SAVING THE WORLD, ONE PLATE AT A TIME?

ACCELERATING A GREEN CONSUMER BEHAVIOUR TRANSITION IN THE FOOD MARKET

Saving the world, one plate at a time? - Accelerating a green consumer behaviour transition in the food market.
Final report of the PlantPro project funded by Innovation Fund Denmark 2021-2024, a research collaboration of AU, CBS, and KU.
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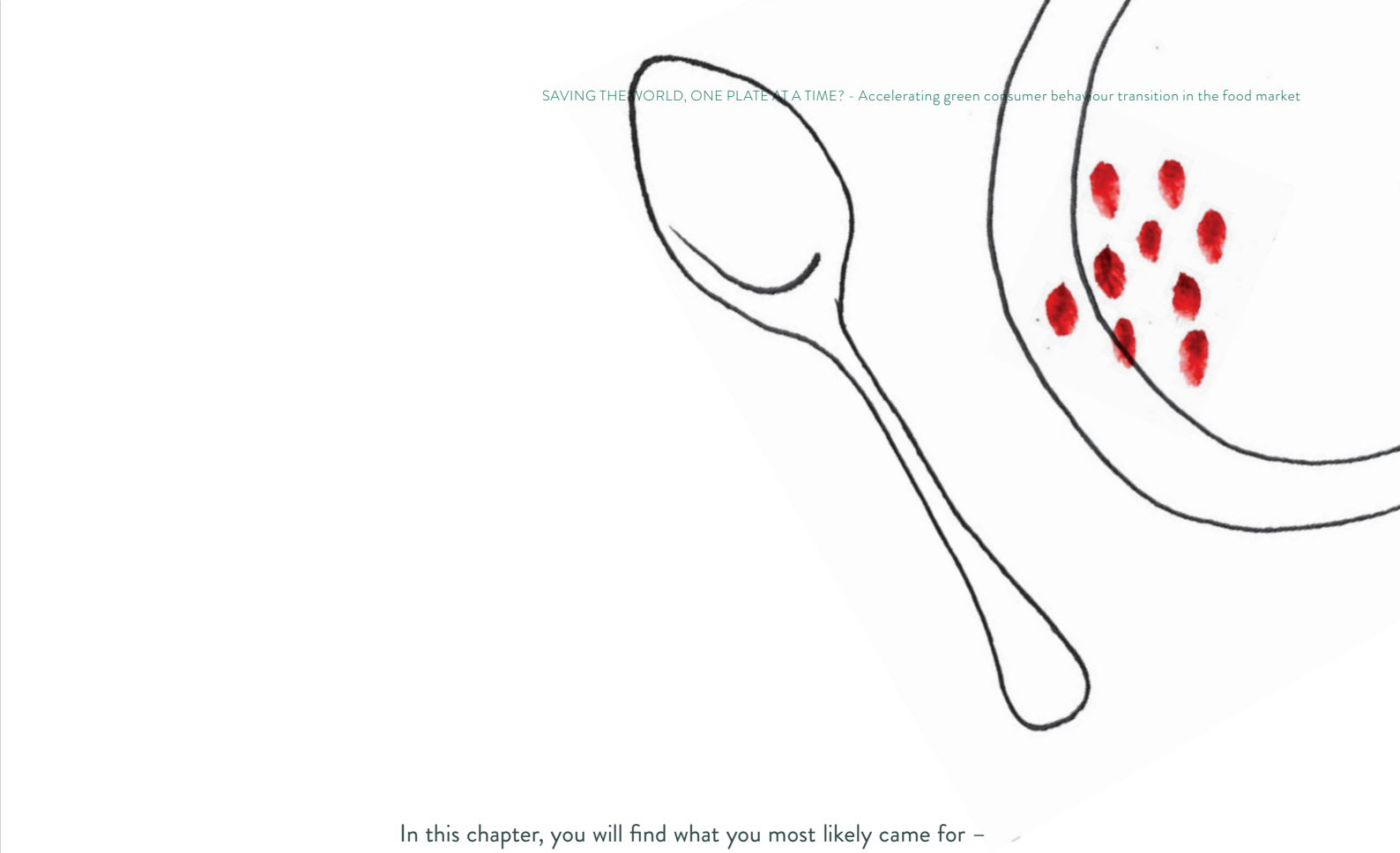
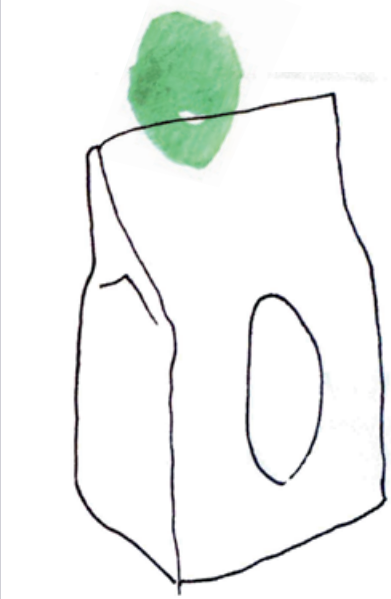
TABLE OF CONTENTS

This report is part of the project 'PlantPro– Accelerating an efficient green consumer transition' funded by Innovation Fund Denmark. See more details about the project after the summary.

WHAT AND WHY





In this chapter, you will find what you most likely came for – an executive summary. Here we list our **3 major conclusions and 10 recommended actions.**

However, please also check the section on **the project** to understand where this comes from and read through our explanation of **why we should accelerate** a 'green consumer behaviour transition' in the food sector. We are passionate about the fact that **social science has a role** to play, and here we have condensed those important arguments for you!

Not least, please also check out the key concepts section – this is a very condensed summary of the **science of change** in behaviour and markets which is the core behind the project.

So yes, summing up, admittedly, we would love for you to read the whole 'background' that we present in this chapter.

