Energy use of cooking in the Swedish diet and Mistra food future scenarios

How do different diets and food groups compare?

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Abstract

There are many stages of the food system playing a part in its impact on the environment, and to understand the whole is to understand every part. The energy used at the consumption stage is substantial and needs to be better understood, in particular areas that have so far received less attention, such as the cooking energy use of different diets.

This thesis aimed to quantify the energy use for cooking in Sweden and to compare it with scenarios of future diets that are targeting a more sustainable Swedish food system. For this, the Mistra Food Futures scenario skeletons were used as examples of what such diets would contain. Existing data on the energy use of food preparation methods was used for calculating each foods energy use in cooking. In examining the results, the focus was put on the overall energy use for each of the diets as well as the different food groups consumed in the scenario diets and the current Swedish diet.

The result showed that three of the four future scenario diets had a 6-20% higher energy use than the current Swedish diet, when using the same standard of appliances, but a lower energy use when accounting for energy efficiency improvements in appliances for the future scenario diets. It was also found that a higher food volume consumption is the case for the four future scenario diets, being one of the factors in the differences in energy use. The scenario diet *Food as Culture* was found to have the lowest energy use in cooking out of all the diets in this study, despite containing a larger volume of food than the current Swedish diet. The different food groups were found to have large variations in their energy intensity per kg of food, affecting the food groups' energy use. Despite this, the volume of food consumed for a food group is likely to be the main deciding factor in determining its share in the total cooking energy use.

Further research on the nutrient-energy relationship in cooking energy use could provide a better understanding of the differences between diets, as the nutrition they provide is a key aspect of their sustainability. Additionally, studying the frequency of methods used for preparing different food groups, as well as using more current data on the energy use of those methods could shed further light on the energy requirements of different diets in their cooking.

Keywords: cooking methods, energy use, Sweden, sustainable diets, home cooking

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Abbreviations

IEA	International Energy Agency
GHG	Greenhouse Gases
PEF	Primary Energy Factor
RISE	Research Institutes of Sweden
SEPA	Swedish Environment and Protection Agency
SLU	Swedish University of Agricultural Sciences

1. Introduction

Food is in everybody's mouth, both literally and figuratively. Among the industries causing the highest amount of damage to the climate and ecosystems around the world, the food system is one of the worst offenders (Willett *et al.* 2019; Crippa *et al.* 2021). Yet food is arguably also the most important good that humans produce and trade.

The food systems energy consumption across all stages is one of the main causes for its negative impact on the environment, particularly in primary production (Woods *et al.* 2010; Vermeulen *et al.* 2012). The energy used at home has also been in focus and the idea of conserving it is nothing new, as the household use of electricity for cooking, cooling and washing-up makes up roughly 25% of a food products energy use across the food system (Wallgren & Höjer 2009). But what about the food that we eat? A *diet* is understood as the collection of foods, or a way of eating across a period of time, such as a year. A meal on the other hand describes only the food eaten in one instance. Different diets are known to have vastly different impacts on the environment and the climate. Especially an omnivorous diet with a high meat consumption, which is the standard diet in much of the world, has been called out for its negative impact (Willett *et al.* 2019; Scarborough *et al.* 2023). A reduction of meat consumption would mean a significant reduction in greenhouse gas (GHG) emissions (Martin & Brandão 2017), targeting mainly the emissions from the primary production part of its food supply chain (Vermeulen *et al.* 2012). Besides meat, there are other foods with their own host of issues. Like the avocado, which has a high water usage and issues of pollution and deforestation (Bhore *et al.* 2021), palm oil production faces similar issues (Naidu & Moorthy 2021). Aside from a high use of water and pollution, horticulture also has a high use of energy (Wainwright *et al.* 2014). Fish and seafood have, among other issues - high GHG emissions from farmed fish (Gephart *et al.* 2021). Understandably, determining a diet that is sustainable for the environment and our health can prove to be a challenge. The Mistra Food Futures project has attempted to do so, by creating four different scenario skeletons of what a sustainable diet and food system can look like in Sweden (Gordon *et al.* 2022). The four scenario diets are based on current trends in the Swedish food consumption, as well as nutritional guidelines and environmental goals. Differences in consumption frequency of certain foods, as well as a different landscape of food industry, export and culture set them apart

from the current Swedish diet, and from each other (Gordon *et al.* 2022). The usage of the terms *current Swedish diet* or *current diet* throughout the text refer to the average food consumption of a person living in Sweden today. The Mistra Food Futures project and its four scenarios are detailed in subchapter 2.4 of this thesis.

Most of the research on the improvement of energy use during food preparation at home and in industrial processing has so far focused on conserving energy by changing technology or habits (Xu *et al.* 2015). At home cooked food has also been compared with industrially processed food in regards to its energy use (Sonesson *et al.* 2005) which found no significant differences between the two. Consideration for the choice of foods and the different diets that are being cooked however has been sparse (Frankowska *et al.* 2020; Reynolds 2020). But does the type of food consumed and how it is prepared also play a role? If it is meat or beans, bread or rice. Do they differ in the energy amounts used to cook them?

1.1 Aim

The purpose of this thesis project was to explore energy use for cooking, and to quantify the energy use for cooking of whole diets in Sweden. In order to imagine possible future consumption patterns, the current consumption will be compared with diets from the four future food scenarios, that were created in the Mistra Food Futures project. The aim of this thesis was to quantify and compare the energy used for preparation of different diets and food groups. I wish to answer the following questions:

RQ1 How do different diets compare in their energy use during cooking?

RQ2 What impact do food groups have on the energy use of diets?

To answer these questions, I aimed to develop the methodology required to calculate the energy consumption of cooking.

2. Background

This chapter will give an overview of the topics relevant to the current study. It will begin with a brief presentation of the importance of cooking and food processing for humans, followed by a section about the use of energy in the food system. The chapter will also briefly discuss the environmental impact of the food system and the role of cooking in that impact. Lastly, the Mistra Food Futures project and its scenario skeletons will be presented, to give a basis for the scenario diets used in this study.

2.1 Food preparation as a cultural practice

The preparing and processing of food beyond its raw state holds an important role in human lives and human history. The benefits of doing it are making food more palatable, easier to digest and safer to eat (Pimentel & Pimentel 2007:245). Preparing food is social, creative, and therefore inherently cultural. In this study, the term *food preparation* is considered to include several processes involved in preparing, preserving and processing food, that are associated with cooking. Furthermore, in this study, the term *cooking* is considered to be one part of food preparation and to include only those processes that involve heating the food.

Although research exists on the connection between cooking food and human development (Wrangham & Conklin-Brittain 2003; Carmody & Wrangham 2009), it is debated if cooking contributed to human evolution or if evolution only enabled cooking abilities for humans (Cornélio *et al.* 2016). It is likely, that human biology has adapted to cooked food, to the point that it is now required for optimal nutrition (Wrangham & Conklin-Brittain 2003). Cooking, which is one of the ways to prepare and process food, increases the energetic value of food (Magargal 2022), and studies show, that cooking vegetables and legumes can enhance nutrient availability and improve digestion of foods (Fabbri & Crosby 2016), thereby expanding the variety of foods consumed by humans (Pimentel & Pimentel 2007:245). It can however also destroy valuable nutrients such as vitamin C and thiamine and cause the loss of minerals from the foods (Pimentel & Pimentel 2007:245).

When looking at cooking from an anthropological lens, the use of fire and the procurement of fuel has always been an issue to consider (Henry *et al.* 2018).

Examples from more current societies, in which people rely on wood and other organic material for fuel, show that the collection of firewood can be a time costly activity, and that scarcity of fuel leads to a more efficient use of it (Henry *et al.* 2018). Although in these examples, fuel for cooking is not regarded by its users as an issue because of its environmental impact as it is by wealthy countries, it has its challenges and still, is used, nonetheless.

There are also many ways to process and prepare food outside of cooking, although some still utilize heat in their process. Practices such as fermentation, soaking and sprouting, pickling etc. can alter the foods state to achieve similar effects to cooking, such as increased digestibility and change in texture. These methods have been used and relied upon in case fire was not available, for example in Arctic environments (Henry *et al.* 2018). In modern societies however, such practices are no longer widespread, following the increase of industrial food production and a Western diet (Wiest & Schindler 2011). In parts of the world today, people still produce and preserve a large portion of their diet, other than in the West where people are more reliant on the availability of fresh foods and commercially processed goods (Pimentel & Pimentel 2007:246). Although food processing is difficult to define, as it has been described differently in existing literature, Ristic *et al.* (2024) has described it as changing the properties of food and positively or negatively impacting the health and nutrition benefits of food.

Current cooking methods across the world reflect the historical development and environment of cooking (Dingbo & Murphy 1994 see Coe & Spiro 2022). This can be seen for example, in the prevalence of methods such as stir frying and other frying and grilling techniques in the Chinese cuisine, where ovens for cooking were less common (Dingbo & Murphy 1994 see Coe & Spiro 2022).

2.2 Energy use in food preparation and the food system

According to a report published by SEPA the Swedish Environment and Protection Agency in 1997, 20% of the energy use in Sweden can be allocated to the food system (SEPA 1997 see Sonesson *et al.* 2005). The food system was defined by the United Nations Food Systems Summit as follows.

> "*Food systems embrace the entire range of actors and their interlinked value-adding activities involved in the production, aggregation, processing, distribution, consumption, and disposal (loss or waste) of food products that originate from agriculture (incl. livestock), forestry, fisheries, and food industries, and the broader economic, societal, and natural environments in which they are embedded." (von Braun et al. 2021:30)*

The top users of energy in the Swedish food system are agriculture, the food industry and home cooking, in that order (Sonesson *et al.* 2005). For products of the food system and the diets in which they are consumed, there are several factors determining their energy use besides what is expended in the top categories. These are for example differing storage requirements, the amount of transport in between processing stages and the final product destination. The choice of ingredients and the quantity consumed is also dependent on gender and age (Carlsson-Kanyama *et al.* 2003).

Geeraert (2013) has found the energy use per person in Sweden to be 1655 kWh/year for the food that is consumed, based on data for 2006. This includes the production and distribution of food products, not however the consumption which refers to the cooking and cold storage of foods (Geeraert 2013). For the whole life cycle of Swedish food consumption, Carlsson-Kanyama *et al.* (2003) estimates an energy consumption range of 1917 to 5833 kWh per year and person. To preserve energy, time and water in food preparation, new techniques for extraction, processing and pasteurization have been developed that are hoped to be "green and innovative" (Chemat *et al.* 2017).

In a study performed by Arrieta and González (2019), three food groups, represented by beef, wheat-based bread and soybeans were examined on their energy consumption in cooking and their impact on the foods' total energy consumption across the food system. What they found was that foods with high density of nutrients have a more efficient use of energy than those with low nutritional density, as foods that may have similar weight can differ significantly in nutritional value. The study concluded a gap in the impact that plant-based and meat foods have on their respective total energy consumption, and the authors state, that including the cooking energy consumption would reduce the gap between the food

groups regarding their total energy consumption. They further argue, that including nutrients as a unit of measurement would be more realistic than the weight of a product, as meeting nutritional needs is the aim of producing food in the first place (Arrieta & González 2019).

According to Dutilh and Kramer (2000), energy that is required for the production of a food product can be seen as an indicator of its environmental impact. In which stage of the food chain the majority of energy is spent depends on the product and consumer preference. They determine the season in which it is consumed, whether it is prepared at home or at industrial scale, and whether it is animal or plant based (Dutilh & Kramer 2000). When it comes to preparing and processing foods however, it is not as well-understood and researched, what the impacts of certain diets are, and how they differ from one another.

2.3 Environmental impact

The food system is widely acknowledged to have a deep impact on the environment, and contributes to climate change with 19-29% of GHG emissions (Vermeulen *et al.* 2012). Many stages in the food system play a part in this, most prominently the primary production by contributing 80-89% of the food systems GHG emissions (Vermeulen *et al.* 2012). Other impacts on the environment are the use of large amounts of fresh water, pressuring particularly areas under water stress, pollution and land use change (Springmann *et al.* 2018).

Martin and Brandão (2017) used diet scenarios in quantifying the environmental impacts of Swedish food consumption. The scenario diets that were studied had decreased amounts of meat consumption, increased vegetable and fruit consumption, and increases in Swedish food and organic food consumption. Trade-offs were found for all diets. Among them were results such as that diets lower in meat had a significant reduction in GHG emissions yet increases in vegetables potentially lead to increased human and ecosystem toxicity, and organic food risking the increase in eutrophication and land use (Martin & Brandão 2017).

The difference in environmental impact between homemade and ready-to-eat meals was quantified by Sonesson *et al.* (2005). Although industrially processed food has been claimed in public discussions, to increase the environmental impact of food, Sonesson *et al.* (2005) found small differences between homemade and ready to eat meals, while the industrially processed meals had a slightly higher energy use, the homemade meals were higher in emissions that cause eutrophication and global warming, due to differences in raw material use between the scenarios (Sonesson *et al.* 2005). On the other hand, Vermeulen *et al.* (2012) find it likely that an increased demand for processed food will also increase emissions resulting from the post-production stage of the food system. Mitigation opportunities in this

sector concern the reduction of fossil fuel demand and lowering emission intensities of electricity and transport fuels (Niles *et al.* 2018).

A 2022 study comparing home cooking frequencies and their GHG emissions in the United States, found that a higher frequency (5-7 times a week) of cooking dinner at home was associated with higher emissions than a lower frequency (0-2 times a week) (Wolfson *et al.* 2022). A possible reason for this is that individuals in this study who cook at home more often, have a higher consumption of meat, poultry and fish (Wolfson *et al.* 2022). According to Siddiqui *et al.* (2023), better cooking skills can be associated with a higher frequency of cooking at home and frequent home cooking has been in turn associated with a better diet quality (Coe & Spiro 2022).

Niles *et al.* (2018) have reviewed opportunities to mitigate climate change in the food system, arguing that the food system beyond agriculture needs to be better understood, and better integrated. Regarding refrigeration, they estimate that if energy efficiency is improved, cold storage of foods can be expanded to new regions without increasing the emissions of greenhouse gases. As this has the potential to reduce food waste, emissions on a whole could be reduced.

2.4 Mistra Food Futures

Mistra Food Futures is a Swedish research programme that aims to create a science-based platform for the transformation of the Swedish food system into a sustainable system (Mistra Food Futures n.d.-a). It is comprised of researchers from several academic and research institutes, with the core consortium partners being the Swedish University of Agricultural Sciences (SLU), Stockholm Resilience Centre at Stockholm University, the Research Institutes of Sweden (RISE), the Beijer Institute of Ecological Economics and the Royal Swedish Academy of Sciences (Mistra Food Futures n.d.-b). The Mistra Food Futures (2022) project explores various future scenarios for how a sustainable and resilient Swedish food system can be achieved, and what a sustainable and healthy diet can look like in Sweden. The development of the scenarios was based on Sweden's current food system trends (Gordon *et al.* 2022). Importance was given to trends that either portray a key development or that are of particular interest due to their relation to issues in the scenario storylines (Gordon *et al.* 2022).

