



Creation of a professional kitchen equipment layout for

“Green Hippo” restaurant

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Abstract

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<p>The topic of the thesis is a design of a professional kitchen layout. The main objectives of this product-based thesis are kitchen workflow improvement, together with work safety and ergonomics development. Final product represents restaurant’s kitchen layout with changed new kitchen appliances. The product is created for Green Hippo restaurant, because of personal work experience in its kitchen and a wish to create a comfortable workspace for its kitchen employees.</p> <p>The theoretical background of this thesis is collected from books and articles on kitchen space design and planning, kitchen work ergonomics and safety, as well as on current kitchen equipment trends. Theoretical part also includes mostly used kitchen appliances’ classifications and comparisons, their work principles’ explanations for choosing the right one, according to the type of restaurant’s menu and kitchen.</p> <p>As a method of research is used qualitative survey, in which respondents, who are working in Green Hippo restaurant, answer questions about their kitchen space and equipment and give comments and suggestions on its improvement. The survey results are described with a circle diagram.</p> <p>Kitchen planning requires analyzation of different things, such as restaurant menu, serving speed, kitchen size and employees’ awareness of working with several appliances. The final product is designed based on the theoretical part and collected data from survey answers. A new kitchen layout describes reasons of implementation modern appliances in order to make a kitchen space more efficient, safe, and ergonomic.</p> <p>The result of this thesis helps the commissioner to analyze its kitchen space, find out kitchen workers’ opinions on its inconveniences, and implement some parts of the new layout in the future.</p>
Key words Kitchen space planning, kitchen layout, kitchen equipment, work safety and ergonomics

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1 Introduction

The kitchen is, without a doubt, the heart of any restaurant. Its planning plays a significant role in the restaurant's organization. Before opening a restaurant, designers decide, what type of kitchen there is going to be, and what kind of appliances needs to be installed. Efficient kitchen space should be comfortable, safe, wide, ergonomic, and fully equipped with all needed kitchen devices. Kitchen appliances aim to minimize service time, workers' movements, and possible risks. Nowadays a professional kitchen equipment market offers a big variety of different appliances and tools, moreover everyone can create a kitchen layout with several free programs. That's why the process of making a workable kitchen model is getting easier day by day, however there are still lots of important things to consider.

The main objective of this thesis project is to create an efficient and ergonomic kitchen layout for "Green Hippo" restaurant, using Metos Professional Kitchen planner as a main design software. Green Hippo kitchen is selected for designing, because of personal work experience in its kitchen and aspiration to make it more ergonomic and comfortable for kitchen employees. The project includes recognizing of kitchen planning process, making a survey for restaurant workers, collecting data, and creating a new kitchen layout. A new layout doesn't necessarily mean creating a whole new kitchen, but mostly making changes of its appliances and installing modern ones. The reasons for choosing Metos Professional Kitchen planner are experience of using the program and its easiness. The app is informative, handy, fast, and accessible for creating a kitchen layout, even a new user gets used to it fast. The big advantage of this program for the commissioner is an automatically formed receipt with appliances' prices and parameters at the end of the process.

In order to collect data, during the project is used qualitative research methods, such as open-ended question survey. With the help of it, workers' opinions are collected and analyzed, and possible changes are determined. Data collection happens through several concrete questions to get more detailed information about a structure of restaurant's kitchen, advantages and disadvantages of different appliances and possible improvements. The survey is created with Webropol, a common tool for Haaga-Helia students. Comparing to other tools, it's more informative, because Webropol does not only collect answers, but also analyzes them and creates different data diagrams.

As a result, the commissioner is going to get a ready-made efficient layout with changed kitchen appliances, that they could possibly implement in the future. The outcome of this thesis project helps the company to get different useful suggestions on its kitchen space development.

2 Kitchen space planning

Kitchen space planning consist of defining the size, style, shape, decoration of space and equipment (Gregoire, 2017, 76). Kitchen is always designed by creating a working layout using several design programs and tools. The layout is a detailed plan of the kitchen space and floor, where all kitchen appliances and work sections are located. Work sections are areas of the kitchen, described by the nature of the work being done there: baking section, cooking section and others (Thomas, Norman & Katsigris, 2014, 17-18). Creating a kitchen plan means considering firstly restaurant's menu and style of production and then secondly creating the layout, knowing the sizes and types of equipment. Kitchen space and its constraints, such as doorways, beams, partitions, exterior and interior walls, should be properly explored before identifying the most challenging obstacles during the planning.

A well-organized kitchen plan contains space analysis and information on how to use the space of a kitchen efficiently. The kitchen should be analyzed section by section, to help estimating the concrete size needed for each (Thomas, Norman & Katsigris, 2014, 35). Depending on the size of a kitchen, each consists of at least 4 areas: preparation, production or cooking, storage, and dishwashing. Preparation area refers to any food preparations, such as washing, peeling, cutting, chopping or others. In this area should be located at least one worktable with drawers, sink, refrigerator, scales, cutting boards, knives, mixers, and other required mechanical equipment. Production area is often divided into hot-food and cold-food cooking zones (Thomas, Norman & Katsigris, 2014, 37). Before arranging hot-food cooking zone, the cooking methods should be determined depending on the menu of the restaurant. Dry-heat methods (sauté, broil, roast, fry, bake) and moist-heat methods (braise, boil, steam) are two main ways to cook food, differencing from each other in the use of liquid (Thomas, Norman & Katsigris, 2014, 37). At this area fryers, stoves, ovens, broilers, pans, exhaust hoods and various steam equipment could be located. They are often grouped together especially in a small kitchen, where is not enough space to separate stations by cooking methods. Storage area is divided into dry storeroom, which is usually located in a different space not far from the kitchen, refrigerated storage and freezer. In a professional kitchen should be at least one refrigerator and freezer to store the ingredients. Dishwashing area's specific tasks are restaurant dishes' collecting, cleaning, rinsing, sanitizing, and drying. For sanitation reasons, it's important to separate the area into soiled and clean dishes' sections. The size of the dishwashing area should be designed properly according to the volume of ware delivered to it. Planning of a restaurant's kitchen has a huge impact on the efficiency and quality of a foodservice operations. When kitchen space is arranged properly, restaurant works like a well-oiled mechanism, where each employee works productively and rapidly. According to Birchfield (2007, 62-64), efficient kitchen design should be simple, flexible, and modular, it should also use kitchen space efficiently,

promote food safety and enhance customers' experience. Nowadays restaurant owners and managers are seeking to implement new ideas and concepts "for using their kitchen space wisely by reducing operating costs and increasing productivity" (Thomas, Norman & Katsigris, 2014, 18). The main kitchen-related costs, such as labor, utilities, and food, could be lowered, if a kitchen environment is designed efficiently.

2.1 Kitchen ergonomics

According to Thomas, Norman & Katsigris (2014, 217), ergonomics is "an applied science that involves studying the characteristics of people and designing of arranging their activities (sports, on-the-job duties, etc.) so they are done in the safest and most efficient manner." Regardless of technical progress and smart technologies, cooking is still a manual process, and a designer of a kitchen space should consider features of this type of work, as well as proportions and dimensions of a human body. Ergonomics aim to increase kitchen workers' well-being, productivity, job satisfaction and efficiency. It's not always an easy path to find the most ergonomic solution for restaurant's kitchen, but there are certain important things to take into consideration for getting the best result. First, exact ergonomic problems of a kitchen should be identified, for example highly located shelves, low worktables, or crowded work areas. Then, possible solutions or alternatives, such as designing tables and shelves according to workers' average height, should be considered to solve these problems. Furthermore, there are several height recommendations for worktables in the professional kitchen (Thomas, Norman & Katsigris, 2014, 219):

1. Worktable for light work should be 93-99 cm for women and 94-100 cm for men
2. Worktable for heavy work (cutting, chopping) should be 92 cm
3. Equipment table (for mixers, etc.) should be 66-71 cm

Kitchen tables also must withstand both high temperatures and excessive humidity, be resistant to damage and stains, and meet sanitary requirements. Height of the kitchen shelves should be designed ergonomically to reduce the risk of accidents and the load on a worker's body associated with lifting. The most comfortable space at eye and hand level is about 100-190 cm, suitable for storing frequently used appliances, tools, and dishes (Kaukiainen, Nyberg & Sillanpää, 2006, 25). To reach shelves, that are over 200 cm high, workers should use special stepladders. According to safety guidelines, it's also recommended to store only unbreakable lightweight items on the high shelves.

Permanent use of arms and hands can lead to wrist-, fingers-, arms-, or shoulders pains. To avoid this, kitchen should be equipped with light tools, that keep workers' wrists straight. In addition, employees should be trained on how to hold tools properly, for example, some kitchen objects must be grabbed with the whole hand, not just with a few fingers (Työterveyslaitos, 2022).

Each kitchen work area (preparation, production, storage, or dishwashing) should be equipped with all the necessary tools and appliances (Työterveyslaitos, 2022). That is why one of the growing trends in kitchen ergonomics is equipment mobility, which gives an opportunity not only to move appliances, but also quickly reorganize kitchen areas, according to employee's needs. Appliances have special wheels, which allows to replace or move them without lifting. Moreover, it helps in cleaning a kitchen and its equipment, because workers can reach every corner by just changing a position of equipment. Carts with wheels are also created for avoiding the lifting and carrying heavy appliances and supplies.