EXECUTIVE SUMMARY

The PlantPro project aimed at researching the acceleration of an efficient green consumer behaviour transition in the food sector, with a major focus on more plant-rich diets. It is a research project funded by Innovation Fund Denmark which ran from the first of April, 2021 to December, 2024.
Social scientists focusing on the food sector from three Danish universities, including Aarhus University, Copenhagen Business School, and the University of Copenhagen, collaborated with 16 partners – sector representatives from large and small companies, retailers, NGO´s, think tanks, and network organisations. As such, the project is **unique in its focus on market and behaviour, and the way it brings together a broad range of stakeholders.**

The research in the project explored previous and ongoing **food sector transitions**, consumer-citizen **behaviour changes and perception** across different segments, and the actions to **nudge, inform, or motivate** behaviour change in different public and private choice contexts.
This research was built on **well-studied theories** of sector sustainability transitions and social tipping, as well as a broad range of behaviour change theories. **Diverse methods** were used, ranging from case studies and expert interviews, to repeated representative surveys following trends over time, and experimental online surveys looking at specific mechanisms of change, to finally lab and real-life experiments looking at household, canteen, and supermarket behaviours.

As a practical implication, the project delivers a **catalogue of marketing and policy actions** that can contribute to accelerating an efficient green consumer behaviour transition in the food sector. We list and describe this catalogue on the next pages.

We have three major conclusions.

The first is about the **status** of change. The second is about the **road** from here. The third is about the range of **actions** for both immediate and sustained effects.

1 /
THE STATUS

A lot has changed during the past years in the food sector when it comes to sustainability in general and plant-based in particular. Many stakeholders and policy makers have a motivation to act. But when it comes to a green consumer behaviour transition, **there is *neither* an acceleration *nor* a social tipping point** in view in Denmark at this point. There are well-established niche consumer groups, yes, but in terms of upscaling to more plant-rich eating that could have a major effect on reducing the environmental impact of diets across the board, there is a stagnation at best.

2 /
THE ROAD FROM HERE

Acceleration and upscaling of green consumer behaviour transition **needs *more* marketing and policy actions**, and these actions should be characterised by the following three C´s:

a. Collaboration across the sector and all stakeholders,

b. Combination of different consumer-directed measures to appeal to different consumers and different drivers of consumer behaviour,

c. Co-activation - active public policy engagement and investment and bold action by larger business actors that can potentially trigger cascading effects.

3 /
THE ACTIONS

Based on the project's insights and the state of research on the project topic, we suggest distinguishing between **'immediately effective actions'** (approaches and measures that can be taken right away and can start having an effect now) for the short run, and **'sustained effect actions'** (approaches and measures that might not have an effect right away but are important for building and sustaining long-term plant-rich dietary habits) for the long run. We suggest five actions for immediate effect and five actions for sustained effect.

IMMEDIATELY EFFECTIVE ACTIONS:

1 / Always (always!) remember plant-rich is eating diverse.

Because consumers and consumption contexts are so diverse, it needs a diverse set of solutions. Solutions span from vegetables to replacement products to legumes and back. This way, there is always an affordable option as well as a convenient option, depending on what a certain consumer wants or needs in a specific situation. In any case, diversity is also what the nutritional guidelines recommend. Help to ensure that eating plant-rich is not perceived by consumers as just 'fancy patties' or 'only oat milk'. Present and talk about the whole range of what it means, in order to appeal to a whole range of consumers.

2 / Give (more) centre stage to legumes.

Despite their potential role in the diet, legumes are undertalked and under-represented right now. Plant-based 'alternatives' get more attention – even though they are only part of the solution. Vegetables and legumes suffer from the fact that there are less likely profitable margins and patentable innovations – thus, it needs action to support such categories. It is possible to 'nudge' consumers to notice and choose legumes in retail and food service. This implies that legumes need to get more and better shelf space in retail and active marketing, that we need more professional kitchens with improved capability to use them, and that legumes need research innovations for even better variants and products. Research shows many consumers prefer legumes – and if the products also taste good, consumers have double the reason to prefer the product.

3 / Go 'all in' with the nutritional guidelines.

Nutritional dietary guidelines are already here. They say that consumer-citizens do not need to change their diets radically or switch their dietary identity. Complying with the nutritional guidelines means eating better and healthier – and for many, this is just a bit. 'All in' means using the nutritional guidelines more actively by all stakeholders and in all contexts, in order to help citizens in Denmark to eat in line with the recommendations. Research shows many consumers prefer reducing meat consumption – and using the recommendations means establishing reduced meat meals in work and school canteens and promoting the reduction of meat in supermarkets. This can have a triple win for health, costs, and the environment.

4 / Help consumers to cross the gap.

It is not eating a more plant-rich diet that is difficult – it is the process of change that is hard. Habits are strong, and so they can be, once they are changed. The gap to getting there needs to be closed. Here is where all stakeholders can help – by collaborating across the sector on concerted actions that provide an opportunity for consumers to move from intention to behaviour. Campaigns like Veganuary or the Green January are such an opportunity, and research shows that campaigns and interventions of this type can in fact change dietary patterns and the perception of barriers to the better. These concerted actions invite consumers to 'challenge' themselves – reminding them of their intentions and helping to put these into practice by making it much easier to do so for a period of time.

5 / Talk up taste (AND walk up taste).

It is better to name plant-based products for what they are – not for what they are not. That means name it after their taste giving ingredients or the taste experience – not necessarily for being alternatives and for being vegan or vegetarian. Research shows that taste expectation and experience means a lot for plant-based product choice. The alternatives (in the sense of replacement products) are one part of the solution, and when looking for this type of product, the main consumer motivations are good taste and easy convenience. Thus, it is best to underline taste in communication – AND to actually make sure the taste is up to speed with respective innovations.

SUSTAINED EFFECT ACTIONS:

1 / Long-term partnership for legumes.