The four scenarios by Mistra Food Futures are named *Food as Industry, Food as Food Tech, Food as Culture* and *Food Forgotten*. They explore varying degrees of processed food in the diet, as well as local food production, export-focussed food industry and differing emotional values given to food. Each of the scenarios is designed to meet targets by 2045 for biodiversity, climate change and nutrition and health, that are classified as either *ambitious* or *more ambitious* (Mistra Food Futures 2022).

In the scenario *Food as Industry*, the consumption of fruit and vegetables has gone up, while the consumption of meat has gone down and shifted to more sustainable meat sources (Gordon *et al.* 2022). A large portion of the previously consumed meat has been replaced with cheap plant-based meat. Home cooking has gone down and the consumption of ready-made meals and eating out has increased. Numbers for the meat consumption and that of legumes, vegetables and fruit lie at around 55 kg carcass weight and 330 kg per person per year respectively. The next scenario, *Food as Food Tech*, describes the consumption of many novel food items such as lab grown meat, proteins from bacterial and fungal production, and plant-based products. People consume very personalized diets that often consist of pre-cooked, ready-to-eat meals. The consumption of processed foods has gone up, with a shift towards non-animal-based proteins and unsaturated oils from novel foods instead of dairy fats. Also increased is the consumption of fermented products and functional foods. *Food as Culture* is a scenario in which much time is spent preparing and eating food, using diverse food products – a large part of which are produced regionally. There is an increase in the consumption of blue foods, vegetables, pulses, fruits and tubers while dairy, meat and particularly red meat are consumed less. A closer relationship to food production is reflected in the increased food preparation at home. In the final scenario, *Food Forgotten*, the diet of people in Sweden remained more or less the same. Food producers have gradually modified foods, for example blending vegetable proteins into meat products. People have also shifted to a lower consumption of animal products, particularly beef and dairy. As diets and consumption patterns largely remain the same, the balance between home cooking and industrial production is similar to today's status (Gordon *et al.* 2022).

The report by Gordon *et al.* (2022) contains further details about the environmental and health targets of the scenarios, and how they were achieved by 2045 according to the storylines of the respective scenarios.

3. Methods

To answer the research questions, which ask what the energy use of cooking is for different future diets, and what the contribution of different food groups is, a suitable methodology must be applied. This chapter will lay out the structure of the study, by explaining the use of a scenario-based study and describing the system boundaries. The chapter further presents the data that was used in the thesis and how the energy calculations were conducted. Following that, details are given as to what assumptions were made and factors were used during the calculations. Lastly, the delimitations of this study are presented.

3.1 Scenario based analysis

In studies of future food systems, there are several reasons for using scenarios to explore future consumption patterns and their impacts. An extensive review of food system scenario analysis and modelling has been done by Reilly and Willenbockel (2010), wherein the authors discuss its history, types, uses and challenges. Scenario analysis can be used to manage uncertainties in a system, like the food system, and explore 'what-if' scenarios (Reilly & Willenbockel 2010). To explore the energy use that different future consumption patterns have in their cooking, scenarios need to be used. For this purpose, I will utilize the Mistra Food Futures scenarios (Mistra Food Futures 2022) as a guideline and source of projected consumption data for the Swedish diet. In the case of the Mistra Food Futures scenarios, they are target-seeking, aiming to reach certain biodiversity, climate, health and nutrition targets by 2045 (Gordon *et al.* 2022). When referring to the scenarios in this study, it is also assumed that the consumption and preparation of food occurs in 2045. This is accounted for in the calculations by including an energy efficiency improvement factor, which is further explained in subchapter 3.5.2.

3.2 System boundaries

As this study's focus is the energy use of cooking at home and in other places such as schools and hospitals, these are the areas of the food system that will be included

in the system boundaries. Figure 1 illustrates those system boundaries, which include the cooking processes themselves, such as boiling, baking and frying, but not the cold storage of fresh ingredients prior to cooking. Meal consumption from restaurant cooking or any other kind of public meal serving service is considered the same as home cooking, and all are part of *Cooking* in the system boundaries in Figure 1. All foods consumed in the Swedish diet are considered to come from *cooking*, meaning for example that food amounts that would in reality be consumed in the form of ready-made-meals, are considered to have been prepared at home. The energy consumed by the cooking processes will be measured in secondary energy and converted into primary energy, the secondary and primary energy use are therefore included in the system boundaries. The conversion is further discussed in chapter 3.6.

Excluded is data on any other energy uses in each scenario such as transport by the consumer between the store and their home, or by supply chain transport, primary production or industrial processing is excluded. The retail sector and its storage energy consumption as well as waste generated in any step of the food system, including industrial processing and home cooking and consumption, are not included in the system boundaries. Leftovers including storage and re-heating of leftovers were excluded. Also excluded from *cooking* are processes such as blending, mixing and kneading by means of electric machinery which uses energy in its process.

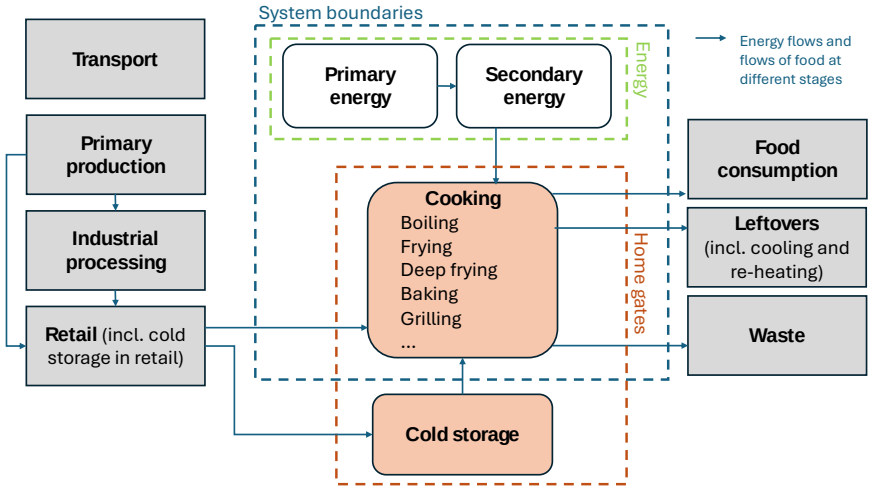

*Figure 1. System boundaries diagram *Cooking includes food prepared at home and in larger kitchens such as in restaurants, schools etc.*

3.2.1 Diet terminology

In the introduction of this thesis, the term diet was briefly explained as a sum of foods, that are eaten in a certain period, such as a year. The Mistra Food Future

scenario diets contain all foods, and their specific amounts consumed within the period of one year by the average person living in Sweden for each of those future scenarios taking place in 2045. The differences between the four scenario diets are presented in more detail in subchapter 2.4. The current Swedish diet as explained in the introductory chapter of this thesis, refers to the foods and their amounts that are consumed by the average person living in Sweden within one year. A sustainable diet refers to a diet which has a low impact on the environment that is also nutritionally adequate and accessible, and preserves the environment to provide this not only to current but also future generations (FAO 2010).

3.3 Calculation process of energy use

Calculating the energy use of the Swedish diet in cooking requires several components. The process illustrated in Figure 2 shows three phases, in which the components are introduced into the calculations and how they lead to the result.

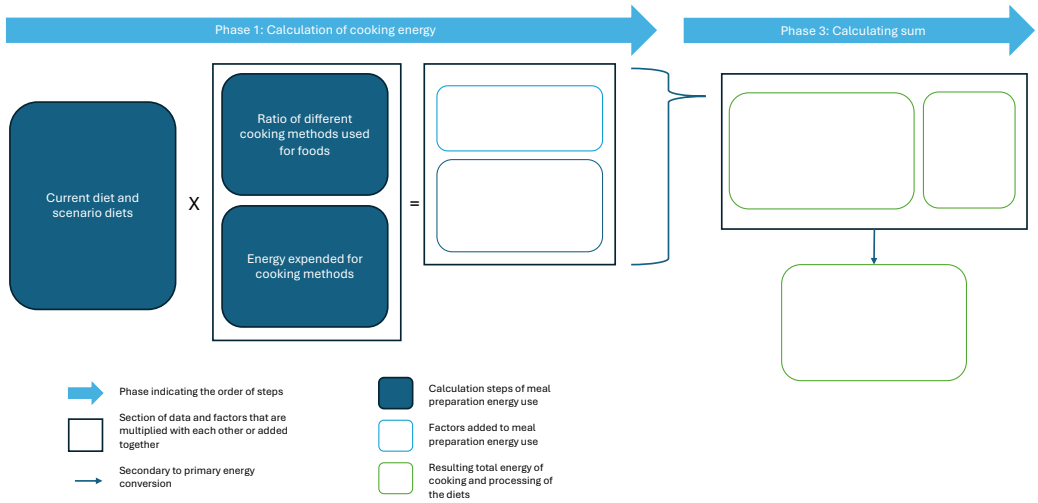

Figure 2. Illustrated process of calculating energy used in the cooking of diets.

In the first phase, the list of foods of the current and scenario diets is matched with ratios of the frequency of cooking methods used for those foods or food groups. The food potato for example, is determined to be prepared by boiling 73% of the time it is eaten, 8% by frying, 8% by baking, and 12% by deep-frying. These ratios are then multiplied with the energy expended for each cooking method, before they are multiplied with the amounts of foods eaten in the diet, measured in g/day for the individual food items. The assumed energy efficiency improvement that is discussed in the next chapter 3.5, is deducted from the cooking energy. In phase 2, the result of phase 1 is multiplied with a primary energy factor (PEF) specific for Sweden, which is explained in more detail in chapter 3.6.

The data generated from this process can be analyzed to find patterns food groups and their respective contribution to total energy usage.

3.4 Data sources

For the calculation of energy costs for each scenario, I used data on what foods are eaten in each of the diets. This data I received from the MISTRA Food Futures project (Mazac *et al.* submitted manuscript) and is found in Appendix 2. The state of the food items in that data is largely raw and unprocessed, with a few exceptions for a few food items. All consumed flour for example, is considered to have been previously milled but not baked. This means that the consumed bread is not considered to be baked industrially and purchased in the store, but that baking of all bread is done at home, and thus the energy for those processes is included in the energy calculations. Dairy products on the other hand are considered fully pre-processed and purchased in various forms such as homogenized and pasteurized milk, yoghurt, various cheeses, cream and creme fraiche. The only energy expended for these products are for the ways they are used in cooking and not the pre-processing of the product itself.

Data for the energy requirement of different cooking techniques were received through the Plan'Eat project (SAFAD 2024). This data can be found in the Appendix D. The various sources of data for the ratio of preparation for different foods are discussed in the following chapter 3.5 on assumptions and can be found in Appendix C.

3.5 Assumptions in the calculations

To calculate the energy use during cooking for different foods, the cooking methods used and their respective share in at home cooking had to be determined.

3.5.1 Cooking practices

For many of the foods consumed in the Swedish diet, it was challenging to find concrete data on the cooking methods that are used. Where no data was available, whether that would be for Sweden or globally, assumptions had to be made about the ratio between different cooking methods. These are discussed in this chapter for some of the food groups and a full list of references and assumptions can be found in Appendix C.

If possible, some form of reference was used as a basis for these assumptions. In cases where this was not possible, assumptions were based purely on the authors perception of the use of a given food item. Data on the utilization of cooking

methods by Swedish consumers was available for the case for most grains and for potatoes where taken from a food habit survey (Amcoff *et al.* 2012), as well as meat (Rohrmann *et al.* 2002). Rice and Quinoa are assumed to be prepared by boiling 100% of the time. For flour from mixed grain, an average of the other grains is assumed.

Exact data on the frequency of different preparation methods of cream could not be found. In a survey from the Swedish National Food Administration conducted in 1989 (Becker 2001), the researchers found a discrepancy between cream reported as bought and consumed. They therefore assumed, that cream consumed in cooked dishes instead of raw was being underreported. This led to the conclusion, that most of the cream was consumed cooked (Becker 2001). In the present study, cream will therefore be divided into 60% cooked and 40% raw consumption.

For fruits and vegetables, data was reported by Hoelzer *et al.* (2012) on the percentage of fresh vs. heat treated produce that was consumed in the United States. This showed a consumption of 64% heated vegetables and 24% fresh vegetables. For fruit it was 28% heated and 67% fresh. Both categories were also consumed frozen, cured and dried in small amounts (Hoelzer *et al.* 2012). For the purpose of calculating the energy used in cooking the vegetables, it is assumed that frozen vegetables are later also heated. The 9% of frozen vegetables are therefore added to the 64% of heated vegetables to make a total of 72%.

The diets of the four Mistra scenarios differ in their total vegetable and fruit consumption, but also in what vegetables and fruits are consumed. For vegetables therefore, a small augmentation of the ratio of heated and fresh produce consumption was applied for each of the four scenarios. This data is listed in Table 1. For all four scenario diets it was assumed that higher amounts of fresh vegetables will be consumed than the results by Hoelzer *et al.* (2012) show for the consumption in the United States. The scenario diet Food Forgotten had the lowest increase in consumption of vegetables typically consumed fresh such as lettuce and cucumber. It was therefore assumed that it had the lowest consumption of raw vegetables with 26% fresh and 70% heated. The other three scenarios have differences in amounts of vegetables that can be consumed both fresh and heated. Based on this, the assumptions were made that for Food as Industry, the percentages are 28% fresh and 68% heated, for Food as Culture they are 30% fresh and 66% heated, and for Food as Food Tech 32% fresh and 64% heated.

The assumptions on what methods are used for heating the vegetables in the current Swedish diet are that 30% are boiled, 30% are fried, 30% are baked and 10% are grilled. To accommodate for differences in consumption of vegetables between the four scenario diets, they have slightly modified percentages for the different cooking methods. The percentages of fresh and heated vegetable consumption as well as of what cooking methods are used to heat vegetables are listed in Table 1 below. These assumptions were based on several inputs, one of

these being the amount of fat consumed from oils and animal fats in the diets, which is assumed to inform to some degree on the amount of frying done in the respective diets.

Table 1. Assumptions on the state of vegetables when consumed (other states such as cured, dried are excluded and the percentages therefore do not add up to 100), and assumptions on the share of cooking methods used for heating vegetables.

Share of state of consumption and method of preparation (%)	Current diet	Food as Industry	Food as Food Tech	Food as Culture	Food Forgotten
Fresh	26	30	34	32	28
Heated	72	68	64	66	70
Boiled	30	35	30	25	35
Fried	30	30	25	30	25
Baked	30	25	35	25	30
Grilled	10	10	10	20	10

3.5.2 Projected energy efficiency gain

For the future scenarios, it is assumed that the processes and devices used have improved in their energy efficiency. This assumption is based on the general aim towards energy efficiency by the European Commission, in particular towards sustainable products and appliances (2023, 2024). While it is difficult to find a concrete source for an efficiency gain percentage, the gain used for this calculation was based on the achievements report on energy efficiency standards and labelling by the International Energy Agency (IEA/4E TCP 2021). Based on the report by the IEA, a reduction of the appliance energy consumption of 1% annually has been determined, to account for the efficiency improvement in appliances. The Mistra Food Future scenarios are designed to achieve their targets for nutrition and health, climate change and biodiversity by 2045 (Gordon *et al.* 2022). The point of comparison for the future scenarios will therefore be in 2045, resulting in an efficiency gain of about 23.2% between 2024 and 2045.

