that a biweekly meeting schedule helps a team be more efficient with their work.
- Research is important but making it simple for the user to digest this information is equally as important.
- A Design Brief without constraints limits your creativity as there are less ways in which you must think of creative solutions.
- If I want to improve skills that I feel I am lacking it is important to step out of my comfort zone.

Significant learning goals for project 2:

- Challenge myself in different expertise areas such as ‘Technology and Realization’ and ‘Math, Data and Computing’ and increase my learning potential for the project.
- To be less critical in the initial ideation process to allow more creative freedom and find more unique solutions. Do not shut down ideas in their earlier stages of realization.
- Work with group members who are better in areas that I am weaker in and learn from them as we work on specific aspects that I would like to challenge myself in.
- Increase my input in the expertise area of Creativity and Aesthetics and contribute more to design solutions and creating visualizations for any ideas we come up with.
- Learn how to use Fusion 360, SolidWorks or Blender in order to develop designs in computer software.

Willem Neelissen

So, what happened in the last 6 months, I almost feel like project 1 lasted for such a long time that is quite hard to remember the first stages of the project and accurately reflect on that. Luckily, I still had the reflection from the draft report from the midterm demo day and this made things a bit clearer.

Did project 1 help me to become the designer I want to be? I asked that question a lot the last few months since I am just simply unsure of what designer I want to be. I do have some idea of what I want to become but this just changes quite rapidly every 4-6 months. With project 1 we mainly focused on the user and society part and less on other more physical expertise areas. This I kind of dislike since I find myself to already be quite competent within this expertise area. In the future, I need to focus on doing the uncomfortable tasks within the group. This however proves to be a difficult task since I seem so hardwired to deliver quality work instead of quality learning. We talked this specific goal over with the project group and we concluded that it indeed is weird that it often does not feel learning-focused but more result-focused. I concluded that this needs to change at that this will be a very harmful way of following the course. If everybody in the group just does what they do best the learning potential is minimized, and you never get outside your comfort zone. But again, in reality, there is such a big pressure on demo day and the report that you just don’t want the inexperienced person to do the 3D modelling if it can be done way better and in a shorter time period by an experienced modeler.

For project 2 I want to do everything I never did before, now is the time to learn, I need to realize we do not get graded on how well the project turned out but on how we developed and what we learned. Now that I have time for learning I should take that opportunity and use it. For the rest of my working life, I will be solely graded on outcome and learning will be minimized. That is what I learned during project 1.

George Condos

In the first part of Project 1 we mostly focused on ideation and research and not much on other aspects of a design such as realisation. This was a nice opportunity to gain additional experience on iteration processes such as design sprints and how-might-We's. This let us think of the big picture and then dive to more specific details several times. This showed me the number of ideas you can find if you are not stuck in a certain idea that was found in the beginning. Although this led to an abundance of ideas from which we couldn't choose one specific or couldn't leave another one, our criticism solved this issue easily. So, another thing I learned is to take a step back and think of our ideas from a third's perspective.

My contribution in the team is mainly through ideation and visualising ideas. I stood critical to our ideas and that was what led us to the point where we are now. I think that through visualising ideas and concepts, you can have a clearer image of what something could look and function like. That is why I spent a lot of time sketching and designing ideas that could, not necessarily lead us somewhere, but become source of inspiration.

On the second half of the project I spent most of the time on creating digital prototypes of the bin and the app, as well as making posters. As I had already experience on creating such prototypes using Fusion 360, Figma and procreate my development in this tools was not drastic. However, having in mind the user and other inputs was the greatest lesson I received from Project 1. All my previous projects were based on my opinion and my judgment of what works and what looks great. This happened in this project as well with the first iteration of my design of the bin. It was then that we considered the input gained through interviews and our talk with the experts that we reconsidered the deign and came up with a new design more fitting with our goals. This showed me the difference this approach in designing has as before this year I would have stopped in the first iteration and I would not have proceeded with making it

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Interview Summaries and Discussion with Expert

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