The past has shown that cross-sector and public-private partnerships for specific aims – such as promoting legumes - can be very successful. Therefore such a partnership for legumes is a really good idea. Stakeholders can exchange knowledge and experience, thereby reducing risks of action, and coordinate towards a common goal over a longer period of time. These collaborations can work towards a sustained consumer behaviour change by building new habits and norms. Many small actions can contribute to that change, such as including learning to cook with legumes already in primary school as part of the already existing food knowledge classes (Madkundskab).

2 / Shape the system.

Individual behaviour change alone is not enough. Just giving information and do nudging is not enough. It is also important to shift the agricultural and food system. There needs to be enough options at competitive and affordable prices available at the consumer end. The path thereto – whether via changes in production subsidies, regulations, taxes, diversified value added tax, or retailers changing profit margins and price promotion priorities – does not necessarily matter for the consumer. What counts is the comparison at the point of sale. Over time, this can also alleviate the high price expectation towards plant-based foods, provide a rationale for more consumers to try plant-based foods, and 'normalise' plant-based foods as an option.

3 / Address societal polarisation.

There are always different types of consumer groups with different interests. However, it is not helpful for large-scale change if there is polarisation between different societal groups. It is not helpful if identity conflicts become a barrier for change. Polarisation hinders the dissemination and uptake of new ideas. Sector stakeholders and civil society need to have an eye on avoiding this by having a balanced discussion, open dialogue, and products and solutions for different consumer groups.

4 / Improve food capability and food literacy.

Supporting continued and improved knowledge about food, how to 'deal' with food, as well as enjoy food can have a sustained effect on establishing more plant-rich eating. This can include for example knowledge about and experience with how to use legumes, cook from scratch, creatively use leftovers, and store vegetables. Not all consumers are motivated at all times to be involved with food, but shaping a system where basic food knowledge and competences are easily learnt and ingrained is a good basis for more plant-rich dietary habits in the long run.

5 / Underline the environmental impact.

Consumers are aware of the differences in environmental impact of foods. However, the degree to which there is a difference might often be underestimated. What might be also underestimated by consumers is how big an impact the sum of all behaviour change can have, and how urgent environmental issues globally require our action. Therefore, underlining the magnitude that dietary behaviour change can have on environmental issues can support consumers motivation to act.

WHAT OTHERS SAY ABOUT THIS REPORT

"This report is an engaging and dynamic read, inviting the reader to actively participate in driving the much-needed transformation of our food system. It offers a comprehensive and up-to-date overview of pivotal research to support the shift toward plant-based eating and a more sustainable food future. By looking ahead, the report provides clear and actionable recommendations—both short- and long-term—on how to inspire change across various actors within the food supply chain.

A key strength lies in its emphasis on collaboration, underlining the critical need for diverse stakeholders to work together to achieve meaningful progress. PlantPro's focus on consumer food choices and behavioural change highlights the vital role of the social sciences in shaping this transition. Changing how we eat is no small feat—it means meeting diverse consumers at multiple decision points and addressing deeply ingrained values and beliefs. Yet, the report underscores a powerful truth: change is possible when we cultivate a shared motivation to act.

One important takeaway is the call to strengthen food literacy and cooking skills in children and adolescents, empowering future generations to make informed, sustainable choices. Equally important is its caution against "information overload" at points of sale—an overload that risks alienating consumers rather than engaging them.

In uncertain times, when the belief that individual choices can make a difference feels fragile, this report serves as a hopeful reminder: every plate is an opportunity. By equipping consumers with knowledge, skills, and confidence, and fostering systemic collaboration, we can turn challenges into opportunities and create a food culture that's both sustainable and empowering. Together, we can move toward a future where greener choices are not just possible—they become the default."

Dr. Antje Gonera is a senior scientist at the Norwegian food research institute Nofima in the Department of Innovation, Consumer and Sensory Science and leads the strategic research programme on innovation, consumer science and food technology. She has her Master's and PhD in Food Science (Germany, USA, Japan) and an MBA in Innovation Studies. Dr. Gonera previously has had international roles in the consumer goods industry, biotechnology, and consulting spanning from product and technology development, consumer research, innovation management, supply chain optimization, to organizational improvement. Her research focus is on the implementation and understanding of the use of design thinking, user focus, and system-oriented design into transdisciplinary academia-industry research collaborations. Many of her projects centre around facilitating the transition to a more sustainable food system including increased consumption of plant-based food.

"The urgent need to transition from meat-dominated to more plant-based diets is crucial for enhancing environmental sustainability and public health. However, changing dietary habits is challenging, especially when current unsustainable behaviors are deeply embedded in our physical, economic, and social environments. This underscores the importance and timeliness of the PlantPro report.

The PlantPro report and its research offer several key contributions:

***1.** Current trends: It provides a comprehensive and up-to-date assessment of recent trends in plant-based food consumption in Denmark, highlighting that the shift away from meat is happening far too slowly.*

***2.** Barriers to change: The report convincingly outlines the perceptual, behavioral, organizational, and political barriers to plant-based food consumption in Denmark. While these barriers are substantial, they can and must be overcome.*

***3.** Actionable recommendations: It presents strong, research-backed recommendations for immediate and long-term actions to accelerate the adoption of more plant-based diets in Denmark. Importantly, these recommendations call for more ambitious and better-targeted political and organizational initiatives, abandoning the notion that all consumers are alike.*

Given the food system's substantial role in contributing to severe environmental problems, we urgently need to increase the consumption of plant-based foods. The PlantPro report provides a clear roadmap for making this happen in Denmark."

Kristian Steensen Nielsen is an Assistant Professor at the Department of Management, Society and Communication, Copenhagen Business School. Kristian's research focuses on the role of behavior change in mitigating climate change and conserving biodiversity. He is particularly interested in understanding how individual behavior changes can contribute to limiting climate change, identifying effective and scalable behavior change interventions, and understanding how to increase the feasibility of transformative climate initiatives. His research is rooted in quantitative environmental psychology and behavioral science but with an interdisciplinary outlook. Before joining Copenhagen Business School, he was a postdoctoral researcher in the Departments of Psychology and Zoology at the University of Cambridge.