The efficiency gain was calculated using the following formula:

$$Efficiency\ factor = (1 + Annual\ Improvement\ Rate)^{Years} = 1.01^{21} = 1.232 \quad (1)$$

This results in the efficiency gain of 23.2%, which translates to devices of 2045 using about 76.8% of the energy that current devices use.

3.6 Secondary to primary energy conversion

For the final step in the energy use calculations, the secondary energy use, which is the electricity use calculated for the cooking processes, is converted into the primary energy use, by multiplying with a primary energy factor (PEF). Different primary energy sources such as nuclear, wind or coal have different conversion factors. To simplify the calculations for this study, varied energy mixes were used. Currently, Sweden produces most of its electricity from hydropower (40%) and nuclear power (29%) according to the International Energy Agency (IEA 2023). Further sources of electricity are wind (21%), biofuels (5%), waste (3%), solar (2%), coal (0.3%), oil (0.2%) and natural gas (0.1%) (IEA 2023). With a mix of all energy sources, the electricity generated has a PEF of 1.8 (Trulsrud & van der Leer 2024), which is slightly higher than the EU average of 1.9, based on the EU directive on energy efficiency (2023). The factor of 1.8 for Sweden is applied to all

energy expended in cooking. This factor is applied to the current Swedish diet as well as the future scenario diets, while acknowledging that the energy mix for Sweden and the PEF for Swedish electricity is subject to change in the future.

The world electricity generation mix has a very different ratio of fuel types, coal taking the largest share at 37%, with renewables (26%) and natural gas (24%) in second and third place (IEA 2021).

3.7 Delimitations

For gathering data to use in the energy calculations, no experiments were conducted. Instead, the study was solely based on pre-existing data from previous research. Nutrients consumed through the different diets studied in this thesis were not used as a functional unit in calculating the energy use of cooking.

Although initially, the idea was to include industrial processing of foods into the calculations and comparison between the scenario diets that differ in their degree of processed food, this proved to be difficult within the scope and time frame of the thesis project. In addition to processing, the cold storage of foods prior to cooking was initially planned to be included. But due to the processing being excluded from the calculations, all foods consumed in the different diets were considered not to be ready-made meals, and an inclusion of the cold storage did therefore not seem relevant to the study.

4. Results

This chapter presents the results of the cooking energy use calculations for the current Swedish diet and the four scenario diets of the Mistra Food Futures project. Furthermore, it presents results for the contribution of different food groups to the diets' energy use.

4.1 Energy use of diets in cooking

The energy used during cooking for all foods consumed in the average Swedish diet today, as well as in the future scenarios is shown in Figure 3. The results are displayed in a unit of kWh per year and are a national average calculated per person. The bar diagram in Figure 3 shows the results calculated with and without the added appliance efficiency gain until the year 2045.

Out of the current Swedish diet and the four Mistra Food Future diets, *Food as Culture* has the lowest cooking energy use, both with and without energy efficiency improvements, at 960 kWh/year without the energy efficiency improvement, and 737 kWh/year with energy efficiency improvements. When comparing the five diets without the energy efficiency improvements, the current Swedish diet has the second lowest energy use at 1026 kWh/year, whereas the remaining three future diet scenarios all land at a higher energy use for cooking. The increase in energy consumption, in comparison to the current diet, ranges between an added 6-20%, with the scenario *Food Forgotten* using the highest amount of energy at 1231 kWh/year. The scenario *Food as Culture* uses about 6% less energy than the current Swedish diet. A slight increase in cooking energy use is seen in the scenario *Food as Food Tech*, closely followed by *Food as Industry*.

The results for taking into consideration a 1% annual efficiency increase in appliances show a different distribution of energy use. Here, all the future scenario diets have a lower energy use than the current Swedish diet. With the order of lowest to highest energy use remaining the same between the four future scenario

diets, *Food as Culture* being the lowest, and then followed by *Food as Food tech*, *Food as Industry* and *Food Forgotten*.

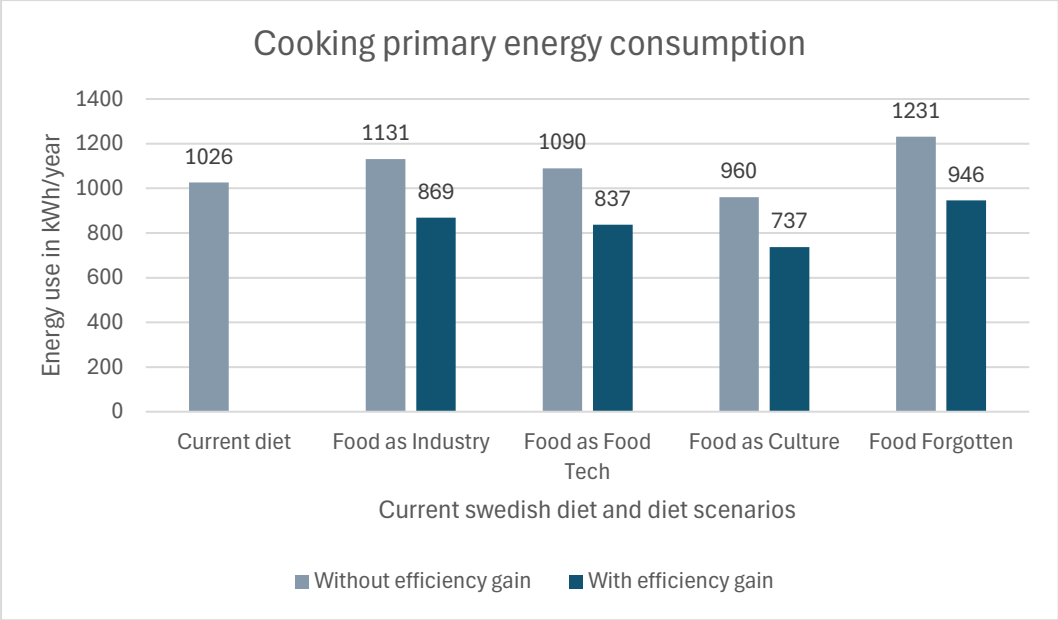

Figure 3. Energy use of cooking for the current Swedish diet and the four Mistra food futures scenarios, measured in kWh of primary energy use per year.

The diets differ also in the amount of food eaten per day, measured in g/day, as presented in Table 2. The lowest amount is eaten in the current diet, whereas the two scenario diets *Food as Industry* and *Food as Food Tech* show a consumption of 273 and 356 g more per day than the current diet. The other two scenario diets have an increase of merely 94 and 105 g/day in comparison to the current diet, *Food as Culture* being the diet with the lowest consumption amount in g/day out of the four scenario diets.

Table 2. Weight of daily food consumption for the current Swedish diet and future diets, and energy use data.

	Current diet	Food as Industry	Food as Food Tech	Food as Culture	Food Forgotten
g/day	1599	1872	1955	1693	1704
kWh/kg	1.76	1.66	1.53	1.55	1.98
kWh/day without efficiency gain	2.81	3.10	2.99	2.63	3.37

When comparing the five diets in their energy use per weight ratio, the diet with the lowest energy consumption is *Food as Food Tech*, at 1.53 kWh per kg of food, closely followed by *Food as Culture* at 1.55 kWh/kg. The current Swedish diet lies somewhat in the middle of the four scenarios at 1.76 kWh/kg. The energy use of

the diets per day in Table 2 shows the same distribution as in Figure 3, with the scenario diet *Food as Culture* having the lowest energy use for cooking. Despite *Food as Culture* having the lowest energy use per day, due to the amount of food consumed being lower, it is not the lowest in energy use when calculated per weight of food.

4.2 Contribution of food groups to overall cooking energy consumption

The foods consumed in the Swedish diet can be grouped together into food groups. The food groups consumed in the Mistra Food Future diets follow the same structure and grouping of foods as the current Swedish diet. A list of all food groups in the diets is given in Table 3.

Table 3. Food groups of consumed food items in the five diets.

Food groups	Food groups
Cereals (excluding beer)	Oil crops
Starchy roots	Tree nuts
Vegetables	Vegetable oils
Fruits (excluding wine)	Animal fats
Milk (excluding butter)	Sweeteners
Meat	Alcoholic beverages
Offal	Stimulants
Eggs	Tea & products
Blue food	Wild food
Pulses	Alternatives

As different food groups utilize various, differing cooking methods, and are consumed in different amounts, their energy expenditure in the cooking process will likewise differ. The impact that the energy expended by the food groups has on the total energy spent during cooking is visualized in Figure 4. The figure shows five bar charts, for the four Mistra food future scenarios and the current Swedish diet. Each bar shows the food groups that make up 2% or more of the total energy spent for preparing that diet respectively. The food categories making up less than 2% of the total energy are grouped together in the category “other”.

In the current Swedish diet, meat is the food group using the highest amount of energy at nearly 33%. After that come starchy roots, cereals and vegetables. For the scenarios *Food as Industry*, *Food as Food Tech*, and *Food as Culture*, vegetables make up the largest portion of spent energy, with shares of around 23%. The

scenario *Food Forgotten* has a substantially lower energy consumption in vegetable preparation at 14%, compared to the other three scenarios. The food groups starchy roots and cereals have similar shares in energy use in the scenario diets as in the current Swedish diet. Substantially lower is the contribution of meat to the diets' energy use different scenario diets, to varying degrees. Likewise, the food group "alternatives" has varying impact on the energy use in the scenario diets. In *Food as Culture*, both meat and alternatives have a low share of the energy use, but in turn the food groups starchy roots, pulses, cereals and blue foods have a larger share than in any of the other diets.

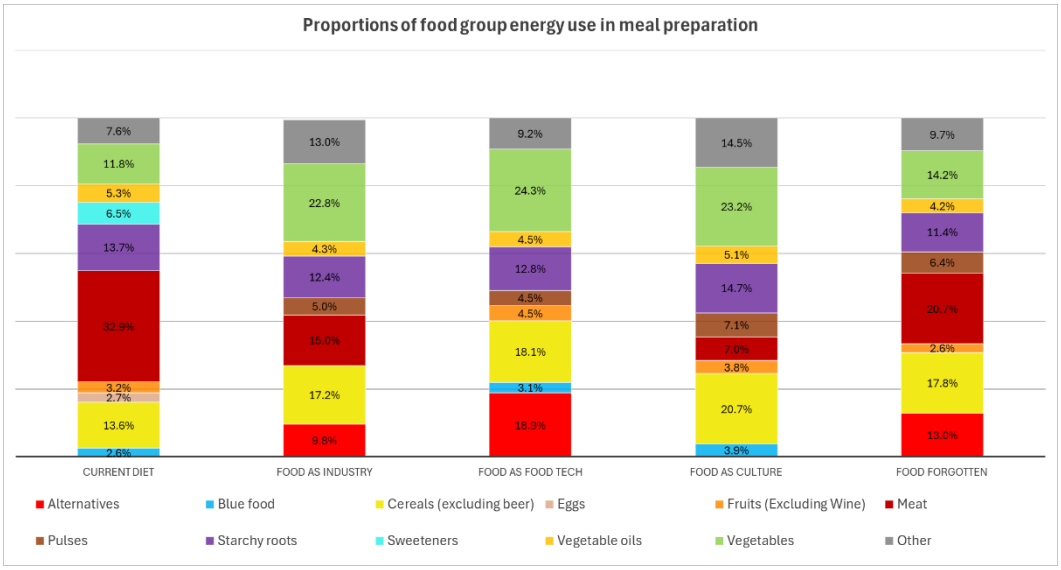

Figure 4. Energy expenditure for food groups in cooking, comparing the current Swedish diet and Mistra food future scenarios. The bar charts show all food categories making up 2% or more of the daily energy usage in cooking for the respective diets. "Other" includes all food groups contributing less than 2% to the energy usage. What is included in "other" differs for each of the five diets.

Food categories that use less than 2% of energy spent, for the scenario diets are milk, eggs and sweeteners. In the scenario *Food as Food Tech* even meat does not make the 2% mark, while it is present to a larger extent in all other scenarios. Food groups that show up in the energy chart of the future food scenarios but not in the current diet are pulses and alternatives, which includes a variety of novel foods, from tofu and tempeh to cell-based meat and microbial egg.

When comparing the consumption amounts of the different diets for each of the food categories, it becomes clear where the differences in total consumed food stem from, that were discussed for Table 2 in chapter 4.1. The food groups with notable variation between the diets in their consumption amounts are vegetables, milk, meat, pulses, sweeteners, alcoholic beverages and alternatives. Figure 5 shows the food amounts consumed in each food group, for each of the five diets. In addition, it shows the energy intensity of those food groups that is derived from the daily

energy expended in cooking for those food groups. As the results for the energy intensity of all five diets were nearly the same, an average of all five is shown in Figure 5.

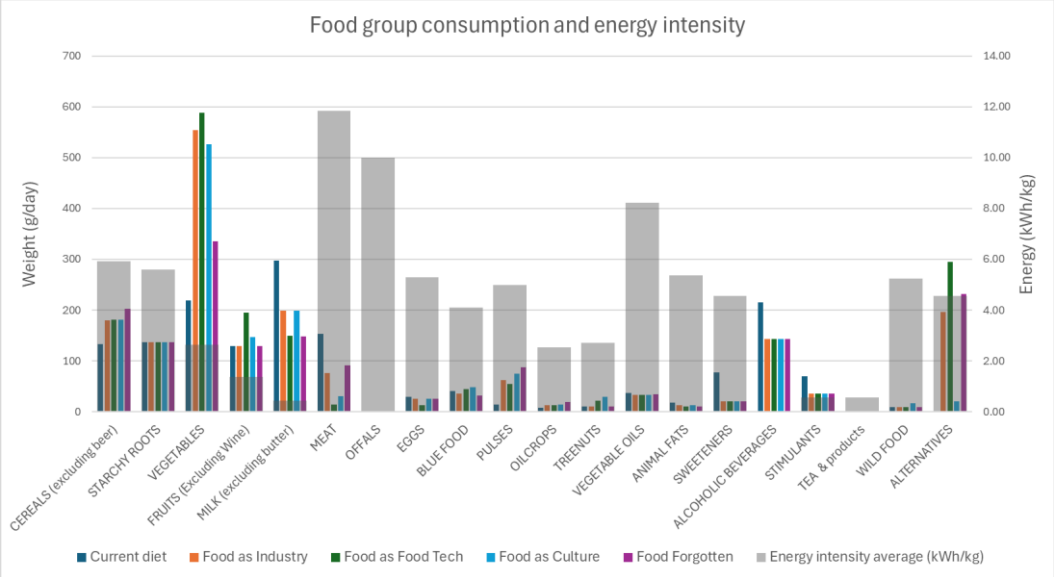

Figure 5. Food group consumption amounts and their energy intensity. The energy intensity pertains to the energy used in cooking and is individually calculated for the different food groups, as an average from the five diets' daily consumption and daily energy use in those groups.

What the contribution of different food groups to the total energy use in cooking shows is that vegetables not only make up a large portion of the energy in all five diets, but that they are consumed in higher amounts in the future scenarios. Compared to meat, vegetables have a higher energy use over all for three of the four scenario diets. The consumption, however, is also much higher, measured in g/day. When comparing the energy intensity of meat and vegetables, meat shows to have a much higher energy use per kg of food.