Responsible kitchen planning helps to design a space ergonomically and safely for people, who are working in it every day. Ergonomically designed kitchen areas and equipment minimize movements of kitchen workers, as well as reduce risks of work accidents and injuries. However, when it comes to ergonomics, it's essential to remember, that even small changes matter.

2.2 Kitchen safety

Most accidents in the kitchen are the result of human errors, which could be prevented by thoroughly instructing workers. Employees must be aware of all potential risks related to work on a kitchen, such as cuts, burns, falls, injuries from using hot or sharp kitchen equipment, and learn options for decreasing them and avoiding accidents (Gregoire, 2017, 218). Main principals of kitchen safety rules, that would help in lowering risks, are improvement of technological processes, modernization of equipment, limitation of sources of danger, as well as ways of individual and collective protection at work.

All kitchen areas must be designed considering the sequence of production processes to exclude oncoming and crossing flows of raw materials and proceeded products, as well as to ensure free access to all food products and compliance with safety regulations at a workplace. A stove or griddle must not be placed near passageway, otherwise there is a risk of getting burned, near refrigerator or freezer (recommended distance is at least 30 cm), or less than 45 cm far from windows, which refers to gas stoves, because it could lead to extinction of the gas fire due to the wind. Also, kitchen should maintain a comfortable temperature - no higher than 23 ° C. Since the operation of heat appliances increases temperature, a professional kitchen must be equipped with a good ventilation system. The humidity level of a space should vary between 50-70 per cent.

Before starting to use an appliance, employee must read instructions and recognize potential risks, that could occur during the work with it (Työsuojelu, 2021). While making food with a griddle or a stove, workers should be aware of heating of its parts during the operation. Touching the heating surface of an appliance with hands can cause severe thermal burns. Hot oil is another big danger

in a professional kitchen, employees could get serious burns by incidental splash or direct contact with it. Oil must be poured exactly to the mark before switching on a fryer. As well as products, that are prepared in a deep fryer, must be fried only in a special metal basket. For slicers, it is strongly recommended to use a chainmail glove, even though it contains injury prevention parts. While using a deep fryer, it's important to pour oil to the mark, and to put products only in metal basket.

Kitchen safety also considers daily appliances' cleaning. It must consist of wiping worktables and shelves, cleaning ovens and stoves, washing dishes and cutlery with disinfecting cleaners, as well as floors and walls washing. Restaurant kitchen equipment should be cleaned from outside and inside, using different types of cleaners. The fat and oil should be daily removed from all appliances and surfaces. Metal worktables and surfaces should also be polished. General cleaning of equipment minimizes risks of foodborne infections, injuries and helps to prolong the lifespan of kitchen appliances.

While creating a safe kitchen space, among other things, a designer should also consider floors. No matter, how carefully employees are working in a kitchen, it is possible for water, oil, or other liquid to get on a floor and walls. To ensure safety in a professional kitchen, floors should be covered with non-porous, easy-to-clean, and nonslip materials.

3 Kitchen equipment

At this point, it's time to go into details and find out, what classifications of equipment are used in a restaurant kitchen. Nowadays kitchen appliances are more efficient, multifunctional, safe, economical, and ergonomic; they lower cooking times and weight loss of food being cooked. Their designs also ease cleaning processes and minimize need of lifting heavy objects. Before creating a layout with required equipment, a designer has to analyze following elements (Thomas, Norman & Katsigris, 2014, 314):

- Type of menu
- Speed of cooking and serving
- Kitchen size and style
- Power requirements to safely handle all the equipment
- Employees' skill levels

When all these elements are determined, the process of choosing the right equipment happens easier and faster. In the following chapters, some of the frequently used kitchen appliances are mentioned and compared to help choosing the most relevant one, relying on basic elements.

3.1 Classifications of professional kitchen equipment

The stove or range can be called the most indispensable attribute of any professional kitchen, because with its help happens the main action – cooking. Based on amount of restaurant customers, kitchen stoves come with one, two, four or six burners. Also depending on the power source, which is either gas or electricity, stoves are divided into two types – gas or electric. The main advantage of a gas stove is the ability of working without any electricity, which now costs more than gas. They also heat up fast, which allows workers spend less time on cooking. However, open flames and the possibility of gas leaks make these types of stoves far more dangerous than others.

Electric stoves are usually made of heat-resistant materials, such as iron and stainless steel, and characterized by high energy efficiency and impressive capacity. The two major advantages of an electric stove are ease of commissioning and safety – to switch it on, employee just needs to insert the plug into a socket. Moreover, an electric stove keeps heat longer, which is convenient for constant cooking during the service. Maintenance and cleaning are also important factors when choosing a stove, and here also wins an electric one, it is easily amenable to sanitation and cleaning procedures. Many of its models have a special container for collecting waste products such as fat, oil, or liquid. Nowadays the most relevant type of electric stove is induction, usually made of tempered ceramic or glass. The principle of its working is different: the electromagnetic field acts on the contents of a pan instantly, without heating a burner and without giving off heat to environment.

Although, induction stove requires magnetic cookware, for now it's the most efficient type of equipment, using "less energy than either its gas or traditional electric counterparts" (Thomas, Norman & Katsigris, 2014, 322).

Another type of preparing food is frying, which means cooking in hot oil or fat. While the basic frying techniques remain the same, equipment in a kitchen has become safer, more energy efficient and easy to use and clean. Deep fryer heats the oil to a temperature between 160-190 °C, that products reach the desired condition faster than in an oven or on a stove. With the help of professional deep fryers, kitchen workers cook not only French fries, but also chicken, fish, vegetables, pasties, and other dishes.

A deep fryer consists of:

- A bowl made of stainless steel, where oil is poured
- Hidden heating element located inside the bowl of a fryer or under a flat steel plate
- Cold zone, or space between the heating elements and the bottom of a kettle
- Metal basket, in which food is lowered into the hot oil
- Control block to adjust temperature, set a cooking mode, as well as other options (timer, notifications, need of oil change)

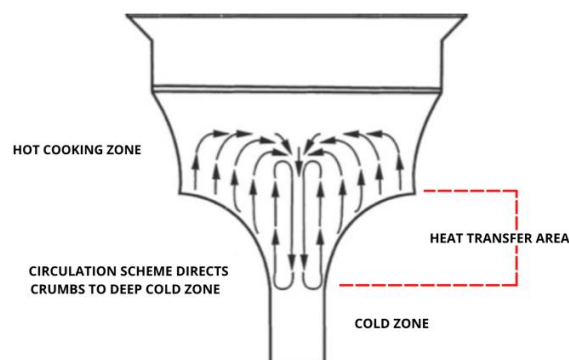


Figure 1. A cold zone in a kettle helps ensure crumbs and debris don't mix with the hot oil above (adapted from Thomas, Norman & Katsigris 2014, 350)

Also, kitchen fryers are equipped with thermostats, overheating protection mechanisms, and a drain tap for fat waste. Choosing between a countertop and a floor fryer depends on a size of professional kitchen and amount of food fried daily. Deep fryers could also be gas or electric, the major difference is that gas fryer heats up faster and provides higher maximum temperatures than electric. The main advantages of this appliance are fast production and temperature control, also

fryer does not require switching off and cooling during the day. Due to the fact, that direct contact with oil in a fryer is excluded and its walls do not heat up during operation, workers are protected from injuries.

Ovens are another frequently used kitchen appliances. Convection is one of the most common functions of modern ovens. In convection ovens, the heat from the heating element spreads evenly in all directions. Convection oven “uses fans to circulate heated air around the oven cavity, reducing cooking times by 25 % to 35 %” (Thomas, Norman & Katsigris, 2014, 324). The heat transfer in this type of oven is more efficient, and the food can be baked at lower temperatures, which significantly decreases electricity or gas costs. The convection oven can be powered by gas or electricity, but gas models are required to have a venting system, because of uneven heating. The popularity of rack ovens has grown due to efficient use of kitchen space: worker can easily wheel in and out big racks of ingredients. Depending on the size of this oven, from 6 to 15 trays can be fitted inside and cooked at the same time.

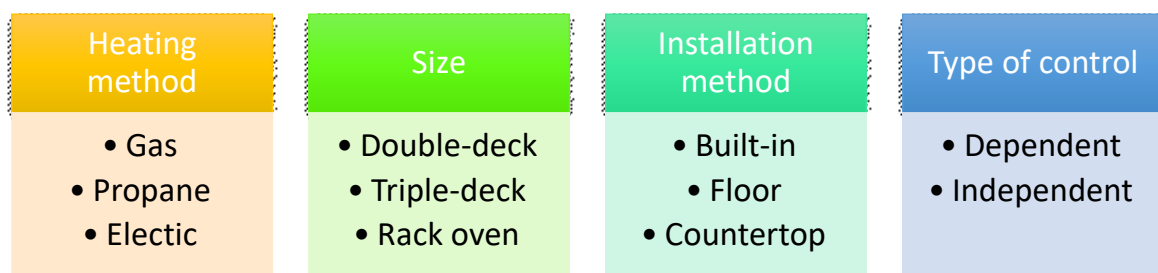


Figure 2. Classification of professional ovens (adapted from Thomas, Norman & Katsigris 2014, 324-327)

According to the type of control, ovens could be dependent and independent. Dependent oven means that it is controlled from a hob that is built in above. The oven and hob are forming one complete system. Independent oven is fully insulated, a panel with buttons and knobs is located on the oven itself.