THE PLANTPRO PROJECT

The project PlantPro contributes to accelerating an efficient green consumer behaviour transition towards more plant-rich diets and reduced food waste. It aims to fill a knowledge gap on factors that drive consumer behaviour change towards more sustainable plant-rich diets and upcycled foods and greater acceptance of sustainable food technologies.

PlantPro is funded by Innovation Fund Denmark under Project nr 0224-00044B. The project ran for over three years, from 1 April 2021 to 31 December 2024. The project is a collaboration between the MAPP Centre at the Department of Management at Aarhus University, Department of Food Science at University of Copenhagen, Copenhagen Business School, Plantebranchen, Dansk Vegetarisk Forening, Thinktank OneThird, Simple Feast, Beyond Coffee / MicroGreens, Circular Food Technology / Agrain, Møllerup Brands / Dava Foods, Food Innovation House, Orkla, Naturli, Planteslagterne / Perfect Season, Upfield, Eachthing / Data Context, Rema1000, Fair Trees, and Nemlig.com.

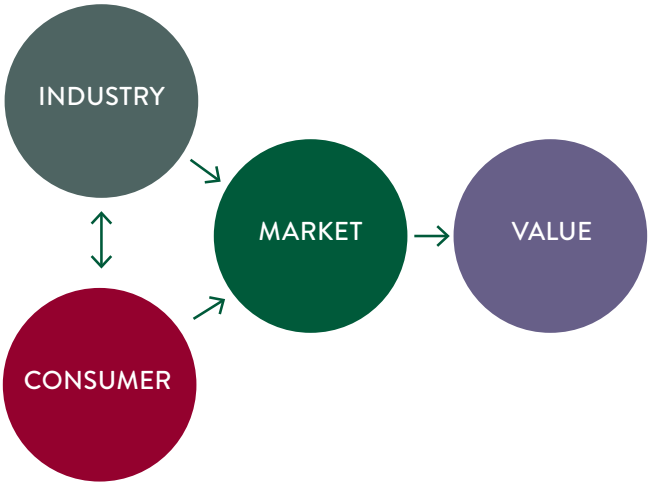
Throughout the project, PlantPro identifies key success factors in industry and societal transitions, maps consumer factors that determine acceptance and behaviour across consumer lifestyle groups, assesses environmental impact, and measures the effect of nudging, information, and motivation on behavioural change in public and private settings under real-life context. It delivers a catalogue of marketing and policy actions.

The commercial value created consists of market growth for innovative plant-based food and food upcycling businesses. The societal value created consists of the achievement of climate targets and sustainable development goals. The overall goal is to contribute to the development that a greater share of the broader population consumes more plant-rich diets in ways that at the same time reduce food waste in the system.

The work package structure focuses on the industry (WP1), the consumer (WP2), and the interplay of both in the market (WP3). WP4 consists of the management of the project, and WP5 entails communication and implementation.

WP1 aims to identify which key success factors shape sustainable industry and societal transitions in the food and other sectors, in Denmark and abroad. WP2 aims to map the consumer factors that determine the acceptance and behaviour across different consumer lifestyle groups, and the respective environmental impact of it. WP3 aims to assess the impact of actions to nudge, inform or motivate behaviour change among consumers in different public and private choice contexts.

See more at **https://mgmt.au.dk/plantpro**



Innovationsfonden

WHY SHOULD WE ACCELERATE?

Why should we accelerate a 'green consumer behaviour transition' in the food sector?

Most of us are aware of the need for change in how humanity manages production and consumption. We are aware of this as actors in the economic sector, as policy makers, and as citizens and consumers. The reports of the Intergovernmental Panel on Climate Change (IPCC) have informed us about the growing severity of climate warming for years (IPCC, 2023). The concept of the planetary boundaries shows which and how much planetary ecosystems are under strain from human resource use (Richardson et al., 2023). We might, however, differ in how transformative a change we envision, how pessimistic or optimistic we are about the success, and which pathway or scenario we think is best.