5. Discussion

The results of this study will be discussed in this chapter, in light of the existing literature and data presented in chapters 1 and 2. The discussion will centre around comparing the five diets energy use in cooking with each other and positioning the results in the greater context of the food system. The limitations of this study and future research ideas will conclude this chapter.

5.1 Comparing different diets' cooking energy requirement

The current Swedish diet is not particularly sustainable (Röös *et al.* 2015; Martin & Brandão 2017), and yet, when it comes to the energy use in cooking, it appears to use less than three of the four Mistra Food Future scenarios that it was compared to in this study. This is the case when comparing them under current appliance efficiency standards. For the purpose of evaluating potential future food scenarios, as is the intention with the Mistra Food Future project (Gordon *et al.* 2022), and with this thesis, the energy use efficiency of appliances used in cooking was considered to have increased. When comparing the five diets in this way, the results change drastically, with all of the four scenario diets now using less energy for cooking than the current Swedish diet.

One possible explanation for the discrepancy in energy use of the five diets is the volume of food consumed, as the three scenario diets that are higher in energy use than the current Swedish diet also have a much higher consumption of food in g/day, whereas the diet *Food as Culture* only has a slightly higher consumption and a lower energy use than the current Swedish diet. However, just the amount of food consumed does not explain the results completely, as the order of which diet uses the most amount of energy does not match that of how much food is consumed.

All four future scenario diets are designed to meet nutritional guidelines. Although nutrients have not been used as a functional unit in this study, when trying to pinpoint the most efficient and sustainable diet of the future, one could argue that the future diet that delivers all necessary nutrients in the least amount of food is the most efficient.

Findings by Arrieta and González (2019) suggest that lower nutrient dense food has higher energy use during cooking, when measured in energy per nutrient. Going further than assuming the same nutrient content for all four scenario diets, and calculating the energy use, using nutrients as a functional unit would give a more accurate comparison with the results found by Arrieta and González (2019).

Although the energy per nutrients was not calculated, the fact that the scenario diets will lead to a better health outcome must be considered in the evaluation and comparison of the current Swedish diet and the scenario diets.

5.2 Cooking energy in context of the food system

The available research on reducing GHG emissions in the food chain, mentions the household only briefly (Garnett 2011), indicating the relatively low contribution of it to the total food system emissions. Carlsson-Kanyama *et al.* (2003) have calculated the total energy use for the Swedish diet to range between 1917 and 5833 kWh per person and year. As opposed to the current study's system boundaries, which focused on the cooking of food at home, that of Carlsson-Kanyama *et al.* (2003) includes the food system from the farm production to the consumer. The in the present study calculated energy use for the current Swedish diet of 1026 kWh per person and year would constitute 17.6% of the higher end of the energy spectrum calculated by Carlsson-Kanyama *et al.* (2003), and 53.5% of the lower end energy use. An approximate contribution of the household stage to the total food system energy use amounting can be gauged by the contribution to the total GHG emissions which amount to roughly 9% that are home food related (Garnett 2011). Considering this, the result of the present study represents a reasonable cooking energy value when assuming a diet of higher total energy use across the food system, such as found by Carlsson-Kanyama *et al.* (2003), but unreasonable for one that uses energy in the scale of the lower end of their findings.

Arrieta and González (2019) argue, that the energy spent in cooking of a food should be included in the calculation of its total energy use across the food system. The impact of this is worth exploring, considering the differences in energy efficiency found between the different food groups in the present study, which indicate that the cooking of a food group would impact its respective total energy use to different degrees, depending on the food group in question.

The habits surrounding quantity of food prepared at once, were not included in the present study. Yet it is important to discuss the implications this might have on how, if and how often leftovers are re-heated. If a meal is cooked at home and has a large energy consumption initially, preparing larger quantities at once, the leftovers of which are then re-heated in the microwave should for example vastly reduce the required energy per meal. A study by Oberascher *et al.* (2011) has found that boiling water and boiling potatoes in larger quantities consumes less energy

per unit of water. If it is assumed that this would be the same for all cooking processes, preparing larger batches would be preferable to reduce energy consumption. There are many variables and connections within the food system that impact the result of whether preparing larger batches of food and consuming them spread across time is the more energy efficient method, some of which are cold storage, food waste and energy use in re-heating.

When considering what factors determine a sustainable diet, the cooking energy use plays only a minor role, as it contributes only a small amount to the food systems total GHG emissions and energy use. Other factors weighing in more for the environmental impact are the energy use and GHG emissions from areas of the food system such as primary production, the use of freshwater resources, land use for crop production, and the application of fertilizers, pesticides and herbicides (Springmann *et al.* 2018). Furthermore, a core element of a sustainable diet is its nutritional quality and health impact (Auestad & Fulgoni 2015), which is a point in which the current Swedish diet is lacking in comparison to the four Mistra Food Future scenario diets.

5.3 Limitations of the study

The availability of data, or lack thereof, on the frequency of cooking method application required many assumptions to be made. This has an uncertainty as a result, that is likely to have influenced the outcome of the study. Most of the research that provides data on the application ratio of cooking methods centers around health outcomes of those methods, for example Hoelzer *et al.* (2012) and Rohrmann *et al.* (2002). This was the case not only when narrowing down on Sweden but even when the search radius was extended to a global field. A focus on environmental sustainability concerns in studies regarding cooking method application for specific foods is lacking.

Much of the data on cooking method energy use was used from studies that are more than a decade old, such as Carlsson-Kanyama and Faist (2000). By adding an efficiency bonus in this study for 21 years into the future, the implication is made that much can change in such a timeframe and affect the results. Using “outdated” data for the current diet, a false image is possibly created about the energy use of cooking methods, and through its application, for the energy use of preparing the consumed diet.

The energy calculated for the preparation of pulses does not account for the vastly different cooking times of that food group when comparing them in their dry form, and pre-cooked, packaged form. Depending on the form that pulses are in when preparing them at home, there can be two possible cooking times and the respective energy use that differ greatly. Lentils for example, have a cooking energy use of 2.9 MJ/kg for unsoaked lentils, and 1.7 MJ/kg for a soaking time of 4 hours

before boiling (Arrieta & González 2019). A preboiled package of pulses as is the norm to use in Sweden, would not have the same cooking time as dried pulses.

Due to the format of the food consumption data used in this study, bread was assumed to be wholly baked at home. This is not a realistic representation of the current Swedish food system. These uncertainties of which state foods are in when they are cooked and eaten at home prove to be a further limitation on the accuracy of this study's results.

Waste as well as retail has been excluded from the system boundaries, and therefore the impact of certain practices such as throwing out bread after a short time in the store due to loss of freshness (Rosenlund *et al.* 2020) are not reflected in the energy use of cooking that is calculated within this study.

The energy value for *cooking in water* (4.4 MJ/kg) is applied to all foods "boiled" and represents an average of varying lengths of time for boiling food items. Another method called *cooking and similar thermal preparation processes* has an energy value of 2.98 MJ/kg. A distinction between these two processes could be made, depending on how the individual food item or food group would typically be processed. Berries for making jam for example, would be "cooked" whereas potatoes would be "boiled". The lack of this distinction in the present study lowers the accuracy of the results. This example shows the difference between cooking methods for a similar purpose, and the importance of the choice of what cooking method is applied to which foods.

The use of a Sweden-specific energy mix and primary energy factor means that the results from this study are potentially only applicable to Sweden and countries with the same energy mix.

5.4 Future research

Using nutrients as a functional unit, rather than the weight of a food, in calculating the energy use of cooking foods could give a more representative picture of the current Swedish diet's energy use in comparison to possible future diets. Aspects that were excluded from the system boundaries of this study, such as the comparison between industrially processed food and home-made food, and the quantity of food cooked at a time should be further researched under the topic of scenario diet comparison. This would further the understanding of how different foods and diets compare in their energy use in a realistic and complex food system.

A factor unexplored in this study, but potentially relevant to the sustainability of cooking and dietary choices, is the question of gender in the kitchen, moreover, who is the one buying the food and preparing it? In relation to the storing and heating leftover food comes also the question of who is in charge of those tasks. A number of studies have explored the change of gender dynamics in Swedish kitchens (Holm *et al.* 2015; Neuman *et al.* 2017; Andersson & Eriksson 2022), but

as of yet none that have drawn connections to the question of sustainability of cooking at home.

6. Conclusion

The purpose of this thesis was to quantify the energy use for different diets in their cooking, and to find out if and to what extent certain food groups have different energy consumption in cooking, to answer the question of how the diets studied in this thesis compare to each other in their energy consumption for that area.

The main findings of this study are, that the current Swedish diet uses less energy in preparing meals compared to three of the four studied Mistra Food Future diets; *Food as Industry, Food as Food Tech* and *Food Forgotten*, but more than the scenario diet *Food as Culture*. This was found to be mainly based on the higher volume of food eaten and the consumption of different food groups. The increase in energy use is roughly 6-20% for three of the four future scenarios.

To more accurately determine the impact of food groups and cooking methods on the diets' energy use at the consumption stage, more current data on cooking method energy use and the ratio of what cooking methods are applied is needed.

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Popular science summary

Cooking for the planet so we don’t cook the planet

It is no secret anymore that human actions are harming the planet, and that we need to act more sustainably. The food that we eat is no exception to this. In order to understand the impact that our food has on the environment, we need to study it from many different angles. Only when understanding the problem can we change our behaviour and improve the situation. But one step at a time.

If you think about how you interact with food, what comes to mind? Buying the food, cooking it, eating and throwing out or storing the leftovers? Even on a personal level there are many actions taken. When cooking your food, have you ever wondered how much energy it takes, for a meal, a day or in a whole year? Cooking actually makes up an important part of the energy bill in households. Not only can it impact the costs, but a high energy use also causes more greenhouse gases to be released. That is why it matters, how much energy our cooking uses.

I decided to find out how much this is for cooking in the average Swedish diet. And because I wanted to explore how we can impact that energy, and improve our habits for the future, I compared the current diet with possible future scenario diets. And surprisingly, on paper, the current Swedish diet does better than most of the diets I compared it to, when it comes to the amount of energy used for cooking. I had assumed more sustainable would mean less energy use. And the future diets that I compared it to, are definitely more sustainable when it comes to the impact from the diet’s whole supply chain on biodiversity and climate, as well as our health. In those future diets, Swedes consume much more vegetables and pulses, like beans, peas and lentils. And the higher food consumption is most likely the reason for the higher energy use in cooking, compared to how we eat now. Not because food groups such as vegetables would use the most energy per kg, which is actually the case for meat, but because more food is eaten overall. More, but healthier.

While there is still a lot to learn about how we prepare the food that we eat, it seems, that there are cooking practices and foods that are more and some that are less favourable to a low energy use in our homes. Although different diets use different cooking methods and different amounts of energy, we shouldn’t base our diet choices solely on that. Rather, we should look at the whole picture and consider our health and the environmental footprint.

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Appendix A: Calculation tables

This appendix contains the data sheets that were used for the calculations.

Appendix Table 1. Cooking method percentages of different foods and food groups.

Average between men and women in kg/y					
Potato	**Cooked**	**Fried**	**Baked**	**Deep fried**	**Raw**
Baked potato			1.6		
Potato gratin			2.03		
Pommes frites				3.99	
Fried potatoes		3.744			
Potato salad	1.02				
Cooked potatos	27.7				
Mashed potatos	4.86				
Potato dumplings	0.85				
Potato chips				1.6	

Total	34.43	3.744	3.63	5.59	
Percentage	72.6%	7.9%	7.7%	11.8%	
Wheat flour	**Cooked**	**Fried**	**Baked**	**Deep fried**	**Raw**
Rye bread			0.87		
White bread			6.49		
Standard müsli					0.36
Pancakes		0.99			
Pizza			8.65		
Spaghetti	12.50				
Soft cakes			0.84		
Cakes			0.90		
Cookies			1.33		
Crackers			1.85		
Total	12.50	0.99	20.94	0.00	0.36
Percentage	35.9%	2.8%	60.2%	0.0%	1.0%
Whole grain wheat flour	**Cooked**	**Fried**	**Baked**	**Deep fried**	**Raw**
Soft whole grain bread			6.98		
Total			6.98		
Percentage			100.0%		
Barley flour	**Cooked**	**Fried**	**Baked**	**Deep fried**	**Raw**
Soft whole grain bread			2.03		

Total			2.03		
Percentage			100.0%		
Maize, dry	**Cooked**	**Fried**	**Baked**	**Deep fried**	**Raw**
Cornflakes			3.10		
Standard müsli			1.01		
Total	0.00	0.00	4.11	0.00	0.00
Percentage	0.0%	0.0%	100.0%	0.0%	0.0%
Rye flour	**Cooked**	**Fried**	**Baked**	**Deep fried**	**Raw**
Soft whole grain bread			1.58		
Rye bread			0.87		
Hard bread			3.68		
Standard müsli					0.36
Total	0.00	0.00	6.12	0.00	0.36
Percentage	0.0%	0.0%	94.4%	0.0%	5.6%
Oats	**Cooked**	**Fried**	**Baked**	**Deep fried**	**Raw**
Soft whole grain bread			0.45		
Oatmeal	6.37		0.87		
Standard müsli					0.52
Total	6.37	0.00	1.32	0.00	0.52
Percentage	77.6%	0.0%	16.1%	0.0%	6.3%

Rice	Cooked	Column1	Column2	Column3	Column4
Percentage	100.0%				
Quinoa	Cooked	Column1	Column2	Column3	Column4
Percentage	100.0%				
Treenuts	Baked	Roasted	Fried	"Raw"	
	26.95%	6.49%	5.16%	61.40%	

From study by Rohrmann et al. (2002) on meat and fish cooking methods											
Frequency of cooking methods in percent (For Sweden)											
Meat	Number of consumption events	Baked / roasted	Barbecued	Boiled	Fried	Stir fried	Grilled	Stewed	Coated and fried	Other	No cooking method applied
Beef	858	0.198	0.019	0.042	0.396	0.230	0.101	0.001	0.002	0.010	0.000
Veal	42	0.214	0.024	0.333	0.262	0.000	0.000	0.000	0.167	0.000	0.000
Pork	1422	0.188	0.051	0.120	0.410	0.063	0.072	0.001	0.069	0.025	0.000
Lamb	52	0.192	0.115	0.212	0.365	0.115	0.000	0.000	0.000	0.000	0.000
Minced meat	597	0.152	0.035	0.045	0.750	0.010	0.002	0.000	0.003	0.002	0.000
Processed meat	2965	0.145	0.013	0.126	0.240	0.008	0.062	0.000	0.002	0.020	0.383
Chicken	518	0.583	0.091	0.081	0.170	0.050	0.008	0.000	0.006	0.012	0.000
Turkey	37	0.514	0.027	0.135	0.162	0.000	0.000	0.000	0.081	0.081	0.000
Fish	1602	0.170	0.004	0.166	0.089	0.006	0.006	0.000	0.145	0.024	0.390
Crustaceans	496	0.163	0.000	0.738	0.006	0.030	0.000	0.000	0.000	0.024	0.038

When no number was given for "no cooking method applied", then "other cooking method" includes "no cooking method applied". "No cooking method applied" includes "raw" and "cooking method not applicable".											
From study by Hoelzer et al. (2012)											
On US produce consumption habits											
Produce	**Fresh**	**Heat-treated**	**Dried**	**Frozen**	**Cured**	**Column1**					
Vegetables	24.3%	72.2%	0.0%	8.5%	3.4%						
Fruit (incl. Juice)	66.9%	28.1%	0.8%	4.2%	0.0%						
Total Produce	47.3%	44.5%	0.4%	6.2%	1.6%						
Milk	**Cooked**	**Fried**	**Baked**	**Raw**	**Frozen**						
Milk and yoghurt "raw"				96%							
Mashed potatoes	1%										
Pannkaka		2%									
Soft cake			0%								
Sweet wheat bread			1%								
Total	1%	2%	1%	96%							
Cream	**Cooked**	**Fried**	**Baked**	**Raw**	**Frozen**						
cream-raw											
Potato gratin			7%								
icecream					11%						
cake			11%								
Total	0%	0%	18%	0%	11%						

Cheese	Cooked	Fried	Baked	Raw	Frozen
"Raw"				91%	
in recipes			9%		
Total	0%	0%	9%	91%	0%
Alcohol	Cooked	Column2	Column3	Raw	Column5
Glögg	0.48%				
Other				99.52%	

Appendix Table 2. Energy of cooking processes in MJ/kg.