If a restaurant offers breakfast menu or meat dishes, such as pancakes, toasts, steaks or burgers, its kitchen needs to have a griddle. A griddle is “a piece of surface cooking equipment, an appliance on which food is heated from below by gas or electric heating elements located directly under the flat surface” (Thomas, Norman & Katsigris, 2014, 384). Griddles with a solid surface are universal kitchen equipment, on which employees can not only fry meat, fish, or vegetables, but also cook pancakes, scrambled eggs, toasts, etc. The main task of a griddle is fast cooking at high

temperatures, so it should warm up fast to about 270-300 ° C and provide this temperature over entire frying surface.

The benefits of using a griddle in the kitchen are:

- Change in the structure of egg, meat, and fish proteins
- Flavor enhancement
- Tenderizing certain food products (steaks, chicken breasts, pancakes)
- Crispness development for bacon or other products

As many other kitchen appliances, griddles are also could be gas or electrical, countertop or floor. A gas professional griddle is designed for a power up to 15 kW, and often such device is superior in size and efficiency to its electric counterparts. Depending on the menu frying surfaces could be smooth or corrugated, which is used mainly for creating grill marks on steaks or fish. The frying surface is usually protected by a high rim to prevent splashing of oil. In addition, modern equipment has a special grease collector tray to simplify maintenance and washing.

Along with all these kitchen appliances, designer could install some other equipment, such as meat mincer, mixer, blender, toaster, or others. The choices of appliances should be made according to the menu of a restaurant, size of its kitchen and speed of service. Also, it's important to explain safety regulations and principles of use to workers before new appliances' installation.

3.2 Kitchen equipment trends

Smart technologies not only simplify lives of people, but also make work processes of kitchen employees more optimal, ergonomic, and time saving. In 2022, the most popular kitchen equipment trends are touch displays, remote control and service, minimization of waste, automatization, mobility, and interaction between appliances (Nelimarkka, 2022). Some of them are already implemented in kitchen working processes and used daily by millions of professionals. For example, remote control of appliances gives workers an opportunity:

- To turn on an oven, multicooker, mixer or coffee machine
- To set a required temperature
- To monitor the whole process of cooking
- To indicate the cooking mode for products that were left in an oven
- To measure electricity consumption of kitchen appliances

For making all these actions, workers only need to have their smartphones and a special app. A lot of manufacturers are already selling the kitchen appliances with smart operating. Smart Kitchen Solutions company offers a big variety of equipment, according to a customer need (Smart Kitchen

Solutions, 2022). For example, they have a SmartKitchen MachineLink system for remote control of any kitchen appliance. SmartKitchen Machine Link is a device with a built-in Internet connection and the SIM card inside, that could use the services of the 4G mobile network. The Machine Link is always configured for each type of kitchen appliance. The device is suitable for controlling all types of kitchen appliances, such as cooking stoves, dishwashers, refrigerators, and freezers. The ML appliance is either assembled in a standard SmartKitchen equipment or a kitchen own equipment. It can be installed on the outside of the kitchen appliance (for example, on the back wall) or placed inside the kitchen appliance. The device has a built-in mobile network antenna, that can also be used to amplify the network signal.

The most time-consuming process in the kitchen is heating of ingredients, that is why current trends also refer to innovations in commercial ovens. In the nearest future, kitchen workers will use multifunctional ovens, which could do the job of kettles, steamers, deep fryers, dehydrators, and smokers (Kulkarni, 2022). These appliances would not only save time for preparing and heating food, but also would reduce needs to buy lots of other kitchen appliances. It means, that even a small space could be suitable for designing a kitchen.

A modern smart kitchen contains a sufficient number of technological kitchen appliances, which create comfort and bring invaluable benefits in the preparation, storage, and disposal of food. The security system in a form of water leakage sensors, gas analyzers, smoke detectors, allows minimizing the risk of fire, flooding, gas poisoning and preventing serious accidents.

4 The process of creating a kitchen equipment layout for Green Hippo restaurant

Design of a kitchen equipment layout consists of at least four important steps (Figure3):

- Proper analysis of kitchen space and its equipment – making notes and photos, finding out its parameters and features, together with finding useful theory on kitchen design and planning
- Doing research – making a survey or arranging interviews to gain more information about kitchen space from the people, who are working in it
- Collection and analysis of workers' answers – understanding what workers need the most, and how to implement it in a kitchen
- Creation of a kitchen equipment layout – designing a new kitchen layout with a help of different design apps, relying on the collected data



Figure 3. The process of creating a kitchen layout (Olga Skukhtorova 2022)

When all these steps are followed, the process of making a kitchen layout would go more productively and easily. One of the main things to find out is for whom a designer is going to create a new kitchen layout. A proper kitchen design should include receiving answers and feedback from people, who are supposed to work in this kitchen and use these appliances.

Restaurant "Green Hippo" is selected as a commissioner for this project. The restaurant is located in Punavuori district, in the southwestern center area of Helsinki, and has a static type of menu, which offers the same menu items every day. There are approximately fifty seats in the restaurant,

but every summer season it has an open terrace, that fits around one hundred customers. The restaurant is quite popular in the area, and it's usually full of customers, especially in the evenings and weekends. The kitchen area in the restaurant is small but fits all required appliances. However, if the restaurant hires more workers in the future, it will be challenging to find enough workspace for each of them.

The new layout allows commissioner to implement kitchen equipment changes, that help to develop or improve working processes, minimize risks, and increase work efficiency. Kitchen appliances are operating during the whole day, and sometimes even longer that the restaurant is open itself, that is why they should be efficient, economical, reliable, easy-to-use, and every kitchen worker has to be acknowledgeable about instructions of use and potential risks. Moreover, the kitchen layout helps the company to optimize the space, to get rid of old-fashioned equipment and to become acquainted with new kitchen appliances.

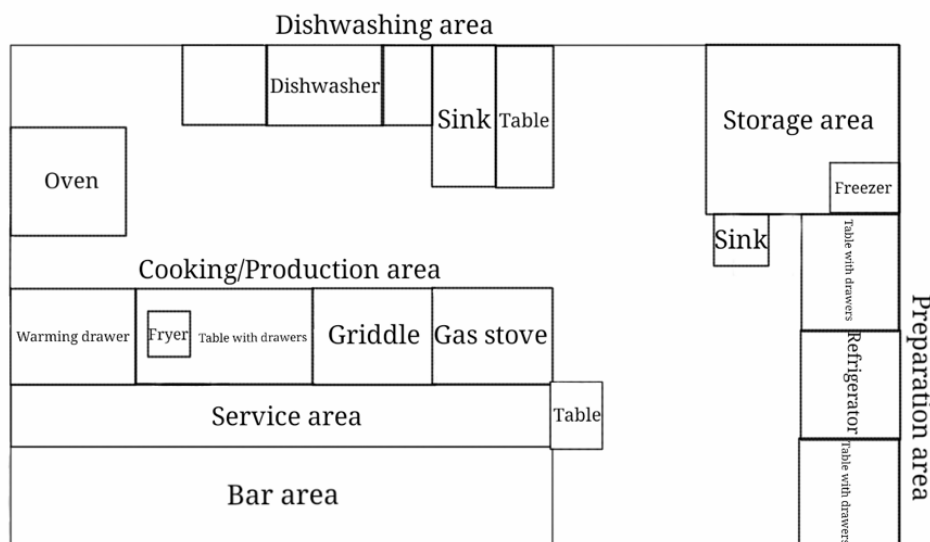


Figure 4. The layout of current Green Hippo restaurant kitchen (Skukhtorova 2022)

Self-drawn kitchen layout (Figure 4) helps to analyze the whole space and understand the structure of a current kitchen, in order to get more information about exact changes. The areas are not going to be changed or switched during the project, because they organized well according to sewage and electricity system regulations.

4.1 Green Hippo restaurant menu

Green Hippo serves different variety of dishes depending on the time of the day: breakfast, lunch, or dinner; and specializes mostly on a healthy food, such as porridges, salads, and bowls (Figure

5). Also, the restaurant offers special combos during breakfast and lunch, and brunch combos during Sundays. Combos usually include main dish, drink, and smoothie bowl, but evening combo is similar to three course menus, including starter, main, dessert and drink. Every customer can choose the dish, that is going to be in combo. It's a great offer not only for the customers, but also effective way to increase the restaurant profit. The menu is diverse enough for every customer to find the most desired dish, and the kitchen also offers vegan, gluten-free, and nut-free options.