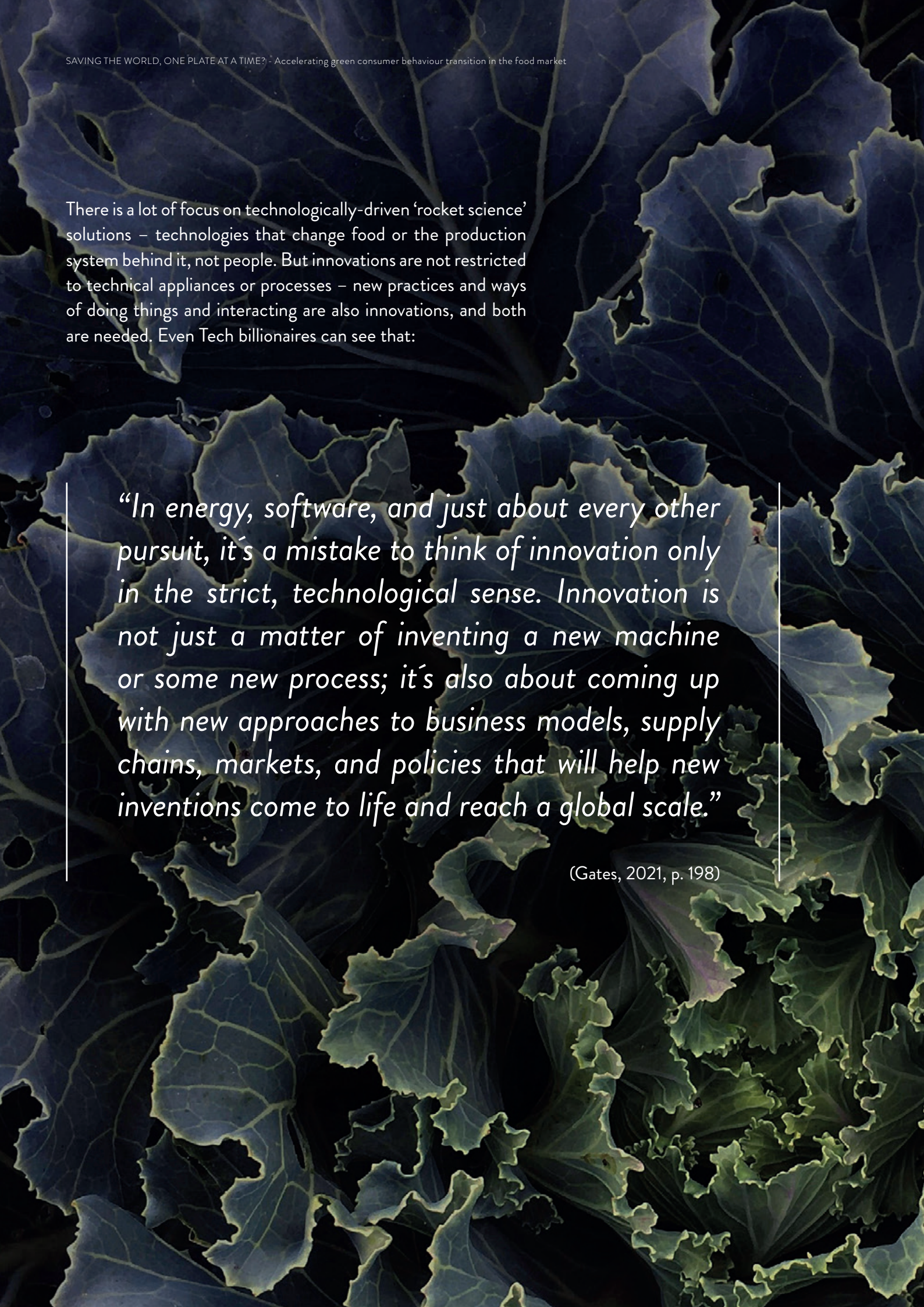
The agricultural and food sector is a crucial and central sector for future environmental and social sustainability. Nearly all of the sustainable development goals agreed on by the UN have a relation to the food system. The agricultural and food sectors account for roughly a third of greenhouse gas (GHG; Crippa et al., 2021; Foley et al., 2011), they are the main cause of biodiversity loss and of imbalances of the nitrogen and phosphorous cycle, they majorly drive land-use change, they require freshwater for irrigation purposes, and they contribute to introducing 'novel entities' such as pesticides into natural systems (Richardson et al., 2023). At the same time, poor rural or urban communities depending on subsistence agriculture or affordable food prices are hit the hardest when climate warming affects agricultural production potential and destabilises food supply chains (Kraak & Aschemann-Witzel, 2024).

One decade ago, a group of scholars picked up on the idea of 'solution wedges' (Pacala & Socolow, 2004), they applied it to the agriculture and food sector, and they defined what they called 'food wedges' (Keating et al., 2014). These researchers suggested that there is a triangle-shaped gap between future sustainable production levels and currently projected demand curves, which should be closed by essentially three equally important types of strategies: 1) avoid losses (e.g. combating soil degradation, adapt to climate warming), 2) fill the production gap (e.g. innovate systems and optimise yields), and 3) reduce demand (e.g. reduce waste and overconsumption and shift to lower-impact foods). This report is about accelerating the latter.

The call for accelerating a green consumer behaviour transition in the food sector is based on the fact that a large-scale shift in demand has a considerable role to play. The IPCC assessed that demand-side mitigation in the food sector can decrease its GHG emissions by 44% (IPCC, 2023). Given that plant-based foods have a substantially lower footprint than most animal-based foods (Clark et al., 2022; Poore & Nemecek, 2018), a dietary shift towards more plant-rich diets is assessed to be the most impactful change from the consumer side, closely followed by reducing food waste (Hoolohan et al., 2013; Springmann et al., 2018). Ensuring a healthy and sustainable dietary shift, adapted to different local contexts, is crucial (Loken et al., 2024). Global emissions caused by diets are assessed to fall by 17% if a 'planetary health diet' is adopted by all (Li et al., 2024).

A wide range of solutions are discussed for succeeding with the green transition. Some say, though, that it´s not that much a question of what to do, but of actually doing it.

Consider this: Two decades ago, a seminal publication in the renowned journal Science posited about climate warming, stating that "Humanity already possesses the fundamental scientific, technical, and industrial know-how to solve the carbon and climate problem for the next half-century." The researchers suggested to group solutions by similarity in 'wedges', with each of these contributing a share to the goal (Pacala & Socolow, 2004). The goal was that these wedges then jointly would stabilise GHG emission curves to a less destructive, lower level than the projected business-as-usual-curve. In essence, they were saying we 'just' needed to start implementing what we already have.



There is a lot of focus on technologically-driven 'rocket science' solutions – technologies that change food or the production system behind it, not people. But innovations are not restricted to technical appliances or processes – new practices and ways of doing things and interacting are also innovations, and both are needed. Even Tech billionaires can see that:

> *"In energy, software, and just about every other pursuit, it´s a mistake to think of innovation only in the strict, technological sense. Innovation is not just a matter of inventing a new machine or some new process; it´s also about coming up with new approaches to business models, supply chains, markets, and policies that will help new inventions come to life and reach a global scale."*
>
> (Gates, 2021, p. 198)

Eating something different today than yesterday is not rocket science, but simple. In addition, individual consumers have the agency to change. Consumers in affluent countries can decide what they want to eat. They have even more agency in food than in other areas of our lives. When shifting to greener transport or housing, change hinges relatively more on infrastructure. However, habit and behaviour change is perceived as hard and is often slow, which is why there are many attempts to help and 'nudge' citizens towards actions they might actually want to do, but do not get around to doing (Thaler & Sunstein, 2021). Also, with food often being consumed in the family or in company with peers, food choices are done with our social relations and contacts in mind (Hesselberg et al., 2024). But even considering all of that – deciding the content of your next meal is mostly your choice.