Process	Energy Consumption (MJ/kg)
Bacteria fermentation	0.395
Broiling/grilling	2
Canning / jarring	5.55
Cheesemaking	6.33
Churning	3.04
Concentration / evaporation	4.77
Condensing milk (concentration + sugars)	4.50
Cooking and similar thermal preparation processes	2.98
Cooking in water	4.40
Curing	1.26
Deep frying	9.95
Distillation	14.44
Drying (dehydration)	1.26
Extraction	0.81
Fermentation	0.40
Flaking	18.40
Flattening / rolling	4.01
Freezing	1.15
Frying	9.95
Grain milling	4.01
Grinding / milling / crushing	2.00
Juicing	3.04
Malting	2.68
Oil production	1.52
Pickling	1.60
Polishing	0.19
Processed	2.98
Puffing / expanding	2.98
Pulping / mashing	1.83
Roasting	6.45
Separation (in liquid phase)	0.09

Starch production	6.67
Stewing	4.40
Sugar production	0.89
Toasting / coffee roasting	2.52
Winemaking	2.95
Slicing	0.29
Dicing and stripe-cutting	0.29
Parboiling / pre-gelatinising	1.18
Decaffeinating	0.81
Refining	1.81
Protein Isolate, plant-protein	7.24
Extrusion, plant-protein	1.39
Homogenisation	0.03
Pasteurization	0.86
Boiling Water / Coffe Brewing	0.559

Appendix Table 3. Calculation of energy factor in MJ/kg.

	Energyfactor MJ/kg consumed in Swedish diet										
CEREALS (excluding beer)		Cooked	Fried	Baked	Deep fried	Raw					
Wheat flour	5.75	1.58100494	0.28272982	3.88138198	0						
Whole grain wheat flour	6.45			6.44975							
Rice, dry	4.40	4.4									
Barley flour	6.45			6.45							
Maize, dry	6.45			6.45							
Rye flour	6.09			6.09							
Oats	4.45	3.41471735		1.03566892							
Quinoa	4.40	4.4									
Flour of mixed grain	5.55	5.55									
STARCHY ROOTS											
Total strachy roots											
Potatoes	5.65	3.19643837	0.78562856	0.49399908	1.17298709						
Potato flour, meal, powder, granulates and pellets of potatoes	5.66	boiling + drying									
Potatoes frozen	5.55	boiling + freezing									
Starch of potatoes	11.07	boiling + starch production									
Sweet potatoes	5.65										
Beetroot	4.65										

		Boiling	Frying	Baking	Grilling	Boiled & Frozen	Current	Industry	Tech	Culture	Forgotten
VEGETABLES		1.32	2.9835	1.934925	0.2		4.65	4.31	4.01	4.02	4.31
Vegetables that can be produced in Sweden											
Tomatoes	4.65	4.31	4.01	4.02	4.31			1.54	1.32	1.1	1.54
Onions	4.65	4.31	4.01	4.02	4.31			2.9835	2.48625	2.9835	2.48625
Total vegetables, other Sweden								1.6124375	2.2574125	1.6124375	1.934925
Cabbages (and cauliflower & broccoli)	4.65	4.31	4.01	4.02	4.31			0.2	0.2	0.4	0.2
Lettuce and spinach	4.65	4.31	4.01	4.02	4.31						
Pumpkins, squash and gourds	4.65	4.31	4.01	4.02	4.31						
Cucumbers and gherkins	4.65	4.31	4.01	4.02	4.31						
Other beans, green	4.65	4.31	4.01	4.02	4.31						
Peas, green	4.65	4.31	4.01	4.02	4.31						
String beans	4.65	4.31	4.01	4.02	4.31						
Carrots and turnips	4.65	4.31	4.01	4.02	4.31						
Mushrooms and truffles	4.65	4.31	4.01	4.02	4.31						
Total vegetables likely imported											
Artichokes	4.65	4.31	4.01	4.02	4.31						
Asparagus	4.65	4.31	4.01	4.02	4.31						

Chillies and peppers, green (capsicum spp. and pimenta spp.)	4.65	4.31	4.01	4.02	4.31						
Sweet corn frozen	4.65	4.31	4.01	4.02	4.31						
Sweet corn prepared or preserved	4.65	4.31	4.01	4.02	4.31						
		Boiling	Frying	Baking	Grilling	Frozen					
FRUITS (Excluding Wine)		1.4890625		3.224875		0.04860261	1.37				
Fruits that can be produced in Sweden											
Apples (fresh)	1.37										
Apple juice	1.37										
Apple juice concentrate	1.37										
Pears	1.37										
Sour cherries	1.37										
Cherries	1.37										
Plums and sloes	1.37										
Plums dried	1.37										
Strawberries	1.37										
Raspberries	1.37										
Gooseberries	1.37										
Currants	1.37										
Blueberries	1.37										

Fruits likely imported											
Oranges	1.37										
Orange juice	1.37										
Orange juice concentrate	1.37										
Tangerines, mandarins, clementines	1.37										
Lemons and limes	1.37										
Grapefruit	1.37										
Citrus, other	1.37										
Bananas	1.37										
Plantains	1.37										
Pineapple	1.37										
Dates	1.37										
Grapes	1.37										
Raisins	1.37										
Watermelon	1.37										
Cranberries	1.37										
Peach	1.37										
MILK (excluding butter)		Cooked	Fried	Baked	Raw	Frozen					
Skim milk less than 1%	0.29	0.02978125	0.1989	0.0644975							
Milk 1-2%	0.29										
Whole milk more than 2%	0.29										

Fermented milk less than 1%	0.29										
Fermented milk 1-2%	0.29										
Fermented milk more than 2%	0.29										
Cream low fat (lower than 29%)	2.43	1.26868125		1.160955	0						
Cream high fat (higher than 29%)	2.43										
Sourcream 12%	2.43										
Sum cheese (from dairy milk)	0.58			0.5804775							
Small rumunant cheese	0.58										
Whey condensed											
Whole milk evaporated	0.29										
Whole milk powder	0.29										
Skim milk powder	0.29										
Skim milk condensed	0.29										
Ice cream dairy based											
MEAT		Baked	BBQ	Boiled	Fried	Stir Fried	Grilled	Stewed	Coated and fried		
Bovine meat	7.56	1.3286485	0.043	0.825	3.271905	1.143675	0.101	0.0022	0.8403525		
Mutton/goat meat	6.61	1.238352	0.23	0.9328	3.629925	1.143675					
Pig meat	7.17	1.21	0.10	0.53	4.08	0.63	0.14	0.01	0.69		

Total red meat g raw meat/day		3.78	0.38	2.29	10.98	2.91	0.25	0.01	1.53	21.34	
Poultry	22.12	3.53768788	0.118	0.4752	1.65087	0.248625	0.008	0	0.4326075		
Other meat	6.47	0.96	0.05	0.38	4.92	0.09	0.06	0.00	0.02		
		average of all meat		9.99							
OFFALS											
Offals	9.99										
EGGS		Boiled	Fried	Baked							
Eggs	5.28	3.256	0.9945	1.03196							
		Baked	BBQ	Boiled	Fried	Stir Fried	Grilled	Stewed	Coated and fried		
BLUE FOOD		1.0964575	0.008	0.7304	0.885105	0.05967	0.012	0	1.442025		
Wild caught (freshwater - Arctic char)	4.23										
Coldwater Farmed fish (carp)	4.23										
Warmwater Farmed fish (tilapia)	4.23										
Torsk (cod)	4.23										
Sill (Herring)	4.23										
Tuna	4.23										
Wild caught Salmon	4.23										
Farmed Salmon	4.23										
Sea bass	4.23										

Shrimp and crayfish	4.23										
Mackerel	4.23										
Mussels and oysters	4.23										
Crustaceans	4.68	1.05130925	0	3.2472	0.05967	0.29835	0	0	0	0.024	
		Boiled	Baked	Fried							
PULSES		3.52	0.9674625	0.49725							
Soy foods	4.98										
Peanuts	4.98										
Beans, dry (common beans)	4.98										
Peas, dry (yellow peas)	4.98										
Broad beans and horse beans, dry	4.98										
Chick peas, dry	4.98										
Lentils, dry	4.98										
Lupin, dry	4.98										
Grey pea, dry	4.98										
OILCROPS											
Soybeans	4.98										
Groundnuts, shelled	2.72										
Prepared groundnuts	2.72										
Peanut butter	2.72										
Sunflowerseed	2.72										

Coconuts, in shell	0.00										
Coconuts, desiccated	0.00										
Olives	0.60										
TREENUTS		Baked	Roasted	Fried							
Treenuts and products	2.72	1.7382305	0.46571815	0.51271277							
Chestnuts, in shell	2.72										
Walnuts, in shell	2.72										
Pistachios, in shell	2.72										
Cashews, shelled	2.72										
Almonds, shelled	2.72										
Walnuts, shelled	2.72										
Hazelnuts, shelled	2.72										
Prepared nuts	2.72										
VEGETABLE OILS	8.22	2.2574125		5.967							
Palm oil	8.22										
Total unsaturated oils											
Soybean oil	8.22										
Groundnut oil	8.22										
Sunflowerseed oil	8.22										
Rapeseed oil	8.22										
Sesameseed oil	8.22										
Olive oil	8.22										

Vegetable oil other	8.22										
ANIMAL FATS		baked	frying								
Animal fats	9.95										
Butter	4.22	3.224875	0.9945								
SWEETENERS		Baked	Cooked								
Sugar	4.94	4.1923375	0.74453125								
Sweeteners	0.00										
Honey	0.00										
ALCOHOLIC BEVERAGES		cooked	raw								
Total grams of alcohol		0.014295									
glasses of wine per week (13,5 cl/glass)	0.01										
glasses of beer (33 cl/glass)	0.01										
glasses of vodka (4 cl/glass)	0.01										
Wine	0.01										
Barley beer	0.01										
Apple cider	0.01										
Vodka	0.01										

STIMULANTS											
Coffee, roasted	0.56										
Coffee extractives	0.56	baked	cooked								
Cocoa powder	3.97	3.224875	0.74453125								
Chocolate, solid	0.09	0.0644975	0.02978125								
Candy (sugar-based)	0.00										
TEA & products	0.56										
SPICES											
Total spices											
Pepper											
Pimento											
Cloves											
Herbs											
MISCELLANEOUS											
Instant food											
Miscellaneous											
WILD FOOD											
Moose and deer	8.48										
Wild boar	7.17										
Reindeer	8.48										

Berries	1.37										
Mushrooms	8.60										
ALTERNATIVES		Fried	Cooked	Baked							
Legume-based meat (non-soy, made from yellow pea)	7.51	5.967	0.8934375	0.644975							
Soy protein products (soy)	7.51										
Other plant-based meat (seitan)	7.51										
Plant-based dairy (oat-based)	0.29										
Cellbased meat (sugar)	7.51										
Cellbased dairy (sugar)	0.29										
Fungi based meat (Quorn) from hydrolyzed wheat	7.51										
Tempeh (faba beans)	7.51										
Tofu (soy)	7.51										
Tofu (faba beans)	7.51										
Cell-based fish (cultured meat)	7.51										
Microbial fats (yeast)	7.51										
Microbial fat (algae)	7.51										
Microbial egg (sugar)	7.51										

Appendix Table 4. Final calculation table with energy per day in MJ, calculated based on the daily consumption in g/day.

		Current consumption	At home cooking		Food as industry	At home cooking		Food as food tech	At home cooking		Food as culture	At home cooking		Food forgotten	At home cooking	
		g/day	MJ/day		g/day	MJ/day		g/day	MJ/day		g/day	MJ/day		g/day	MJ/day	
CEREALS (excluding beer)																
Wheat flour		69.8	0.401009149		69.8	0.401009149		48.9	0.280936209		32.6	0.187290806		89.6	0.51476246	
Whole grain wheat flour		23.3	0.150279175		69.8	0.45019255		90.8	0.5856373		97.8	0.63078555		73.3	0.472766675	
Rice, dry		14.1	0.06204		14.1	0.06204		14.1	0.06204		0	0		0	0	
Barley flour		3.5	0.022574125		3.5	0.022574125		3.5	0.022574125		3.5	0.022574125		3.5	0.022574125	
Maize, dry		3.8	0.02450905		3.8	0.02450905		3.8	0.02450905		3.8	0.02450905		3.8	0.02450905	
Rye flour		12.8	0.077924354		12.8	0.077924354		12.8	0.077924354		19.8	0.120539236		12.8	0.077924354	
Oats		5.2	0.023142009		5.2	0.023142009		5.2	0.023142009		15.8	0.070316103		12.3	0.054739751	
Quinoa		0.1	0.00044		0.1	0.00044		1	0.0044		7.1	0.03124		7.2	0.03168	
Flour of mixed grain		0.5	0.002777037		0.5	0.002777037		0.5	0.002777037		0.5	0.002777037		0.5	0.002777037	
			0			0			0			0			0	
STARCHY ROOTS			0			0			0			0			0	
Total strachy roots		137.3	0		137.3	0		137.3	0		137.3	0		137.3	0	
Potatoes		108.1	0.61066264		66.1	0.37340241		66.1	0.37340241		108.1	0.61066264		108.1	0.61066264	