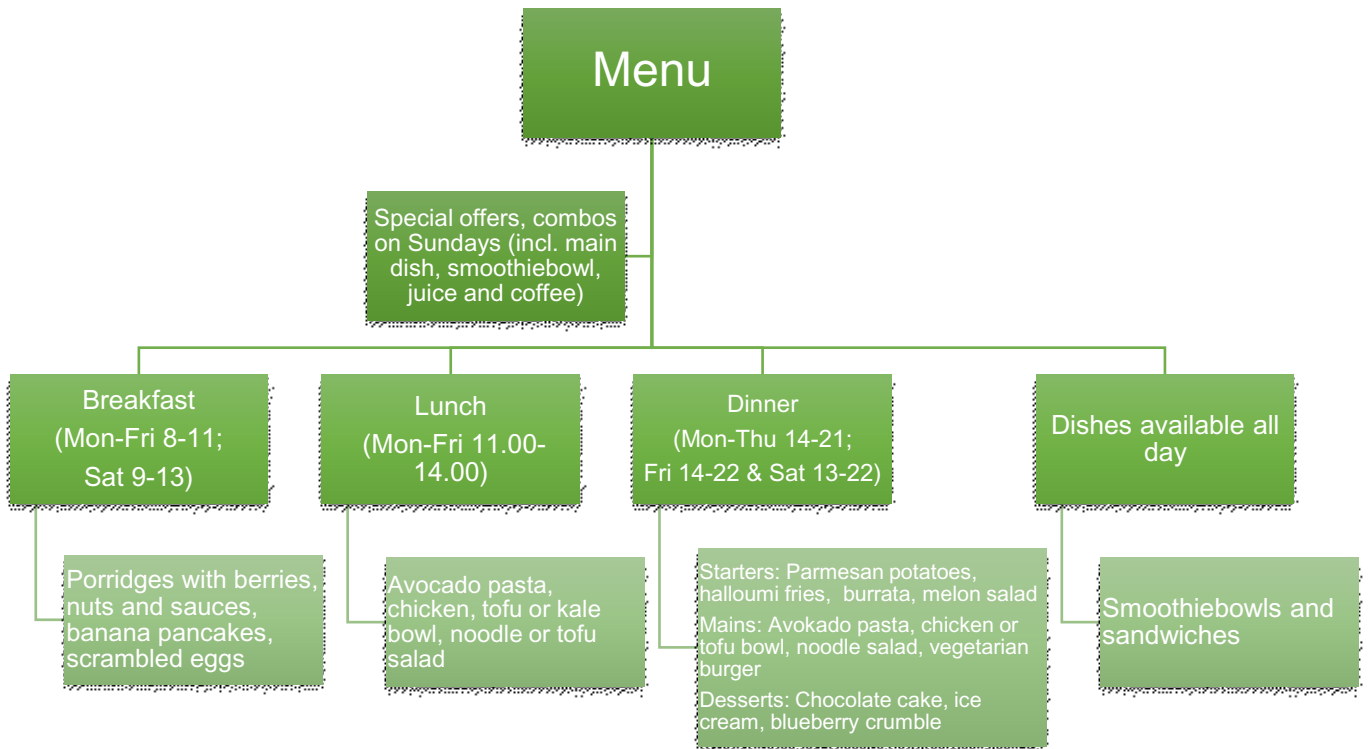


Figure 5. The structure of Green Hippo restaurant menu (Green Hippo Cafe)

During the project, drinks are not considered, and the reason is that they are made mostly in the bar area, however Green Hippo offer its customers a big selection of non-alcoholic and alcoholic drinks, such as wines, cocktails, fresh juices, and others.

4.2 Kitchen areas and potential changes

There are usually two kitchen workers on a shift; morning shift starts early at seven o'clock, evening starts between three and four. Serving time is fast and takes about 10-20 minutes depending on a dish. For most of the dishes, workers have to do a lot of preparations, because salads, bowls and pastas could be prepared in the mornings and left in the cool drawers until the service. The

kitchen space in restaurant Green Hippo could be divided into 4 important areas: preparation, cooking or production, storage, and dishwashing.

The preparation area of the restaurant consists of two tables with under-counter refrigerator drawers, refrigerator, sink and shelves, where are containers, lids and bottles are stored (Figure 6). Mixer, toaster, and small induction stove with one burner are located on the tables. Refrigerators contain vegetables, berries, salad, avocados, and different food preparations for the service. Potential changes in this area are space optimization for making the kitchen space bigger enough for the comfortable work, changing the small low sink to the one that would be installed on the countertop to facilitate the process of washing raw products.



Figure 6. The preparation area of Green Hippo restaurant (Skukhtorova 2022)

Gas stove, griddle, table with under-counter refrigerator drawer, deep fryer, warming drawer, oven and ventilation system are located in the production area of Green Hippo restaurant (Figure 7). Production area is the most dangerous one, because of all potential risks, such as heat, open flame, and hot oil. During the work in this area employees must follow all the instructions and safety precautions for kitchen equipment. The potential changes for this area are:

- Changing the stove from gas to induction in order to cook products quicker, minimize injury risks for workers, and decrease the amount of heat transfer to the kitchen space
- Changing deep fryer to modern version and finding place for it
- Finding alternatives to warming drawers, modern ovens have the same functionality, but use less electricity working on an economic mode

- Optimizing the space in the area to make working processes safe, efficient, and comfortable



Figure 7. The production area of the restaurant (Skukhtorova 2022)

Dishwashing area has a sink, tap, shelves for clean dishes and cutlery, dishwashing machine and trash bins (Figure 8). According to sanitary requirements and instructions, in this area is extremely important to separate dirty and clean dishes to prevent spreading bacteria and causing several human diseases. In Green Hippo restaurant clean dishes are stored near the areas, where they are usually used (preparation, production). Shelves near the dishwasher are used for drying the dishes before putting them back to their places. Potential changes for this area would be space optimization by designing mobile trolley on wheels for storing and moving dishes in a kitchen space.



Figure 8. The dishwashing area (Skukhtorova 2022)

4.3 Survey for Green Hippo workers and results

According to Check & Schutt (2012, 159), survey research “involves the collection of information from a sample of individuals through their responses to questions”. A survey can be considered as one of the most common methods for obtaining information about different subjects. A survey consists of asking a group of people special questions, the answers to which, allow researcher to gather needed information, depending on objectives of a research. The survey should be conducted when the needed information can be obtained with the help of a survey and is mainly aimed to gather the opinions of respondents. With the help of the survey research method, the information can be obtained quickly at a low cost.

Survey questions are usually answered as part of questionnaire or interview, the structure of which has a major impact on how questions are interpreted and answered (Check J., Schutt R. K., 2012, 161). Questions are usually separated into closed or open-ended, subjective or projective. Closed questions involve choosing an answer from a list and can contain one choice (agree or disagree) or multiple choices. The disadvantages of closed questions are a high probability of thoughtlessness of answers or their random choice. Open questions do not contain any prepared answers, and the respondent answers in a free form. Data obtained from responses to open questions is more difficult to process, compared to data gathered from closed questions. Subjective questions

ask the respondent about his/her attitude to something or about behavior in a particular situation. Projective questions ask about a third person without pointing to the respondent.

There are several rules in a proper questionnaire forming:

- Every question should be logical and separate
- Abominable to use specific language terms
- Questions should be short and specific
- Questions should not contain hints
- The wording should prevent formulaic responses
- Questions of a suggestive nature are unacceptable

The objective of the project survey is to gather more information about Green Hippo restaurant space and appliances, possible suggestion on their changing, fixing or modernizing. The survey is created using Webropol, which helps to ease the processes of analyzing collected data. The target group of the survey and the whole project is restaurant workers and managers, especially people working in the kitchen. To separate the large group of employees, survey contains question, that asks respondents, where exactly they work, in the bar area or in the kitchen.

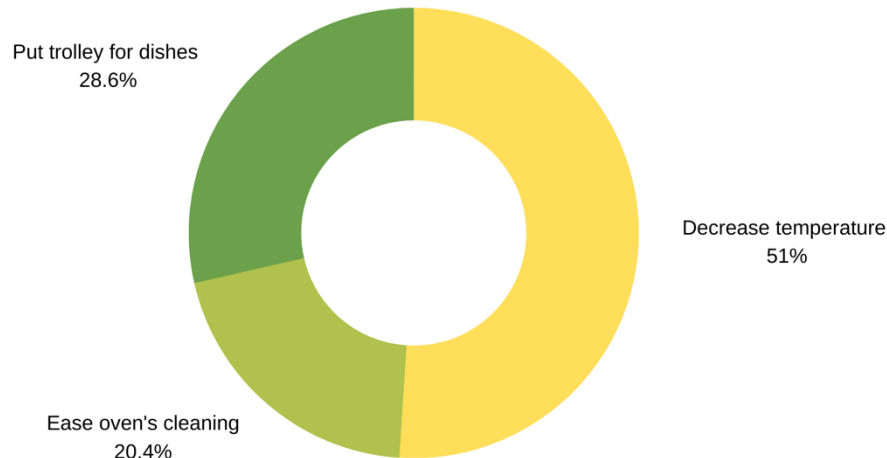


Figure 9. Collected data from research made with Webropol (Skukhtorova 2022)

According to the results, over half of respondents mentioned, that the biggest inconvenience in the kitchen is high temperature, especially in production and dishwashing area (Figure 9). Because griddle and gas stove are located nearby, the temperature increases during the day and causes workers' exhaustions. Extremely hot temperature during the shift is bad for workers' health and wellbeing. However, some of the workers like to use gas stove and stated, that it's the most convenient type of kitchen stoves. To workers opinions, the hardest-to-clean appliance in the kitchen is

oven, because it requires special cleaning surfaces and needs to be cooled down and emptied before the cleaning processes. The kitchen oven doesn't have to be cleaned daily, but anyway its cleaning takes a lot of time and efforts. Many modern ovens cleaning themselves automatically by heating the temperature inside to 400 °C in order to burn off all those spills and spots, however after this, workers also have to wipe the oven with a sponge. Employees also suggested to create some shelves or bring trolley for drying dishes and storing baskets in the dishwashing area.