When it comes down to what is most sustainable and resilient in the long run, changing mindsets and behaviours is essential. The IPCC report makes it crystal clear that a diversity of both short- and long-term policies are needed. This includes demand-side policies and policies that transform the food system – in a more profound, systemic fashion.

This report provides key insights and resulting recommendations from research across the PlantPro project and sets these insights into the perspective of the respective theory and the state of art of research – while nevertheless keeping it short and simple.

All research examples from this project are about people, food, and markets in Denmark and are aimed at understanding a potential green consumer behaviour change. The focus here is on research insights that can help food sector stakeholders who work on accelerating a shift to a more plant-rich diet, including eating more plant-based products – and there is also a section on the role of upcycling for broadening the plant-based ingredient assortment.

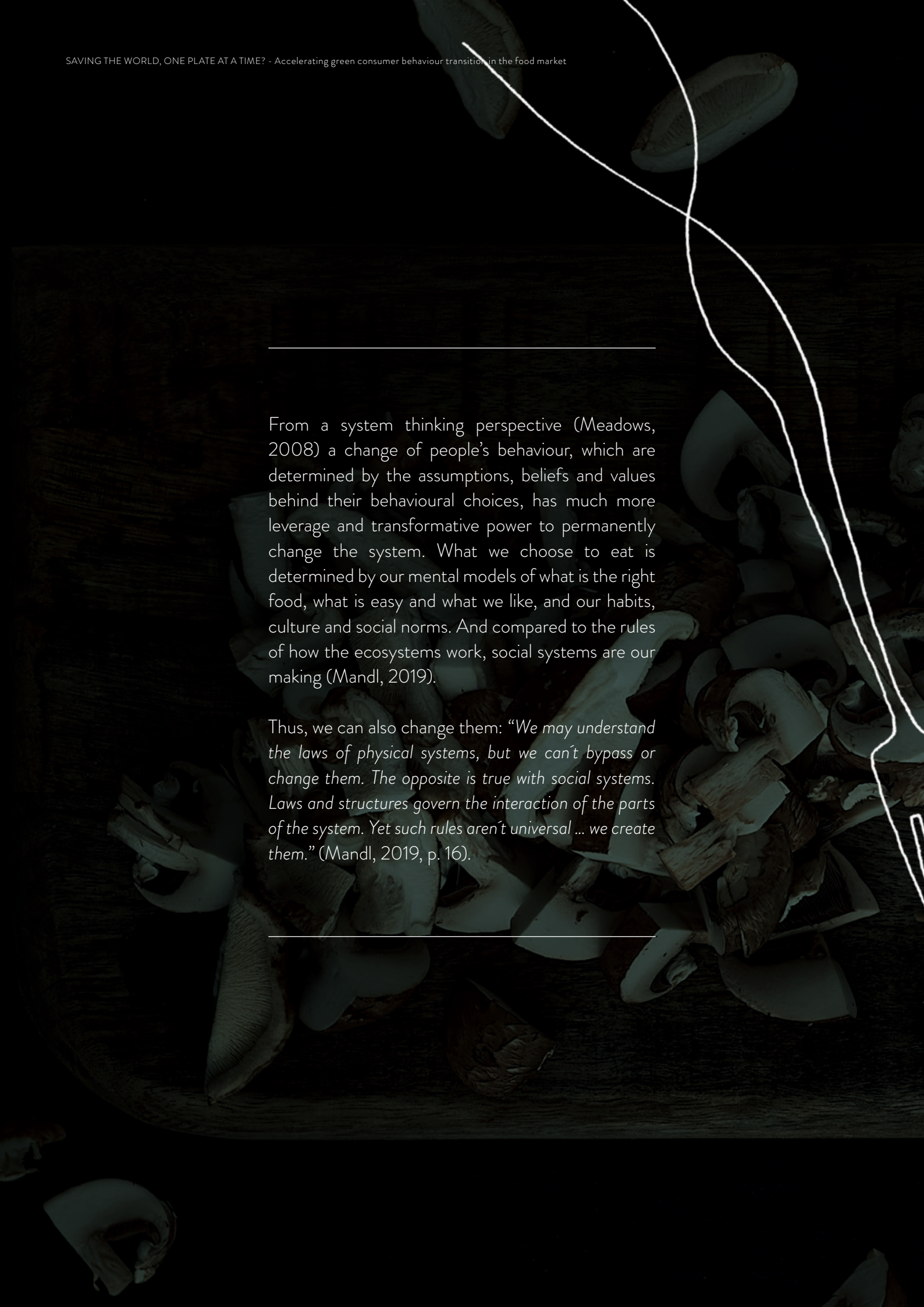
At this point in your reading of this introductory text to the report, we think you might have two questions or even doubts. So let us address these:

First, you might ask yourself: *What do they mean with 'plant-rich' and does this mean the project is against animal-based products?*

In line with the Danish dietary guidelines, a more plant-rich diet does not exclude meat and dairy. Animal-based products deliver important nutrition. More plant-rich means increasing the share of plants in the diet, just as dietary guidelines also recommend. And this can be all kinds of plants, whether 'per se' as vegetables or legumes cooked from scratch, traditional protein alternatives such as tofu or tempeh, or products mimicking meat and dairy. The focus of this report does not exclude that there can be sustainable livestock production systems or animal-based alternative proteins in general – these can be part of a diverse array of potential future solutions, though for environmental and equitable reasons on a much smaller global scale (Li et al., 2024). However, sustainable animal-based products were simply not a part of this project – the project instead focuses on plants. Moreover, the project was funded under the assumption that there is a growing business opportunity in the plant-based market for companies residing in Denmark, both on the home market and abroad.