Potato flour, meal, powder, granulates and pellets of potatoes		0.9	0.005094		0.9	0.005094		0.9	0.005094		0.9	0.005094		0.9	0.005094	
Potatoes frozen		24.1	0.133728222		66.1	0.366781556		66.1	0.366781556		24.1	0.133728222		24.1	0.133728222	
Starch of potatoes		0.3	0.003322		0.3	0.003322		0.3	0.003322		0.3	0.003322		0.3	0.003322	
Sweet potatoes		0.3	0.001694716		0.3	0.001694716		0.3	0.001694716		0.3	0.001694716		0.3	0.001694716	
Beetroot		3.6	0.016740265		3.6	0.016740265		3.6	0.016740265		3.6	0.016740265		3.6	0.016740265	
			0			0			0			0			0	
VEGETABLES			0			0			0			0			0	
Vegetables that can be produced in Sweden			0			0			0			0			0	
Tomatoes		37	0.172052726		55.5	0.239118281		74	0.296647056		37	0.148862794		49.2	0.212190867	
Onions		19.3	0.089746422		29	0.124944688		38.6	0.154737518		38.6	0.155300104		25.7	0.110839538	
Total vegetables, other Sweden		75.6	0		226.8	0		226.8	0		222.6	0		113.4	0	
Cabbages (and cauliflower & broccoli)		14.6	0.067891075		43.8	0.188709563		43.8	0.175582987		43.8	0.176221361		21.9	0.094450813	
Lettuce and spinach		11.3	0.052545832		33.9	0.146056031		33.9	0.135896422		33.9	0.136390506		17	0.073317983	
Pumpkins, squash and gourds		3.8	0.01767028		11.4	0.049116188		11.4	0.045699682		11.4	0.045865834		5.7	0.024583088	
Cucumbers and gherkins		14.3	0.066496053		42.9	0.184831969		42.9	0.171975118		42.9	0.172600374		21.5	0.092725684	
Other beans, green		0.3	0.001395022		0.9	0.003877594		0.9	0.00360787		0.9	0.003620987		0.5	0.002156411	
Peas, green		3.5	0.016275258		10.5	0.045238594		10.5	0.042091812		10.5	0.042244847		5.3	0.022857959	
String beans		0	0		0	0		0	0		0	0		0	0	

Carrots and turnips		25	0.116251842		75	0.323132813		75	0.3006558		75	0.301748906		37.5	0.161730844	
Mushrooms and truffles		2.8	0.013020206		8.4	0.036190875		8.4	0.0336734 5		4.2	0.016897939		4.2	0.018113855	
			0			0			0			0			0	
Total vegetables likely imported		11.1	0		16.65	0		22.2	0		5.55	0		33.3	0	
Artichokes		0.1	0.000465007		0.15	0.000646266		0.2	0.000801749		0.05	0.000201166		0.3	0.001293847	
Asparagus		0.6	0.002790044		0.9	0.003877594		1.2	0.004810493		0.3	0.001206996		1.8	0.007763081	
Chillies and peppers, green (capsicum spp. and pimenta spp.)		6.6	0.030690486		9.9	0.042653531		13.2	0.052915421		3.3	0.013276952		19.8	0.085393886	
Sweet corn frozen		0.4	0.001860029		0.6	0.002585063		0.8	0.003206995		0.2	0.000804664		1.2	0.005175387	
Sweet corn prepared or preserved		3.4	0.0158102 5		5.1	0.021973031		6.8	0.027259459		1.7	0.006839642		10.2	0.043990779	
			0			0			0			0			0	
FRUITS (Excluding Wine)			0			0			0			0			0	
Fruits that can be produced in Sweden			0			0			0			0			0	
Apples (fresh)		12.9	0.017689766		38.7	0.053069228		19.35	0.026534664		25.8	0.035379532		12.9	0.017689766	
Apple juice		2.1	0.002879728		6.3	0.008639185		3.15	0.004319593		4.2	0.005759457		2.1	0.002879728	
Apple juice concentrate		1.8	0.002468339		5.4	0.007405016		2.7	0.003702508		3.6	0.004936677		1.8	0.002468339	
Pears		5	0.006856496		15	0.020569488		7.5	0.010284744		10	0.013712992		5	0.006856496	
Sour cherries		0	0		0	0		0	0		0	0		0	0	
Cherries		0.3	0.000411 39		0.6	0.000822 78		0.45	0.000617 085		0.6	0.000822 78		0.3	0.000411 39	

Plums and sloes		0.8	0.001097039		1.6	0.002194079		1.2	0.001645559		1.6	0.002194079		0.8	0.001097039	
Plums dried		0.3	0.00041139		0.6	0.0008227 8		0.45	0.000617085		0.6	0.0008227 8		0.3	0.00041139	
Strawberries		4.9	0.006719366		9.8	0.013438732		7.35	0.010079049		9.8	0.013438732		4.9	0.006719366	
Raspberries		0.5	0.00068565		1	0.001371299		0.75	0.001028474		10	0.013712992		0.5	0.00068565	
Gooseberries		0	0		0	0		0	0		10	0.013712992		0	0	
Currants		0	0		0	0		0	0		10	0.013712992		0	0	
Blueberries		0	0		0	0		0	0		10	0.013712992		0	0	
			0			0			0			0			0	
Fruits likely imoported			0			0			0			0			0	
Oranges		13.9	0.019061059		6.95	0.00953053		20.85	0.028591589		6.95	0.00953053		13.9	0.019061059	
Orange juice		8.1	0.011107524		4.05	0.005553762		12.15	0.016661286		4.05	0.005553762		8.1	0.011107524	
Orange juice concentrate		3	0.004113898		1.5	0.002056949		4.5	0.006170847		1.5	0.002056949		3	0.004113898	
Tangerines, mandarins, clementines		11.2	0.015358551		5.6	0.007679276		16.8	0.023037827		5.6	0.007679276		11.2	0.015358551	
Lemons and limes		6.7	0.009187705		3.35	0.004593852		10.05	0.013781557		3.35	0.004593852		6.7	0.009187705	
Grapefruit		1.4	0.001919819		0.7	0.000959909		2.1	0.002879728		0.7	0.000959909		1.4	0.001919819	
Citrus, other		1.5	0.002056949		0.75	0.001028474		2.25	0.003085423		0.75	0.001028474		1.5	0.002056949	
Bananas		15.9	0.021803658		7.95	0.010901829		23.85	0.032705487		7.95	0.010901829		15.9	0.021803658	
Plantains		0.1	0.00013713		0.05	6.8565E-05		0.15	0.000205695		0.05	6.8565E-05		0.1	0.00013713	
Pineapple		3.2	0.004388158		1.6	0.002194079		4.8	0.006582236		1.6	0.002194079		3.2	0.004388158	

Dates		0.9	0.001234169		0.45	0.000617085		1.35	0.001851254		0.45	0.000617085		0.9	0.001234169	
Grapes		5.1	0.006993626		2.55	0.003496813		7.65	0.010490439		2.55	0.003496813		5.1	0.006993626	
Raisins		1	0.001371299		0.5	0.0006856		1.5	0.002056949		0.5	0.0006856		1	0.001371299	
Watermelon		17.2	0.023586347		8.6	0.011793173		25.8	0.03537952		8.6	0.011793173		17.2	0.023586347	
Cranberries		0.3	0.0004113 9		0.15	0.000205695		0.45	0.000617085		0.15	0.000205695		0.3	0.0004113 9	
Peach		11.6	0.015907071		5.8	0.007953536		17.4	0.023860607		5.8	0.007953536		11.6	0.015907071	
			0			0			0			0			0	
MILK (excluding butter)			0			0			0			0			0	
Skim milk less than 1%		29.5	0.008648773		19.7	0.005775621		14.8	0.004339046		19.7	0.005775621		14.75	0.004324387	
Milk 1-2%		80.7	0.023659525		53.8	0.015773017		40.4	0.011844422		53.8	0.015773017		40.35	0.011829763	
Whole milk more than 2%		45.6	0.013368951		30.4	0.008912634		22.8	0.006684476		30.4	0.008912634		22.8	0.006684476	
Fermented milk less than 1%		8.5	0.002492019		5.7	0.001671119		4.3	0.001260669		5.7	0.001671119		4.25	0.0012460 1	
Fermented milk 1-2%		14.4	0.004221774		9.6	0.002814516		7.2	0.002110887		9.6	0.002814516		7.2	0.002110887	
Fermented milk more than 2%		44.1	0.012929183		29.4	0.008619455		22.1	0.0064792 5		29.4	0.008619455		22.05	0.006464591	
Cream low fat (lower than 29%)		6.6	0.016035599		4.4	0.0106904		3.3	0.0080178		4.4	0.0106904		3.3	0.0080178	
Cream high fat (higher than 29%)		8.3	0.020165981		5.5	0.013362999		4.2	0.010204472		5.5	0.013362999		4.15	0.0100829	
Sourcream 12%		1	0.002429636		0.7	0.001700745		0.5	0.001214818		0.7	0.001700745		0.5	0.001214818	
Sum cheese (from dairy milk)		46.8	0.027166347		31.2	0.018110898		23.4	0.013583174		28.1	0.016311418		23.4	0.013583174	

Small rumunant cheese		0	0		0	0		0	0		3.1	0.0017994 8		0	0	
Whole milk evaporated		1.3	0.0003811 32		0.9	0.0002638 61		0.7	0.0002052 25		0.9	0.0002638 61		0.65	0.0001905 66	
Whole milk powder		1.8	0.0005277 22		1.2	0.0003518 15		0.9	0.0002638 61		1.2	0.0003518 15		0.9	0.0002638 61	
Skim milk powder		0	0		0	0		0	0		0	0		0	0	
Skim milk condensed		0.3	8.79536E-05		0.2	5.86358E-05		0.2	5.86358E-05		0.2	5.86358E-05		0.15	4.39768E-05	
Ice cream dairy based		8.1	0		5.4	0		4.1	0		5.4	0		4.05	0	
			0			0			0			0			0	
MEAT			0			0			0			0			0	
Bovine meat		39.9	0.3014756 62		20	0.1511156 2		13	0.0982251 53		13	0.0982251 53		10	0.0755578 1	
Mutton/goat meat		2.9	0.0191754 63		1.5	0.0099183 43		1	0.0066122 29		1	0.0066122 29		1.5	0.0099183 43	
Pig meat		60.6	0.4347899 71		30.3	0.2173949 86		0	0		6.06	0.0434789 97		30.3	0.2173949 86	
Total red meat g raw meat/day		103.4	0		51.7	0		14	0		28	0		42	0	
Poultry		49.5	1.0948024 4		24.8	0.5485070 81		0	0		9.9	0.2189604 88		49.5	1.0948024 4	
Other meat		0	0		0	0			0			0			0	
			0			0			0			0			0	
OFFALS			0			0			0			0			0	
Offals		0.6	0.0059917 17		0.6	0.0059917 17		0.6	0.0059917 17		1.2	0.0119834 33		0.6	0.0059917 17	
			0			0			0			0			0	
EGGS			0			0			0			0			0	

Eggs		29	0.15319134		25	0.1320615		13	0.06867198		25	0.1320615		25	0.1320615	
			0			0			0			0			0	
BLUE FOOD			0			0			0			0			0	
Wild caught (freshwater - Arctic char)		9.2	0.038949649		3.1	0.013124338		4.6	0.019474825		9.2	0.038949649		9.2	0.038949649	
Coldwater Farmed fish (carp)		0	0		3.1	0.013124338		4.6	0.019474825		4.6	0.019474825		0	0	
Warmwater Farmed fish (tilapia)		0	0		3.1	0.013124338		4.6	0.019474825		4.6	0.019474825		0	0	
Torsk (cod)		6.5			3.3	0.01397107		6.5	0.027518774		0	0		6.5	0.027518774	
Sill (Herring)		4.5	0.019051459		4.5	0.019051459		4.5	0.019051459		4.5	0.019051459		4.5	0.019051459	
Tuna		1.7	0.007197218		0.9	0.003810292		1.7	0.007197218		0	0		1.7	0.007197218	
Wild caught Salmon		0.2	0.000846732		0.1	0.000423366		0	0		0	0		0.1	0.000423366	
Farmed Salmon		9	0.038102918		0.3	0.001270097		0.3	0.001270097		0.1	0.000423366		0.3	0.001270097	
Sea bass		2.4	0.010160778		2.4	0.010160778		2.4	0.010160778		2.4	0.010160778		2.4	0.010160778	
Shrimp and crayfish		5.5	0.023285116		5.5	0.023285116		2.7	0.011430875		11	0.046570233		5.5	0.023285116	
Mackerel		0.7	0.00296356		1.4	0.005927121		1.4	0.005927121		0.7	0.00296356		0.7	0.00296356	
Mussels and oysters		0.7	0.00296356		6.8	0.028788871		10.3	0.043606672		10.3	0.043606672		0.7	0.00296356	
Crustaceans		0.7	0.0032763 7		0.7	0.0032763 7		0.7	0.0032763 7		0.7	0.0032763 7		0.7	0.0032763 7	
			0			0			0			0			0	
PULSES			0			0			0			0			0	
Soy foods		1	0.004984713		40.3	0.200883914		32	0.1595108		1	0.004984713		64.6	0.322012428	
Peanuts		6.4	0.03190216		10.2	0.050844068		10.2	0.050844068		13.4	0.066795148		10.2	0.050844068	

Beans, dry (common beans)		0.7	0.003489299		1.4	0.006978598		1.4	0.006978598		4.8	0.0239266 2		1.4	0.006978598	
Peas, dry (yellow peas)		4.5	0.022431206		9	0.044862413		9	0.044862413		24	0.1196331		9	0.044862413	
Broad beans and horse beans, dry		0	0		0	0		0	0		24	0.1196331		0	0	
Chick peas, dry		0.3	0.001495414		0.6	0.002990828		0.6	0.002990828		0.3	0.001495414		0.6	0.002990828	
Lentils, dry		0.6	0.002990828		1.2	0.005981655		1.2	0.005981655		1.2	0.005981655		1.2	0.005981655	
Lupin, dry		0	0		0	0		0	0		3	0.014954138		0	0	
Grey pea, dry		0	0		0	0		0	0		3	0.014954138		0	0	
			0			0			0			0			0	
OILCROPS			0			0			0			0			0	
Soybeans		1	0.004984713		2	0.009969425		2	0.009969425		1	0.004984713		9	0.044862413	
Groundnuts, shelled		0.5	0.001358331		1	0.002716661		1	0.002716661		0.5	0.001358331		1	0.002716661	
Prepared groundnuts		2.2	0.005976655		4.4	0.0119533 1		4.4	0.0119533 1		2.2	0.005976655		4.4	0.0119533 1	
Peanut butter		0.6	0.001629997		1.2	0.003259994		1.2	0.003259994		0.6	0.001629997		1.2	0.003259994	
Sunflowerseed		0	0		0	0		0	0		7	0.019016663		0	0	
Coconuts, in shell		0.1	0		0.2	0		0.2	0		0.1	0		0.2	0	
Coconuts, desiccated		0.4	0		0.8	0		0.8	0		0.4	0		0.8	0	
Olives		2.6	0.001548625		2.6	0.001548625		2.6	0.001548625		2.6	0.001548625		2.6	0.001548625	
			0			0			0			0			0	
TREENUTS			0			0			0			0			0	
Treenuts and products		5.4	0.014669972		5.4	0.014669972		10.8	0.029339943		14.4	0.039119924		5.4	0.014669972	