Overall workers were satisfied with a kitchen space and areas arrangement. Based on the information collected from their answers, kitchen areas are divided logically and ergonomically, and workers are not disturbing each other during work processes.

4.4 Metos Professional Kitchen Planner as a working tool

For creating layout, every designer has to use a special tool in order to get a visible plan of what equipment is going to be in kitchen. Many kitchen planning programs are provided by manufacturers themselves, they can be used online on the company's website, or be installed on the computer. After creating a kitchen layout, a designer can see an approximate costs, as well as send an application straight to manufacturer. Modern tools are comfortable, because a creator does not need to have any special skills or knowledges to use it. Metos Professional Kitchen Planner is chosen as a tool to make Green Hippo restaurant layout for these important reasons (Metos, 2022):

- Anyone can install it for free
- It doesn't require a registration or personal information
- It has a floor plan and a 3D model of a layout
- The program contains only Metos equipment, and when layout is done, a designer can also see a total sum for all appliances
- Finnish or English languages are available
- It doesn't contain any professional language
- A designer can save a layout and continue to work on it later
- The program works without internet connection
- Sizes of appliances are already set according to real sizes

When it comes to designing the kitchen layout, tool is more important, than a designer could think. It can save not only time, but also nerves and help to create an understandable and good-looking layout. Metos Professional Kitchen Planner was created by specialists for professional work, in this program, everyone can create interiors of varying complexity. The main advantage of this tool is the existence of a large catalog with all the necessary kitchen appliances, that are also available

for buying on the website. Besides kitchen equipment, a designer can also draw walls, doors, and windows in the program to make more realistic layout.

The main actions, that every user should make during Metos Professional Kitchen Planner use, are described on the Figure 10. The first main thing is to make sure, that a user has Adobe Air on a computer, because the tool is not working without it. However, a designer can install both Metos tool and Adobe air on Metos website. Then a user opens the tool and starts working from building walls, setting doors and windows. It's not mandatory, but these actions will make a layout more visible and realistic. After that, a designer can set up all required appliances and check the 3D model of a layout.

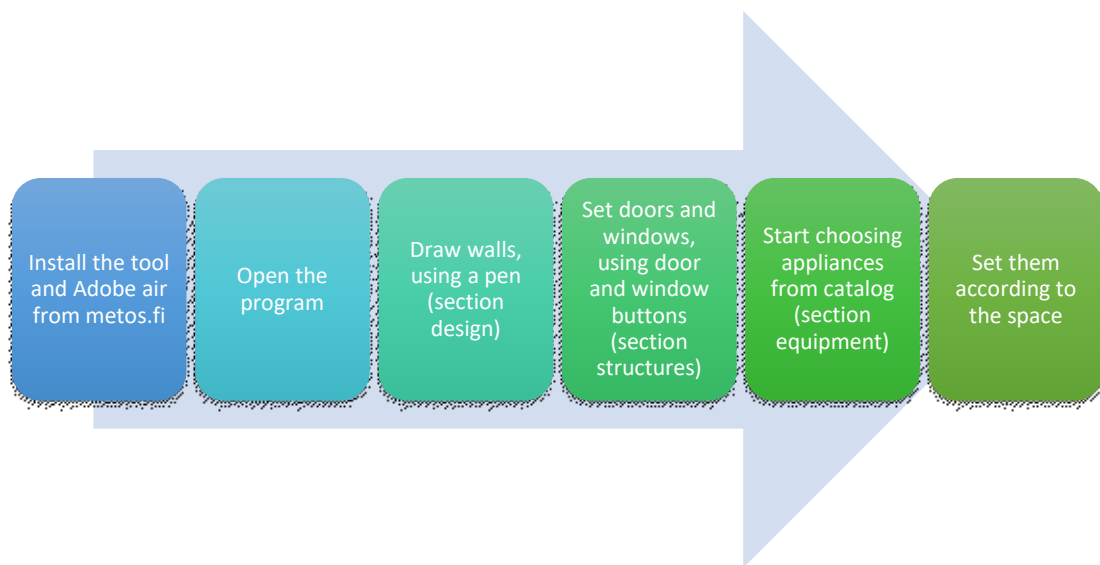


Figure 10. The process of making a layout in Metos Professional Kitchen Planner (Metos 2022)

Metos Kitchen Planner is comfortable tool not only for workers, who are already familiar with kitchen equipment, but also for those, who don't know yet much about kitchen planning. However, if a person faces inconveniences, while using the tool, Metos workers are always happy to help and explain the principles of this program.

5 Results

According to the survey answers, the new plan of Green Hippo restaurant is created in order to modernize and optimize the kitchen space. The new kitchen layout does not concern sewage, electricity, ventilation, and light systems. It is all about the equipment, its efficient and ergonomic use and workers' safety.

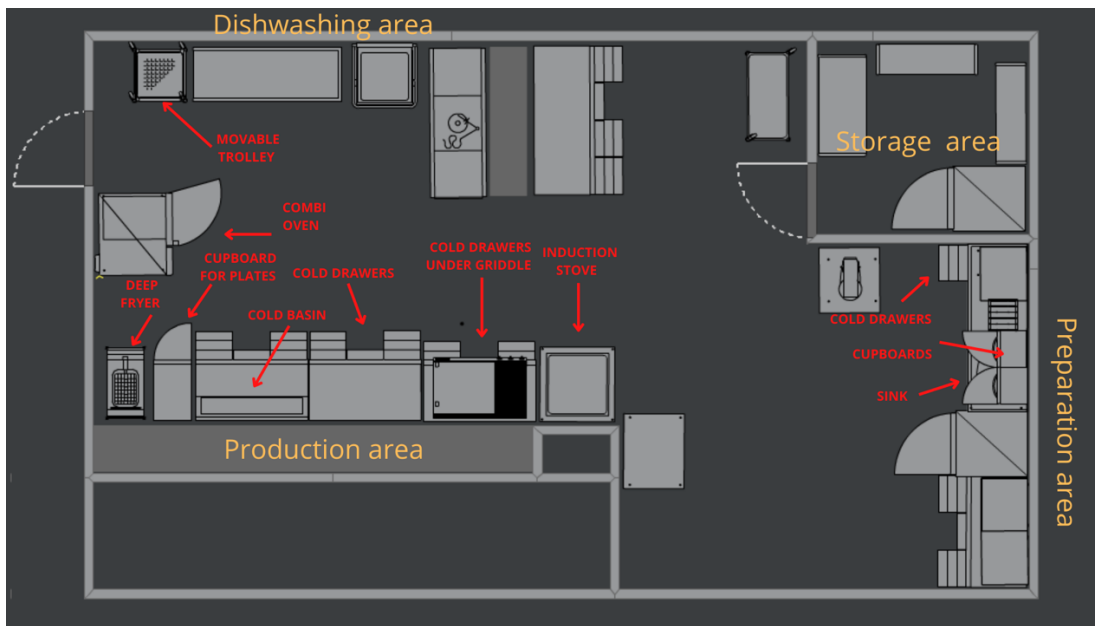


Figure 11. The new kitchen layout for Green Hippo restaurant (Metos Professional Kitchen Planner 2022)

The kitchen areas (preparation, production, dishwashing, storage) are not relocated, because workers are satisfied with all the current locations and find them convenient. They are not interrupting each other during the work and can easily reach all the appliances.

In the preparation area the sink is installed on the countertop to wash ingredients, then chop or cut them on the table and put straight to three different drawers, that are located on the left side (Figure 12). This configuration helps worker to make several actions, using one table and not moving around. Under the sink, there is a space for kitchen equipment, such as cutting boards, kettles, small appliances. Some of the shelves are changed into cupboard to prevent dishes and tools from settling dust. The number of drawers in this area decreases from twelve to ten, but it is not that critical, because a new layout has more drawers in the production area. The location currently used for a sink, has a worktable with adjustable height and a baking mixer on it. The changing height of a table is an ergonomic solution for a small space, since every equipment can be put on it. And workers do not have to bend over or stretch to reach the convenient level for using the tool.