Second, you might wonder: *Why this focus on behaviour change, when we know that 'the system' is more powerful than individual choice – and attention on behaviour even diverts the focus on changing the 'system'?*

If you are beginning to think this here, then rest assured that the project team agrees with you. You will see that the research tackles both behaviour and system change, with a focus on system change (of the socio-technical regime, the point of sale, the canteen, the food assortment, the marketing, etc.) that helps furthering behaviour change. Both aspects are needed and go hand in hand (Jackson, 2023) - please see the chapter 'key concepts.'



From a system thinking perspective (Meadows, 2008) a change of people's behaviour, which are determined by the assumptions, beliefs and values behind their behavioural choices, has much more leverage and transformative power to permanently change the system. What we choose to eat is determined by our mental models of what is the right food, what is easy and what we like, and our habits, culture and social norms. And compared to the rules of how the ecosystems work, social systems are our making (Mandl, 2019).

Thus, we can also change them: "*We may understand the laws of physical systems, but we can´t bypass or change them. The opposite is true with social systems. Laws and structures govern the interaction of the parts of the system. Yet such rules aren´t universal ... we create them.*" (Mandl, 2019, p. 16).

KEY CONCEPTS

The science of change

Change is a constant of life. How society works and how individuals behave as part of it is constantly slightly shifting. At the same time, how we think, feel, and automatically react is by and large physiologically determined. Research shows that societal institutions tend to preserve themselves.

When talking about change towards more environmentally friendly and healthy food, a debate always arises, either explicitly or implicitly, about what needs to change first: ***'is it the individual or is it the system?'*** Theories of societal and individual change stress that it is undoubtedly both. Let us look at a few theoretical concepts that show this.

Sustainability transitions is a field of research that states the current grand challenges and wicked problems ahead of us *"cannot be addressed by incremental improvements and technological fixes, but require radical shifts to new kinds of socio-technical systems, shifts which are called 'sustainability transitions'"* (Köhler et al., 2019). Researchers here study how sectors change over time, such as the energy or food sectors. The focus is on how the sector 'works', understood as the 'socio-technical' system made up of the stakeholders interacting with each other and the technologies. Over time and through these interactions, the mindsets, norms, and cultural practices change. New technologies disrupt markets and alter infrastructure, and power shifts lead to new policies, supply chains, and business models. The field draws from institutional theory and innovation management and states that strategic action is required to create more sustainable innovations or practices to transform them from niche to mainstream. The system of social interactions and technological infrastructure needs to be changed on purpose, but it is individual stakeholder actions or stakeholder collaboration that has to do this.

Social tipping points have been increasingly discussed in the past years. The term takes departure in an aspect we know from ecosystems as systems are for the most part stable and surprisingly resilient. However, when drivers of change – for example GHG emissions, deforestation, melting ice caps – abound, a threshold can be reached and sudden, non-linear shifts to a new, unfavourable state can happen. Social tipping points is applying the same idea of accelerated change at certain points to socio-technical systems (Aschemann-Witzel & Schulze, 2023). The difference is that most discussions are about how this could be a good thing for green transitions. Across our history, there are examples of changes in socio-technical systems that have led to very new states in mindsets and practices in diverse issues such as the uptake of cars for transportation, success of wind energy, or the ban of smoking in public. The societal or social tipping point field draws from theories on innovation diffusion, social networks, consumer behaviour, and social norms.

Social norms and what their change can mean for behaviour is especially in focus when discussing social tipping points, and this often includes meat reduction and dietary behaviours (Nyborg et al., 2016). Sustainable behaviour often involves moralised issues, which means one individual´s choice makes another individual look 'bad', and as social beings, we prefer to avoid this. Due to that, pathways of change in society might follow other rules than mere technology adoption (Judge et al., 2024). A lot of hope is placed on social tipping points (Milkoreit, 2022) as the concept tells stakeholders that want to further sustainability transitions that even though not much is changing now, patience and tenacity is worthwhile; With enough of the right strategic actions, we can have accelerated change at the tipping point

(e.g., Lenton et al., 2023). However, it is difficult to determine which mix of actions is best, as well as how and when. What is certain, though, is that no single action likely does 'the trick' and that a mix of actions is needed (Schulze et al., 2024). Behaviour change theories all point to how behaviour is driven by several factors.

The **behaviour change wheel** visualises how the system and individual interact by showing which interventions and policies are most impactful for which individual-level factors, via the functions each action can have on individuals (Michie et al., 2014). At its core is the COM-B model (also MOAB model) of behaviour change (Ölander & Thøgersen, 1995) which distinguishes capability (C), opportunity (O), and motivation (M) (and its subdivisions of physical/psychological, social/physical, and reflective/automatic) as joint drivers of a behaviour (B) change outcome (for MOAB, see box). The COM-B model is built on the essence of a lot of other behaviour change frameworks, and thus has a similar message as many other abbreviations used in the behaviour change research space, which is that change comes about when several factors point in the same direction. Not all factors will be similarly impactful because their impact will differ based on the behaviour in question. At the same time, because individuals are not alike, the factors that have most importance for a given behaviour might differ from person to person.

Nudging is often suggested as a tool to foster behaviour change. A nudge is a change in the environment or 'choice architecture' that alters a person's choice or behaviour in a way that is favourable for the individual. Or, in other words: *"Nudges are choice-preserving interventions that steer people's behavior in specific directions while still allowing them to go their own way"* (Sunstein et al., 2018, p. 3). So, nudging is not to forbid certain choices. For instance, putting fruit at eye level counts as a nudge. Banning junk food does not, as explained by Thaler and Sunstein (2008).