Chestnuts, in shell		0.1	0.000271666		0.1	0.000271666		0.2	0.000543332		0.1	0.000271666		0.1	0.000271666	
Walnuts, in shell		0.1	0.000271666		0.1	0.000271666		0.2	0.000543332		1	0.002716661		0.1	0.000271666	
Pistachios, in shell		0.1	0.000271666		0.1	0.000271666		0.2	0.000543332		0.1	0.000271666		0.1	0.000271666	
Cashews, shelled		0.5	0.001358331		0.5	0.001358331		1	0.002716661		0.5	0.001358331		0.5	0.001358331	
Almonds, shelled		1.4	0.003803326		1.4	0.003803326		2.8	0.007606652		1.4	0.003803326		1.4	0.003803326	
Walnuts, shelled		0.7	0.001901663		0.7	0.001901663		1.4	0.003803326		7	0.0190163		0.7	0.001901663	
Hazelnuts, shelled		0.2	0.000543332		0.2	0.000543332		0.4	0.001086665		2	0.005433323		0.2	0.000543332	
Prepared nuts		2.3	0.006248321		2.3	0.006248321		4.6	0.012496643		2.3	0.006248321		2.3	0.006248321	
			0			0			0			0			0	
VEGETABLE OILS			0			0			0			0			0	
Palm oil		15	0.123366188		5	0.041122063		5	0.041122063		5	0.041122063		5	0.041122063	
Total unsaturated oils		21.53	0		27.53	0		27.53	0		27.53	0		29.05	0	
Soybean oil		0.08	0.000657953		0.08	0.000657953		0.08	0.000657953		0.08	0.000657953		10	0.082244125	
Groundnut oil		0.02	0.000164488		0.02	0.000164488		0.02	0.000164488		0.02	0.000164488		0.02	0.000164488	
Sunflowerseed oil		8.2	0.067440183		8.2	0.067440183		8.2	0.067440183		8.2	0.067440183		6.62	0.054445611	
Rapeseed oil		6	0.049346475		12	0.09869295		12	0.09869295		12	0.09869295		5.93	0.048770766	
Sesameseed oil		0.03	0.000246732		0.03	0.000246732		0.03	0.000246732		0.03	0.000246732		0.03	0.000246732	
Olive oil		2.8	0.023028355		2.8	0.023028355		2.8	0.023028355		2.8	0.023028355		2.35	0.019327369	
Vegetable oil other		4.4	0.036187415		4.4	0.036187415		4.4	0.036187415		4.4	0.036187415		4.1	0.033720091	

			0			0			0			0			0	
ANIMAL FATS			0			0			0			0			0	
Animal fats		2.39	0.0237685		2.39	0.0237685		2.39	0.0237685		2.39	0.0237685		2.39	0.0237685	
Butter		15.3	0.0645564 38		10.2	0.0430376 25		7.65	0.0322782 19		10.2	0.0430376 25		7.65	0.0322782 19	
			0			0			0			0			0	
SWEETENERS			0			0			0			0			0	
Sugar		74	0.3653282 88		18.5	0.0913320 72		18.5	0.0913320 72		18.5	0.0913320 72		18.5	0.0913320 72	
Sweeteners		2.9	0		0.7	0		0.7	0		0.7	0		0.7	0	
Honey		1	0		1	0		1	0		1	0		1	0	
			0			0			0			0			0	
ALCOHOLIC BEVERAGES			0			0			0			0			0	
Total grams of alcohol		20.3	0		13.5	0		13.5	0		13.5	0		13.5	0	
glasses of wine per week (13,5 cl/glass)		3.5	5.00325E-05		2.3	3.28785E-05		2.3	3.28785E-05		2.3	3.28785E-05		2.3	3.28785E-05	
glasses of beer (33 cl/glass)		2.7	3.85965E-05		1.8	0.0000257 31		1.8	0.0000257 31		1.8	0.0000257 31		1.8	0.0000257 31	
glasses of vodka (4 cl/glass)		1.4	0.0000200 13		0.9	1.28655E-05		0.9	1.28655E-05		0.9	1.28655E-05		0.9	1.28655E-05	
Wine		67.4	0.0009634 83		44.9	0.0006418 46		44.9	0.0006418 46		44.9	0.0006418 46		44.9	0.0006418 46	
Barley beer		125.5	0.0017940 23		83.7	0.0011964 92		83.7	0.0011964 92		83.7	0.0011964 92		83.7	0.0011964 92	
Apple cider		6.9	9.86355E-05		4.6	0.0000657 57		4.6	0.0000657 57		4.6	0.0000657 57		4.6	0.0000657 57	
Vodka		7.9	0.0001129 31		5.3	7.57635E-05		5.3	7.57635E-05		5.3	7.57635E-05		5.3	7.57635E-05	
			0			0			0			0			0	

STIMULANTS			0			0			0			0			0	
Coffee, roasted		20.5	0.0114595		10.25	0.00572975		10.25	0.00572975		10.25	0.00572975		10.25	0.00572975	
Coffee extractives		1.1	0.0006149		0.55	0.00030745		0.55	0.00030745		0.55	0.00030745		0.55	0.00030745	
Cocoa powder		6.3	0.025007259		3.15	0.01250363		3.15	0.01250363		3.15	0.01250363		3.15	0.01250363	
Chocolate, solid		21	0.001979854		10.5	0.000989927		10.5	0.000989927		10.5	0.000989927		10.5	0.000989927	
Candy (sugar-based)		21	0		10.5	0		10.5	0		10.5	0		10.5	0	
			0			0			0			0			0	
TEA & products		1.3	0.0007267		0.65	0.00036335		0.65	0.00036335		0.65	0.00036335		0.65	0.00036335	
			0			0			0			0			0	
SPICES			0			0			0			0			0	
Total spices		3.02	0		3.02	0		3.02	0		3.02	0		3.02	0	
Pepper		0.4	0		0.4	0		0.4	0		0.4	0		0.4	0	
Pimento		0.5	0		0.5	0		0.5	0		0.5	0		0.5	0	
Cloves		0.02	0		0.02	0		0.02	0		0.02	0		0.02	0	
Herbs		2.1	0		2.1	0		2.1	0		2.1	0		2.1	0	
			0			0			0			0			0	
MISCELLANEOUS			0			0			0			0			0	
Instant food		0.56	0		0.56	0		0.56	0		0.56	0		0.56	0	
Miscellaneous		19.8	0		19.8	0		19.8	0		19.8	0		19.8	0	
			0			0			0			0			0	
WILD FOOD			0			0			0			0			0	
Moose and deer		3.9	0.033072		3.9	0.033072		3.9	0.033072		3.9	0.033072		3.9	0.033072	

Wild boar		1.2	0.008609702		1.2	0.008609702		1.2	0.008609702		1.2	0.008609702		1.2	0.008609702	
Reindeer		0.1	0.000848		0.1	0.000848		0.1	0.000848		0.1	0.000848		0.1	0.000848	
Berries		3.9	0.005348067		3.9	0.005348067		3.9	0.005348067		7.8	0.010696134		3.9	0.005348067	
Mushrooms		0	0		0	0		0	0		4.2	0.036121168		0	0	
			0			0			0			0			0	
ALTERNATIVES			0			0			0			0			0	
Legume-based meat (non-soy, made from yellow pea)		0	0		38	0.285205675		10	0.075054125		0	0		0	0	
Soy protein products (soy)		0	0		38	0.285205675		30	0.225162375		0	0		46	0.345248975	
Other plant-based meat (seitan)		0	0		0	0		10	0.075054125		0	0		0	0	
Plant-based dairy (oat-based)		0	0		120	0.03518145		0	0		0	0		120	0.03518145	
Cellbased meat (sugar)		0	0		0	0		60	0.45032475		0	0		0	0	
Cellbased dairy (sugar)		0	0		0	0		150	0.043976813		0	0		0	0	
Fungi based meat (Quorn) from hydrolyzed wheat		0	0		0	0		10	0.075054125		0	0		0	0	
Tempeh (faba beans)		0	0		0	0		0	0		10	0.075054125		0	0	
Tofu (soy)		0	0		0	0		0	0		0	0		10	0.075054125	
Tofu (faba beans)		0	0		0	0		0	0		10	0.075054125		0	0	
Cell-based fish (cultured meat)		0	0		0	0		5	0.037527063		0	0		46	0.345248975	
Microbial fats (yeast)		0	0		0	0		3.75	0.028145297		0	0		0	0	
Microbial fat (algae)		0	0		0	0		3.75	0.028145297		0	0		0	0	

Microbial egg (sugar)		0	0		0	0		12	0.0900649 5		0	0		10	0.0750541 25	
Sum g/day																
Sum MJ/day			5.62			6.20			5.97			5.26			6.75	
		Current			Industr y			Tech			Cultur e			Forgotte n		
Energy efficiency improvements (EEI)						4.76	**Without EEI**		4.59	**Without EEI**		4.04	**Without EEI**		5.18	**Without EEI**
Sum MJ/year			2052.78			1737.17	2261.9 4		1674.49	2180.3 3		1474.53	1919.9 6		1891.22	2462.524 61
Added cooling energy																
Sum preparation, cooling			2052.78	0.0 0		1737.17	2261.9 4		1674.49	2180.3 3		1474.53	1919.9 6		1891.22	2462.52
Primary energy use MJ			3695.01	0.0 0		3126.91	4071.5 0		3014.09	3924.5 9		2654.15	3455.9 3		3404.19	4432.54
Primary energy use kWh			1026			869	1131		837	1090		737	960		946	1231
kWh/day			2.81			2.38			2.29			2.02			2.59	
kWh/year higher than current						-158	105		-189	64		-289	-66		-81	205

Appendix B: Consumed food amounts

This appendix contains the data of consumed food items and categories, for current consumption as well as the assumed consumption in the MISTRA Food Future scenarios.

Appendix Table 5. Consumed food in the five diets in g/day.

Column1	Current consumption	Food as industry	Food as food tech	Food as culture	Food forgotten
	g/day	g/day	g/day	g/day	g/day
CEREALS (excluding beer)					
Wheat flour	69,8	69,8	48,9	32,6	89,6
Whole grain wheat flour	23,3	69,8	90,8	97,8	73,3
Rice, dry	14,1	14,1	14,1	0	0
Barley flour	3,5	3,5	3,5	3,5	3,5
Maize, dry	3,8	3,8	3,8	3,8	3,8
Rye flour	12,8	12,8	12,8	19,8	12,8
Oats	5,2	5,2	5,2	15,8	12,3
Quinoa	0,1	0,1	1	7,1	7,2
Flour of mixed grain	0,5	0,5	0,5	0,5	0,5
STARCHY ROOTS					
Total starchy roots	137,3	137,3	137,3	137,3	137,3
Potatoes	108,1	66,1	66,1	108,1	108,1
Potato flour, meal, powder, granulates and pellets of potatoes	0,9	0,9	0,9	0,9	0,9
Potatoes frozen	24,1	66,1	66,1	24,1	24,1
Starch of potatoes	0,3	0,3	0,3	0,3	0,3
Sweet potatoes	0,3	0,3	0,3	0,3	0,3

Beetroot	3,6	3,6	3,6	3,6	3,6
VEGETABLES					
Vegetables that can be produced in Sweden					
Tomatoes	37	55,5	74	37	49,2
Onions	19,3	29	38,6	38,6	25,7
Total vegetables, other Sweden	75,6	226,8	226,8	222,6	113,4
Cabbages (and cauliflower & broccoli)	14,6	43,8	43,8	43,8	21,9
Lettuce and spinach	11,3	33,9	33,9	33,9	17
Pumpkins, squash and gourds	3,8	11,4	11,4	11,4	5,7
Cucumbers and gherkins	14,3	42,9	42,9	42,9	21,5
Other beans, green	0,3	0,9	0,9	0,9	0,5
Peas, green	3,5	10,5	10,5	10,5	5,3
String beans	0	0	0	0	0
Carrots and turnips	25	75	75	75	37,5
Mushrooms and truffles	2,8	8,4	8,4	4,2	4,2
Total vegetables likely imported	11,1	16,65	22,2	5,55	33,3
Artichokes	0,1	0,15	0,2	0,05	0,3
Asparagus	0,6	0,9	1,2	0,3	1,8
Chillies and peppers, green (capsicum spp. and pimenta spp.)	6,6	9,9	13,2	3,3	19,8
Sweet corn frozen	0,4	0,6	0,8	0,2	1,2
Sweet corn prepared or preserved	3,4	5,1	6,8	1,7	10,2

FRUITS (Excluding Wine)					
Fruits that can be produced in Sweden					
Apples (fresh)	12,9	38,7	19,35	25,8	12,9
Apple juice	2,1	6,3	3,15	4,2	2,1
Apple juice concentrate	1,8	5,4	2,7	3,6	1,8
Pears	5	15	7,5	10	5
Sour cherries	0	0	0	0	0
Cherries	0,3	0,6	0,45	0,6	0,3
Plums and sloes	0,8	1,6	1,2	1,6	0,8
Plums dried	0,3	0,6	0,45	0,6	0,3
Strawberries	4,9	9,8	7,35	9,8	4,9
Raspberries	0,5	1	0,75	10	0,5
Gooseberries	0	0	0	10	0
Currants	0	0	0	10	0
Blueberries	0	0	0	10	0
Fruits likely imported					
Oranges	13,9	6,95	20,85	6,95	13,9
Orange juice	8,1	4,05	12,15	4,05	8,1
Orange juice concentrate	3	1,5	4,5	1,5	3
Tangerines, mandarins, clementines	11,2	5,6	16,8	5,6	11,2
Lemons and limes	6,7	3,35	10,05	3,35	6,7
Grapefruit	1,4	0,7	2,1	0,7	1,4

Citrus, other	1,5	0,75	2,25	0,75	1,5
Bananas	15,9	7,95	23,85	7,95	15,9
Plantains	0,1	0,05	0,15	0,05	0,1
Pineapple	3,2	1,6	4,8	1,6	3,2
Dates	0,9	0,45	1,35	0,45	0,9
Grapes	5,1	2,55	7,65	2,55	5,1
Raisins	1	0,5	1,5	0,5	1
Watermelon	17,2	8,6	25,8	8,6	17,2
Cranberries	0,3	0,15	0,45	0,15	0,3
Peach	11,6	5,8	17,4	5,8	11,6
MILK (excluding butter)					
Skim milk less than 1%	29,5	19,7	14,8	19,7	14,75
Milk 1-2%	80,7	53,8	40,4	53,8	40,35
Whole milk more than 2%	45,6	30,4	22,8	30,4	22,8
Fermented milk less than 1%	8,5	5,7	4,3	5,7	4,25
Fermented milk 1-2%	14,4	9,6	7,2	9,6	7,2
Fermented milk more than 2%	44,1	29,4	22,1	29,4	22,05
Cream low fat (lower than 29%)	6,6	4,4	3,3	4,4	3,3
Cream high fat (higher than 29%)	8,3	5,5	4,2	5,5	4,15
Sourcream 12%	1	0,7	0,5	0,7	0,5
Sum cheese (from dairy milk)	46,8	31,2	23,4	28,1	23,4
Small ruminant cheese	0	0	0	3,1	0