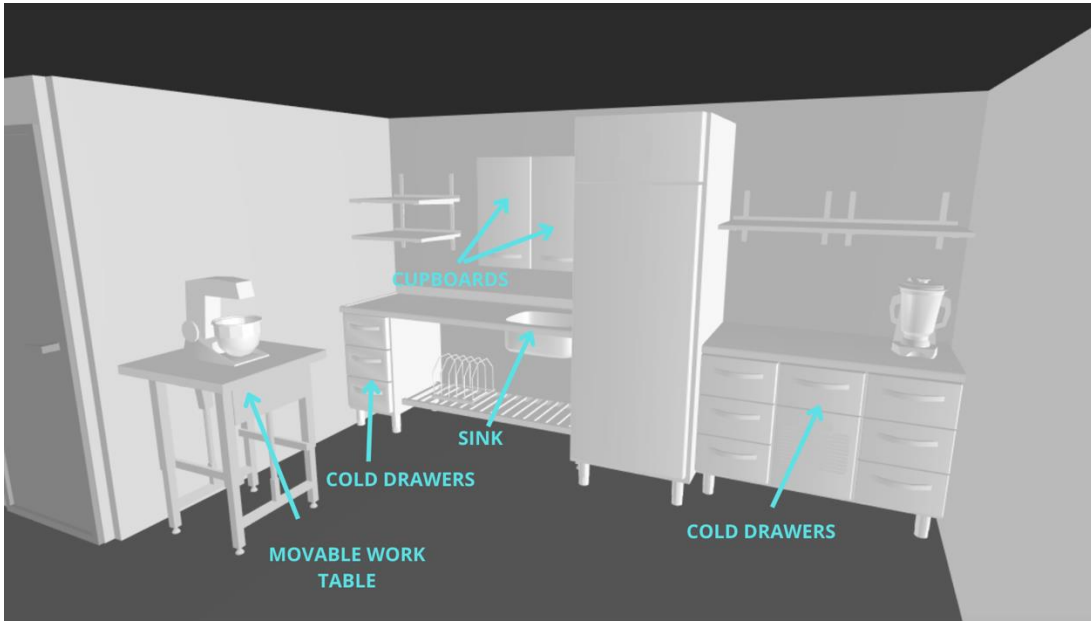


Figure 12. A 3D model of the preparation area (Metos Professional Kitchen Planner 2022)

Relying on workers' opinions, cooking or production area layout is decided to create with induction stove and many cold drawers (Figure 13). There is not enough space in the storage area to fit one more refrigerator, so it's the only one in the preparation area, which is not sufficient for the restaurant with such a big amount of customers. The solution is to create as much cold drawers as possible to store greens, berries, and small vegetables there. The induction stove is located exactly on the same place, where gas stove is currently located, having 4 burners, but not warming up the kitchen temperature, which employees would enjoy especially during summer hot days. It also has shelf under to store pans and kettles there and to get them quickly. The cold drawer under the griddle, for the food preparing on it, is designed to minimize kitchen workers movements, since they do not have to take preparations from another far drawer and carry it to the griddle surface. The required action is just to open the drawer and put the product on the griddle. For optimizing the space and decreasing food safety risks, one table with cold drawers also has cold basin to store ingredients or different sauces for plating. It's the safest way to use sauces without putting them into drawers all the time during service, because they are not going to spoil and always are on hand in these cold basins. A small cupboard is located between the drawer and the deep fryer and is used for storing plates. Green Hippo workers now store plates on the shelves, but usually have to lift for them, that is why cupboard is a better solution. The cupboard is cleaner, and its location does not require unnecessary movements from workers. A deep fryer is located near the wall to minimize the risks of hot oil caused injuries, and to design it as a floor fryer. The deep fryer, located on the floor, is safe to empty, clean and use, it does not occupy lots of space on the table and could be turned on during the whole working day. Since Green Hippo restaurant kitchen workers

use warming drawers, it is necessary to find an alternative, where all cooked preparations could be stored and wait for the service time. The combi oven offers its users low temperature modes, that are doing the exact tasks that warming drawers. The company owners and managers also do not have to care about electricity bills, the combi oven is energy efficient.

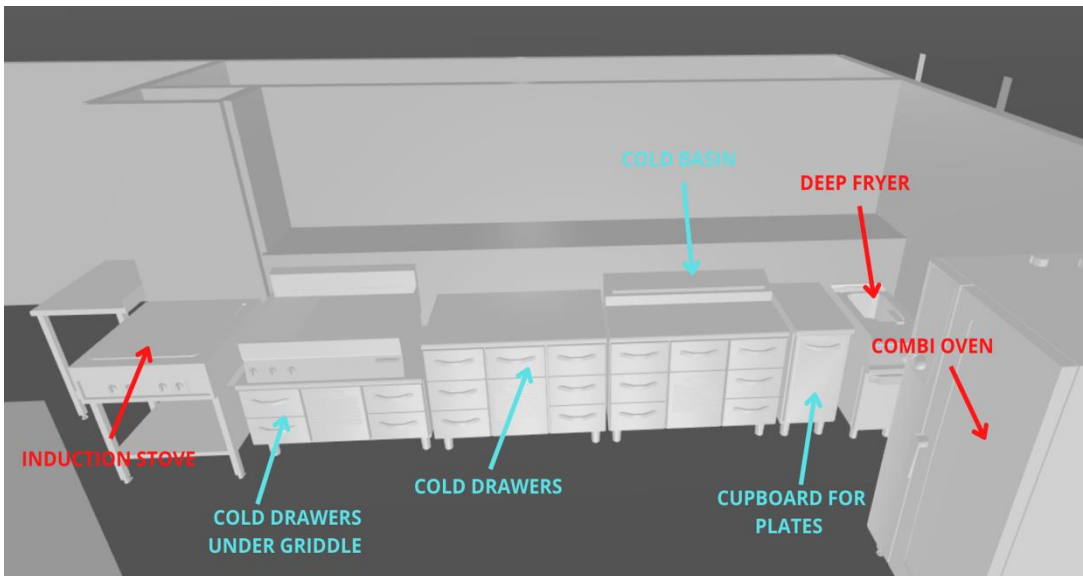


Figure 13. A 3D model of the production area (Metos Professional Kitchen Planner 2022)

A dishwashing area is not heavily modified, mostly because of workers' positive opinions about it (Figure 14). The main thing that is not ergonomic in this area is the absence of shelves and trolleys for clean dishes. Solutions are to bring at least one trolley with wheels, that would be possible to move around the kitchen in order not to lift heavy dishes all the time, and to design more shelves under the table with clean wet dishes for drying them there. If currently used washing machine does not cope with amount of delivered dishes, it should be changed to more modern or bigger model.

A 3D model plans are created to introduce a reorganized kitchen space and new appliances in a visible and realistic way. Hot appliances are marked with red arrows and marked with red letters, while cold appliances or tools with blue. All the changes, that has been made during the project, are deeply described, and explained.

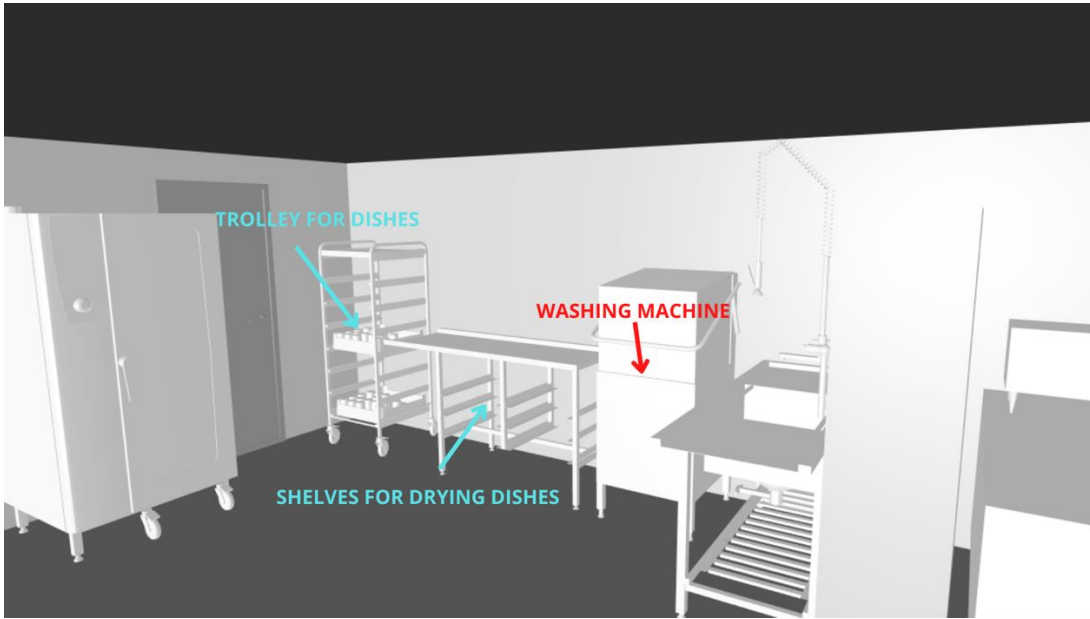


Figure 14. A 3D model of the dishwashing area (Metos Professional Kitchen Planner 2022)

6 Conclusion

The final product refers to efficient kitchen design, and represents, how kitchen appliances' changes could improve workflow, safety, and ergonomics. The project's product did not concern sewage, electricity, ventilation, and light systems, which was reasonable to skip, otherwise designing of a layout would require more time and hard-to-get knowledges. All the main objectives were reached during the project, and as a result the commissioner got a kitchen layout with not only modern efficient appliances, but also kitchen areas with developed ergonomics. The manager of Green Hippo restaurant is enthusiastic about implementing some parts of it in the nearest future.

The most challenging part of the project was to get answers from kitchen workers, at first only two answers were received. It was clear, that people did not want to answer lots of questions, that is why the decision to minimize the number of questions was made. Luckily, it did not affect the quality of results at the end and some good and useful answers were gained.

Use of Metos Kitchen Planner was not that smooth as expected, however the result surprised and turned out visible, realistic, and comprehensible. There were also some disadvantages of Metos Kitchen Professional Planner program, such as off-color design, lack of several appliances, that are available on the website, and inability of relocating the whole section. The color is not the first thing in creating an efficient layout, but the kitchen plan would look more attractive and realistic in a colorful design. The program as well doesn't contain all Metos equipment, which is uncomfortable and needed to be fixed. A designer wants to see all the variety of appliances in catalog, and can easily skip some of them, if they are not added to the program. Relocating each appliance separately could be inconvenient, when creating a layout for a brand-new kitchen, because then designer have to spend more time on switching positions.