Whole milk evaporated	1,3	0,9	0,7	0,9	0,65
Whole milk powder	1,8	1,2	0,9	1,2	0,9
Skim milk powder	0	0	0	0	0
Skim milk condensed	0,3	0,2	0,2	0,2	0,15
Ice cream dairy based	8,1	5,4	4,1	5,4	4,05
MEAT					
Bovine meat	39,9	20	13	13	10
Mutton/goat meat	2,9	1,5	1	1	1,5
Pig meat	60,6	30,3	0	6,06	30,3
Total red meat g raw meat/day	103,4	51,7	14	28	42
Poultry	49,5	24,8	0	9,9	49,5
Other meat	0	0			
OFFALS					
Offals	0,6	0,6	0,6	1,2	0,6
EGGS					
Eggs	29	25	13	25	25
BLUE FOOD					
Wild caught (freshwater - Arctic char)	9,2	3,1	4,6	9,2	9,2
Coldwater Farmed fish (carp)	0	3,1	4,6	4,6	0
Warmwater Farmed fish (tilapia)	0	3,1	4,6	4,6	0

Torsk (cod)	6,5	3,3	6,5	0	6,5
Sill (Herring)	4,5	4,5	4,5	4,5	4,5
Tuna	1,7	0,9	1,7	0	1,7
Wild caught Salmon	0,2	0,1	0	0	0,1
Farmed Salmon	9	0,3	0,3	0,1	0,3
Sea bass	2,4	2,4	2,4	2,4	2,4
Shrimp and crayfish	5,5	5,5	2,7	11	5,5
Mackerel	0,7	1,4	1,4	0,7	0,7
Mussels and oysters	0,7	6,8	10,3	10,3	0,7
Crustaceans	0,7	0,7	0,7	0,7	0,7
PULSES					
Soy foods	1	40,3	32	1	64,6
Peanuts	6,4	10,2	10,2	13,4	10,2
Beans, dry (common beans)	0,7	1,4	1,4	4,8	1,4
Peas, dry (yellow peas)	4,5	9	9	24	9
Broad beans and horse beans, dry	0	0	0	24	0
Chick peas, dry	0,3	0,6	0,6	0,3	0,6
Lentils, dry	0,6	1,2	1,2	1,2	1,2
Lupin, dry	0	0	0	3	0
Grey pea, dry	0	0	0	3	0
OILCROPS					
Soybeans	1	2	2	1	9
Groundnuts, shelled	0,5	1	1	0,5	1
Prepared groundnuts	2,2	4,4	4,4	2,2	4,4
Peanut butter	0,6	1,2	1,2	0,6	1,2
Sunflowerseed	0	0	0	7	0
Coconuts, in shell	0,1	0,2	0,2	0,1	0,2
Coconuts, desiccated	0,4	0,8	0,8	0,4	0,8
Olives	2,6	2,6	2,6	2,6	2,6
TREENUTS					
Treenuts and products	5,4	5,4	10,8	14,4	5,4
Chestnuts, in shell	0,1	0,1	0,2	0,1	0,1
Walnuts, in shell	0,1	0,1	0,2	1	0,1
Pistachios, in shell	0,1	0,1	0,2	0,1	0,1
Cashews, shelled	0,5	0,5	1	0,5	0,5
Almonds, shelled	1,4	1,4	2,8	1,4	1,4
Walnuts, shelled	0,7	0,7	1,4	7	0,7
Hazelnuts, shelled	0,2	0,2	0,4	2	0,2
Prepared nuts	2,3	2,3	4,6	2,3	2,3
VEGETABLE OILS					
Palm oil	15	5	5	5	5
Total unsaturated oils	21,53	27,53	27,53	27,53	29,05
Soybean oil	0,08	0,08	0,08	0,08	10
Groundnut oil	0,02	0,02	0,02	0,02	0,02

Sunflowerseed oil	8,2	8,2	8,2	8,2	6,62
Rapeseed oil	6	12	12	12	5,93
Sesameseed oil	0,03	0,03	0,03	0,03	0,03
Olive oil	2,8	2,8	2,8	2,8	2,35
Vegetable oil other	4,4	4,4	4,4	4,4	4,1
ANIMAL FATS					
Animal fats	2,39	2,39	2,39	2,39	2,39
Butter	15,3	10,2	7,65	10,2	7,65
SWEETENERS					
Sugar	74	18,5	18,5	18,5	18,5
Sweeteners	2,9	0,7	0,7	0,7	0,7
Honey	1	1	1	1	1
ALCOHOLIC BEVERAGES					
Total grams of alcohol	20,3	13,5	13,5	13,5	13,5
glasses of wine per week (13,5 cl/glass)	3,5	2,3	2,3	2,3	2,3
glasses of beer (33 cl/glass)	2,7	1,8	1,8	1,8	1,8
glasses of vodka (4 cl/glass)	1,4	0,9	0,9	0,9	0,9
Wine	67,4	44,9	44,9	44,9	44,9
Barley beer	125,5	83,7	83,7	83,7	83,7
Apple cider	6,9	4,6	4,6	4,6	4,6
Vodka	7,9	5,3	5,3	5,3	5,3

STIMULANTS					
Coffee, roasted	20,5	10,25	10,25	10,25	10,25
Coffee extractives	1,1	0,55	0,55	0,55	0,55
Cocoa powder	6,3	3,15	3,15	3,15	3,15
Chocolate, solid	21	10,5	10,5	10,5	10,5
Candy (sugar-based)	21	10,5	10,5	10,5	10,5
TEA & products	1,3	0,65	0,65	0,65	0,65
SPICES					
Total spices	3,02	3,02	3,02	3,02	3,02
Pepper	0,4	0,4	0,4	0,4	0,4
Pimento	0,5	0,5	0,5	0,5	0,5
Cloves	0,02	0,02	0,02	0,02	0,02
Herbs	2,1	2,1	2,1	2,1	2,1
MISCELLANEOUS					
Instant food	0,56	0,56	0,56	0,56	0,56
Miscellaneous	19,8	19,8	19,8	19,8	19,8
WILD FOOD					
Moose and deer	3,9	3,9	3,9	3,9	3,9
Wild boar	1,2	1,2	1,2	1,2	1,2

Reindeer	0,1	0,1	0,1	0,1	0,1
Berries	3,9	3,9	3,9	7,8	3,9
Mushrooms	0	0	0	4,2	0
ALTERNATIVES					
Legume-based meat (non-soy, made from yellow pea)	0	38	10	0	0
Soy protein products (soy)	0	38	30	0	46
Other plant-based meat (seitan)	0	0	10	0	0
Plant-based dairy (oat-based)	0	120	0	0	120
Cellbased meat (sugar)	0	0	60	0	0
Cellbased dairy (sugar)	0	0	150	0	0
Fungi based meat (Quorn) from hydrolyzed wheat	0	0	10	0	0
Tempeh (faba beans)	0	0	0	10	0
Tofu (soy)	0	0	0	0	10
Tofu (faba beans)	0	0	0	10	0
Cell-based fish (cultured meat)	0	0	5	0	46
Microbial fats (yeast)	0	0	3,75	0	0
Microbial fat (algae)	0	0	3,75	0	0
Microbial egg (sugar)	0	0	12	0	10

Appendix C: Cooking method assumptions

This appendix shows the references for data on the distribution of the cooking methods used for different foods, as well as any assumptions made, whether additional to the referenced data or as sole basis of the numbers used in the calculations.

Appendix Table 6. Methods of cooking: References and assumptions. All raw consumption amounts are omitted from calculations as they do not contribute to energy spent during cooking. In this instance, raw is considered anything that is not heated during cooking but can have been previously heated in industrial processing.

Food category	Reference	Assumptions
Wheat, Barley, Maize, Rye, Oat	Amcoff, E., Edberg, A., Enghardt Barbieri, H., Lindroos, A., Nälsén, C., Pearson, M. & Warensjö Lemming, E. (2012). Livsmedels- och näringsintag bland vuxna i Sverige. Riksmaten-vuxna 2010–11. *National Food Agency*. + RAC (raw agricultural commodity) tables to assume ingredients of recipes	Cooking methods determined by occurrence of food in food item. Ex.: wheat in spaghetti is boiled.
Rice, Quinoa		100% boiled
Flour of mixed grain		Average of other grains
Potatoes and potato products	Amcoff, E., Edberg, A., Enghardt Barbieri, H., Lindroos, A., Nälsén, C., Pearson, M. & Warensjö Lemming, E. (2012). Livsmedels- och näringsintag bland vuxna i Sverige. Riksmaten-vuxna 2010–11. *National Food Agency*. + RAC (raw agricultural commodity) tables to assume ingredients of recipes	Cooking methods determined by occurrence of food in food item. Ex.: baked potato is baked.
Sweet potatoes		As potatoes

Beetroot		As vegetables
Vegetables and fruits	Produce consumption in the United States: an analysis of consumption frequencies, serving sizes, processing forms, and high-consuming population subgroups for microbial risk assessments. K. Hoelzer, R. Pouillot, K. Egan and S. Dennis. Journal of food protection 2012 Vol. 75 Issue 2 Pages 328-340.	Heated vegetables: 30% boiled, 30% fried, 30% baked, 10% grilled Heated fruits: 50% boiling, 50% baking
Milk products (excluding butter)	Amcoff, E., Edberg, A., Enghardt Barbieri, H., Lindroos, A., Nälsén, C., Pearson, M. & Warensjö Lemming, E. (2012). Livsmedels- och näringsintag bland vuxna i Sverige. Riksmaten-vuxna 2010–11. *National Food Agency*.	Cream: for "raw" cream, it is assumed 60% cooked in dishes, see chapter 3.5.1 explanation, and 40% raw consumption.
Meat and fish	Cooking of meat and fish in Europe—results from the European Prospective Investigation into Cancer and Nutrition (EPIC). S. Rohrmann, J. Linseisen, N. Becker, T. Norat, R. Sinha, G. Skeie, et al. European Journal of Clinical Nutrition 2002 Vol. 56 Issue 12 Pages 1216-1230. DOI: 10.1038/sj.ejcn.1601494. https://doi.org/10.1038/sj.ejcn.1601494.	
Offals		As meat
Eggs	Hanna	
Pulses		80% boiled, 15% baked, 5% fried
Oil crops		Soybeans as pulses, groundnuts and peanut butter, sunflower seeds as treenuts. Coconuts consumption considered 100% raw. Olives 80% raw, 20% cooked.
Treenuts	Consumer knowledge and handling of tree nuts: food safety implications. L. E. Lee, D. Metz, M. Giovanni and C. M. Bruhn Food Protection Trends 2011 Vol. 31 Issue 1 Pages 18-27	Use of table 6 in Lee et al. (2011) to create frequency percentages of baked, roasted, fried and raw. Roasted considered 50% roasted, 50% fried due to possible pan-roasting of nuts.

Vegetable oils		60% cooking, 35% baking, 5% raw.
Animal fats		Butter: 40% raw, 50% baking, 10% frying Animal fats: 100% frying
Sweeteners		Sugar is 65% baked, 25% cooked, 10% raw. Other sweeteners assumed 100% raw.
Alcoholic beverages	All glögg sold 2014-2023: https://www.omsystembolaget.se/imagevault/publishedmedia/f8ys07udn9acim4hgop6/Jul_-_ny-r_2023.pdf All alcohol sold 2023: https://www.omsystembolaget.se/imagevault/publishedmedia/kbtsn18yd4o1lbnkn5vj/2023Q4_Varugrupp.pdf	Only glögg is assumed heated. Average glögg sales of past 10 years, 2014-2023 (2 655 000L) divided with average sale of all alcohol sold 2023 (555 519 000 L) to determine heated portion of alcohol.
Stimulants		Coffee assumes boiled water 100% Cocoa powder assumes baked 50%, cooked 25% and 25% cold consumption Chocolate assumes 98% raw and 2% melted/baked.
Tea & products		Assumes boiled water 100%
Spices		Omitted as they are the same across all scenarios and current consumption.
Miscellaneous		Omitted as they are the same across all scenarios and current consumption.
Alternatives		Plant based dairy as dairy products. Plant based meat products, tofu and microbial products assumed 60% fried, 30% cooked, 10% baked.

Appendix D: Energy consumption of food groups

This chapter contains the data on the energy consumption of food groups.

Appendix Table 7. Energy consumption of food groups in percentages.

Food group	Current Swedish diet	Food as Industry	Food as Food Tech	Food as Culture	Food Forgotten
Cereals (excluding beer)	13.6%	17.2%	18.1%	20.7%	17.8%
Starchy roots	13.7%	12.4%	12.8%	14.7%	11.4%
Vegetables	11.8%	22.8%	24.3%	23.2%	14.2%
Fruits (excluding wine)	3.2%	2.9%	4.5%	3.8%	2.6%
Milk (excluding butter)	2.3%	1.4%	1.1%	1.7%	1.0%
Meat	32.9%	15.0%	1.8%	7.0%	20.7%
Offal	0.1%	0.1%	0.1%	0.2%	0.1%
Eggs	2.7%	2.1%	1.1%	2.5%	2.0%
Blue food	2.6%	2.4%	3.1%	3.9%	2.0%
Pulses	1.2%	5.0%	4.5%	7.1%	6.4%
Oil crops	0.3%	0.5%	0.5%	0.7%	1.0%
Tree nuts	0.5%	0.5%	1.0%	1.5%	0.4%
Vegetable oils	5.3%	4.3%	4.5%	5.1%	4.2%
Animal fats	1.6%	1.1%	0.9%	1.3%	0.8%
Sweeteners	6.5%	1.5%	1.5%	1.7%	1.4%
Alcoholic beverages	0.1%	0.0%	0.0%	0.0%	0.0%
Stimulants	0.7%	0.3%	0.3%	0.4%	0.3%
Tea & products	0.0%	0.0%	0.0%	0.0%	0.0%
Wild food	0.9%	0.8%	0.8%	1.7%	0.7%
Alternatives	0.0%	9.8%	18.9%	2.9%	13.0%

Appendix Table 8. Energy consumption of food groups in MJ/day.

	Current	Industry	Tech	Culture	Forgotten
Cereals (excluding beer)	0.765	1.065	1.084	1.090	1.202
Starchy roots	0.771	0.767	0.767	0.771	0.771
Vegetables	0.665	1.413	1.450	1.222	0.957
Fruits (excluding wine)	0.178	0.178	0.267	0.201	0.178
Milk (excluding butter)	0.132	0.088	0.066	0.088	0.066
Meat	1.850	0.927	0.105	0.367	1.398
Offal	0.006	0.006	0.006	0.012	0.006
Eggs	0.153	0.132	0.069	0.132	0.132
Blue food	0.147	0.149	0.188	0.204	0.137

Pulses	0.067	0.313	0.271	0.372	0.434
Oil crops	0.015	0.029	0.029	0.035	0.064
Tree nuts	0.029	0.029	0.059	0.078	0.029
Vegetable oils	0.300	0.268	0.268	0.268	0.280
Animal fats	0.088	0.067	0.056	0.067	0.056
Sweeteners	0.365	0.091	0.091	0.091	0.091
Alcoholic beverages	0.003	0.002	0.002	0.002	0.002
Stimulants	0.039	0.020	0.020	0.020	0.020
Tea & products	0.001	0.000	0.000	0.000	0.000
Wild food	0.048	0.048	0.048	0.089	0.048
Alternatives	0.000	0.606	1.129	0.150	0.876
Sum	5.624	6.197	5.974	5.260	6.747

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