During the project, a lot of new knowledges about kitchen planning and design were acquired. The main important aspects, which should be considered during the process, were determined, and described in the theoretical part of the thesis. The received theoretical basics not only supported the flow of the work, but also helped to get the most effective result.

This type of project also requires collecting lots of information on kitchen equipment and space from the commissioner, because a designer of a kitchen space should know every corner of it, in order to create the most relevant layout. Problems could be easily faced if a commissioner would not interact properly with a designer.

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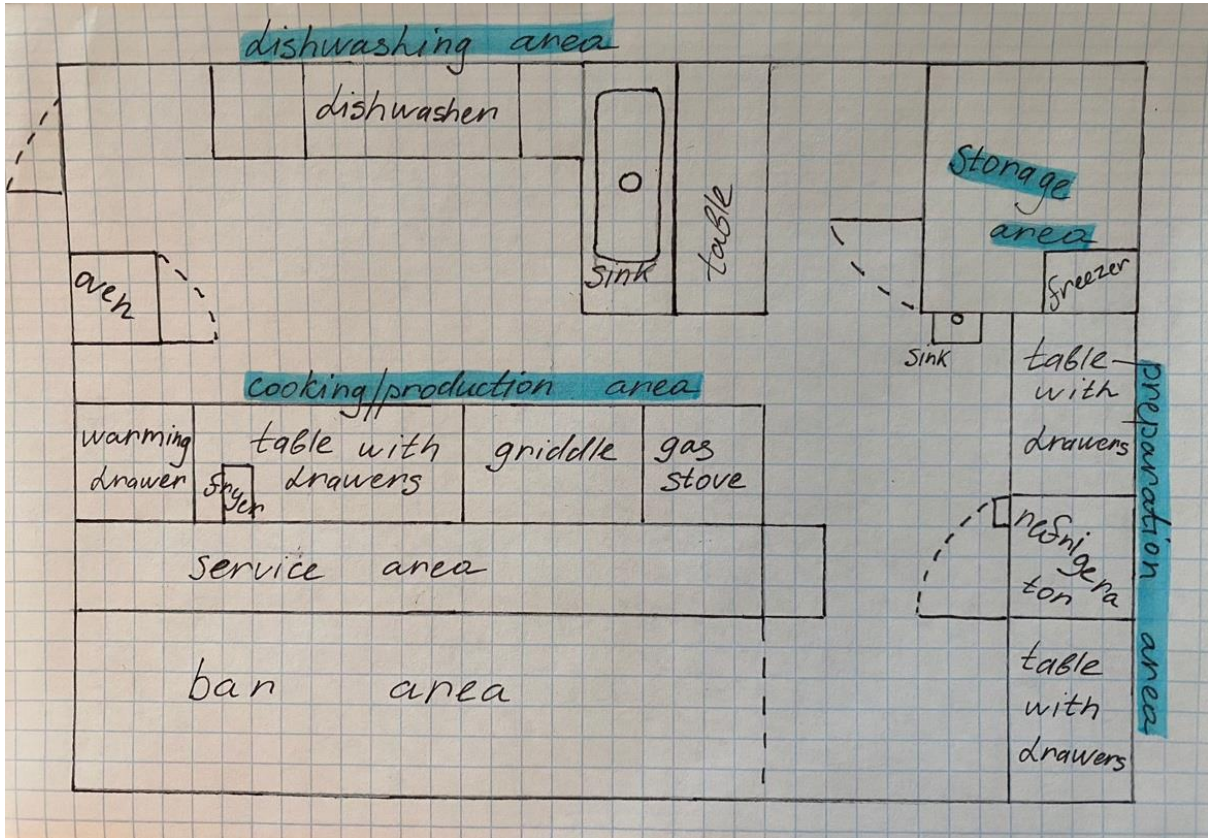
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Appendices

Appendix 1. Survey questions for Green Hippo restaurant workers

- Do you work in the kitchen or front of house?
- How many employees usually work on a shift in the kitchen?
- In your opinion, does your kitchen fit all the required areas (preparation, cooking, dishwashing, and storage)? Is there enough space for comfortable work? If not, please write, which area needs to have more space.
- Please write here at least 2 kitchen appliances, that you would like to use in your kitchen (those, that you don't have yet).
- Could you name your kitchen inconveniences from the perspective of ergonomics and safety (for example, high shelves or worktables, badly working oven, too high temperatures etc.)?
- What is your hardest-to-clean kitchen appliance?
- Do you have kitchen appliances, that you don't use or use rarely?

Appendix 2. First version of current kitchen layout (drawn version)



Appendix 3. New kitchen equipment layout, version for the commissioner

Made by Olga Skukhtorova

KITCHEN EQUIPMENT LAYOUT



Changes in the kitchen space of Green Hippo restaurant:

- ***Sink in the preparation area***

To help worker make less movements, using one table for several actions.

- ***Cupboards instead of shelves***

To store kitchen tools and prevent them from settling dust.

- ***A movable worktable with adjustable height***

To prevent workers from bending over or stretching, while reaching the convenient level for using the tool.

- ***Gas stove changed to induction***

To decrease high kitchen temperature, because induction stove is not giving off heat to the environment.

- ***Movable trolley with wheels***

To put dishes back to shelves and cupboards without lifting them.

- **Cold drawers under griddle**

To minimize kitchen workers movements, since they do not have to take preparations from another far drawer and carry it to the griddle surface.

- **Cold basin**

To store ingredients or different sauces for plating and minimize workers' movements. It's the safest way to use sauces without putting them into drawers all the time during service.

- **Cupboard for plates**

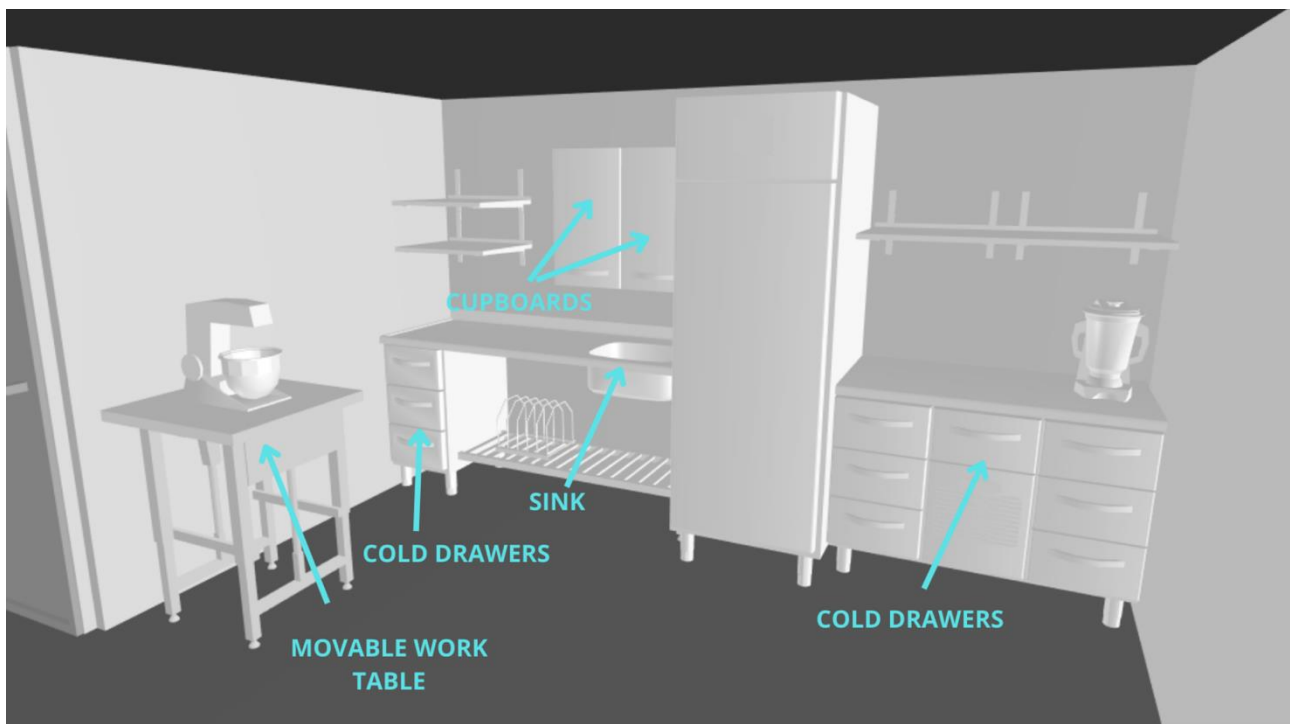
To store plates for service and avoid lifting them on the shelves.

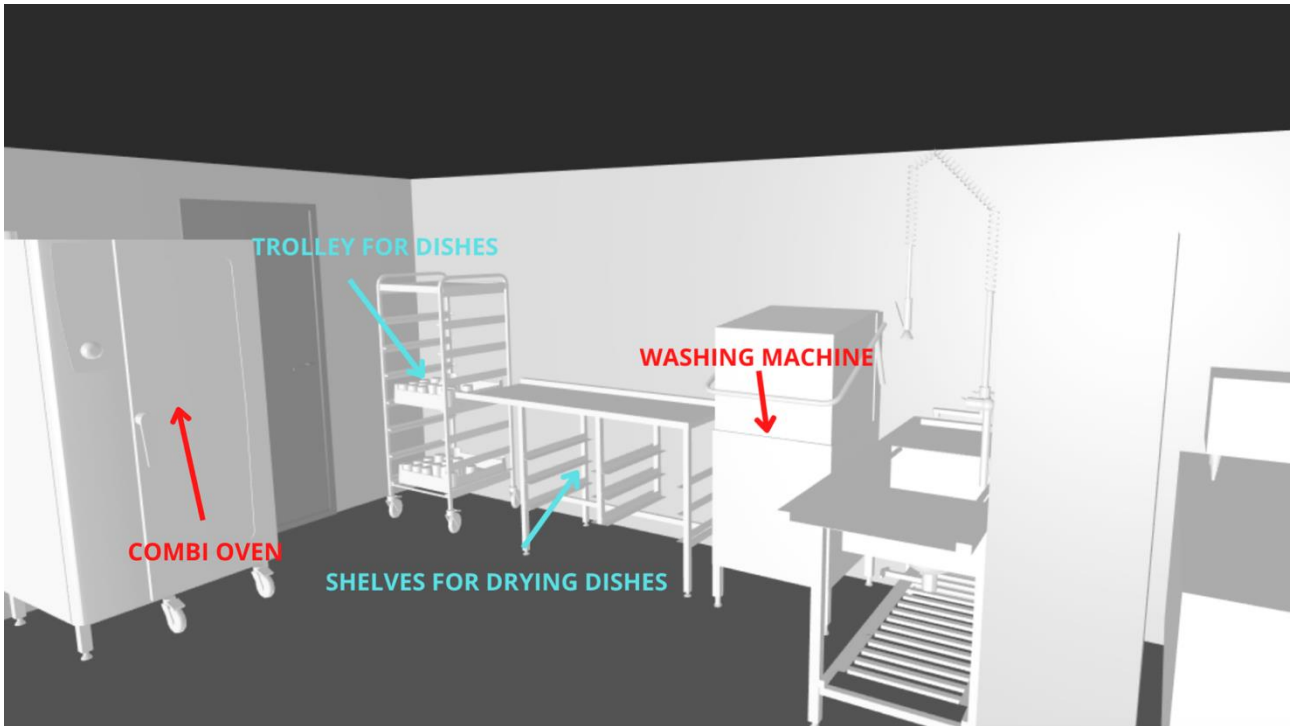
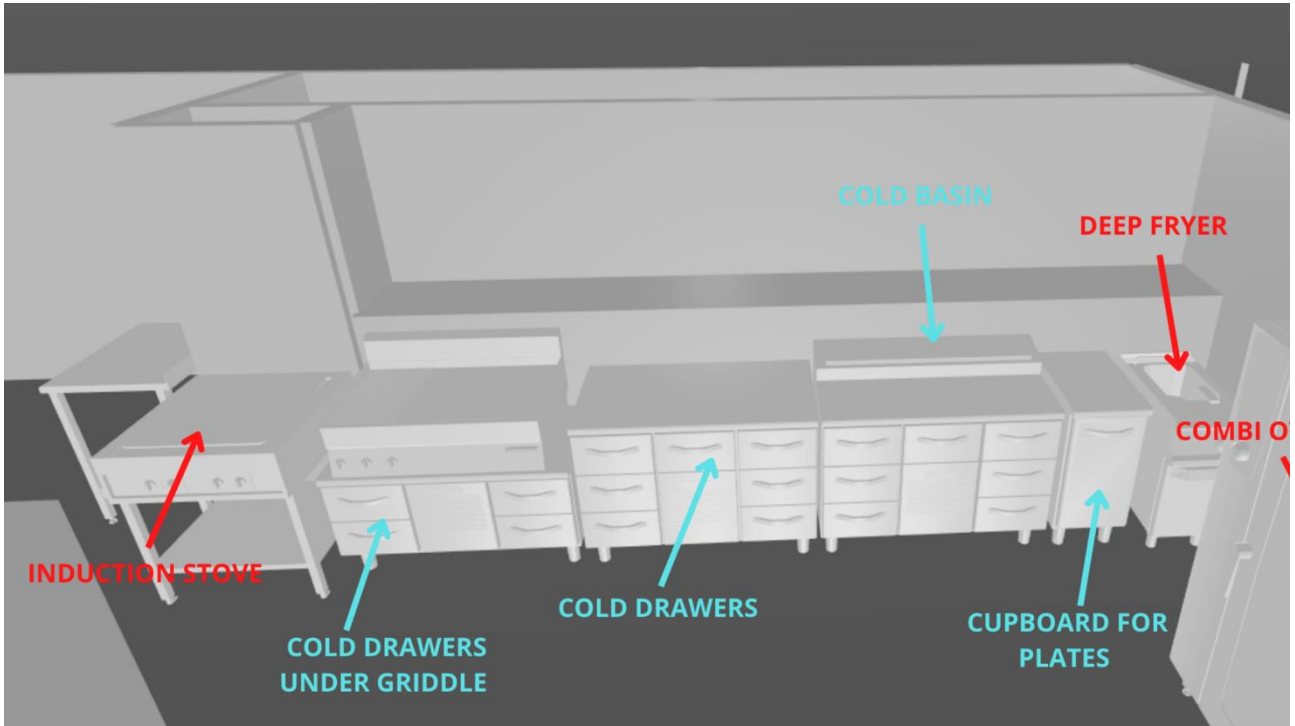
- **Floor deep fryer**

To decrease risks of injuries as it's safe to empty, clean and use, it does not occupy lots of space on the table and could be turned on during the whole working day.

- **Combi oven**

To use it also as a warming drawer and store warm ingredients in it. Also this type of oven is multifunctional and self-cleaning.





**Combi oven movable 20 GN**

Product code : 4242082
 Width : 879 mm
 Depth : 791 mm
 Height : 1 782 mm
 Price : 21 630 €
 Capacity : 20 x GN 1/1-40
 kWh : 37
 A : 63
 Voltage : 400

**Range w/Induction top 4 cooking zones**

Product code : 4210023
 Width : 800 mm
 Depth : 800 mm
 Height : 900 mm
 Price : 4 660 €
 Capacity : 4 zones
 kWh : 14
 A : 35
 Voltage : 400

**Griddle 1000 mm**

Product code : 4391526
 Width : 1 000 mm
 Depth : 650 mm
 Height : 295 mm
 Price : 2 590 €
 Capacity : -
 kWh : 11,7
 A : -
 Voltage : 400

**Deep fat fryer 15 L**

Product code : 4228092
 Width : 400 mm
 Depth : 730 mm
 Height : 900 mm
 Price : 2 160 €
 Capacity : 15 L
 kWh : 12
 A : -
 Voltage : 400

**Grillroom drawer unit 1200 mm**

Product code : 4321032
 Width : 1 200 mm
 Depth : 650 mm
 Height : 650 mm
 Price : 2 890 €
 Capacity : 4 drawers
 kWh : 0,5
 A : 10
 Voltage : 230

**Cold drawer unit 1200 mm**

Product code : 4321002
 Width : 1 200 mm
 Depth : 650 mm
 Height : 900 mm
 Price : 3 170 €
 Capacity : -
 kWh : 0,5
 A : 10
 Voltage : 230

**Cold drawer unit 1200 mm**

Product code : 4321002
 Width : 1 200 mm
 Depth : 650 mm
 Height : 900 mm
 Price : 3 170 €
 Capacity : -
 kWh : 0,5
 A : 10
 Voltage : 230

**Cold drawer unit 1600 mm**

Product code : 4321006
 Width : 1 600 mm
 Depth : 650 mm
 Height : 900 mm
 Price : 3 620 €
 Capacity : -
 kWh : 0,5
 A : 10
 Voltage : 230

**Cold basin w/cupboard 1200 mm**

Product code : 4321052
 Width : 1 200 mm
 Depth : 650 mm
 Height : 1 020 mm
 Price : 3 840 €
 Capacity : -
 kWh : 0,5
 A : 10
 Voltage : 230

**Neutral cupboard 400 mm L**

Product code : 4250131
 Width : 400 mm
 Depth : 650 mm
 Height : 900 mm
 Price : 992 €
 Capacity : -
 kWh : -
 A : -
 Voltage : -

**Cupboard 400 mm R wall type**

Product code : 4250140
 Width : 400 mm
 Depth : 320 mm
 Height : 700 mm
 Price : 625 €
 Capacity : -
 kWh : -
 A : -
 Voltage : -

**Cupboard 400 mm L wall type**

Product code : 4250141
 Width : 400 mm
 Depth : 320 mm
 Height : 700 mm
 Price : 625 €
 Capacity : -
 kWh : -
 A : -
 Voltage : -


Sink 1800 mm basin drawer-grid shelf

Product code : 4180510
Width : 1800 mm
Depth : 650 mm
Height : 900 mm
Price : 2 120 €
Capacity :-
kWh :-
A :-
Voltage :-


Work table height adjustable 700 mm

Product code : 4136101
Width : 700 mm
Depth : 650 mm
Height : 900 mm
Price : 2 220 €
Capacity :-
kWh : 0.3
A :-
Voltage : 230


Basket trolley 8 baskets

Product code : 4554092
Width : 590 mm
Depth : 590 mm
Height : 1 591 mm
Price : 455 €
Capacity : 8 baskets
kWh :-
A :-
Voltage :-

Products: 15 kpl
Total price: 54 767 €