The reason behind the use of nudging is based on our lack of rationality in many of our decisions. There is a lot of research on nudging, and this research points to small but noticeable effects in real-life settings (Bauer & Reisch, 2018). Nudging has shown to be a potentially effective strategy for changing food choices (Mertens et al., 2022). There are questions though as to the long-term behavioural effects of nudging, and some ask whether nudging is 'overrated' – but there is no doubt

Usefully memorable abbreviations for the factors relevant for behaviour change are for example MOAB (motivation, opportunity, ability, behaviour)[1,2], EAST (easy, attractive, social, timely)[3], 4xE (enable, encourage, engage, exemplify)[1] or SHIFT (social influence, habit formation, individual self, feelings and cognitions, tangibility)[4].

[1] WRAP (2011)
[2] Nielsen et al. (2016)
[3] BIT (2014)
[4] Sitra (2021)

that it is an important tool in the mix of potential actions (Kahneman interview, 2021). Currently, research on interventions towards environmentally sustainable food consumption is in fact too much dominated by non-intrusive instruments such as nudging (Ran et al., 2024).

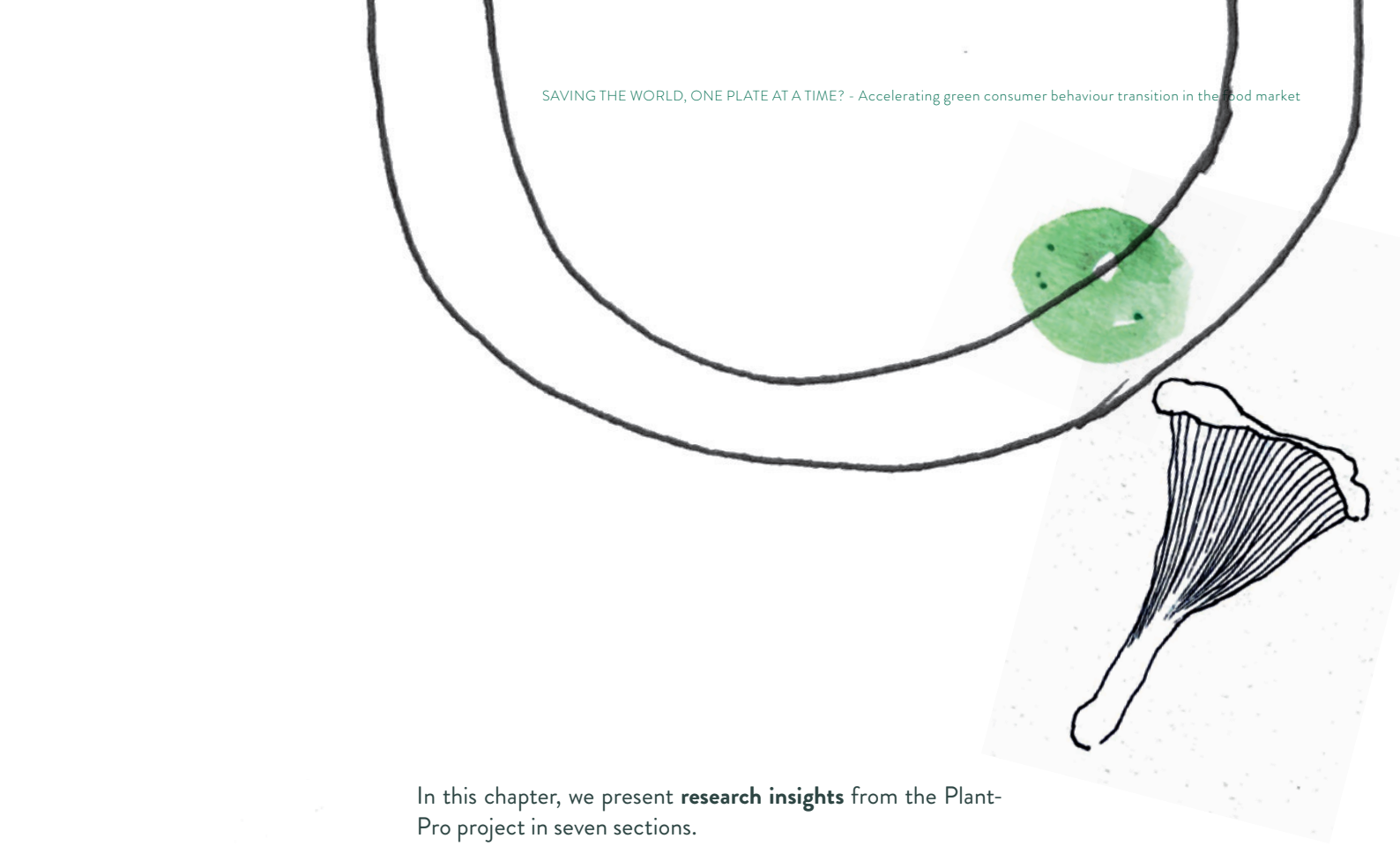
Motivation is somehow central to the discussion of behaviour change. Most behaviour change research topics are on issues that would be 'good for you' (e.g. health) or 'good for the planet' (e.g. sustainability). Many citizens are motivated to contribute to one or both of these. But because motivation alone is not sufficient, tools like nudging are supposed to help us close the gap between intentions and behaviour. Motivation can be of different types – internally, because of values and interests, or externally, because others would like us to or because there is a reward. There is a lot of criticism that motivation-based individual behaviour is overemphasised as a factor (e.g., Davies et al., 2020; Jackson, 2023). Actors might give individual citizens and consumers the larger part of the responsibility, even though it is the choice context that is hampering individuals. For example, ecolabels expect consumers to take care of making the 'right choice', even if it means they pay more for correcting systemic problems and in topics they only partly understand. In fact, the most common and current research interventions towards environmentally sustainable food consumption uses information – which appeals to motivation (Ran et al., 2024).

If motivation is strong, it has more potential for lasting behaviour change than nudging. This holds much more if the motivation is internal instead of external. Self-determination theory (Deci & Ryan, 2000) is a theory that describes the role of these types of motivation and how internal motivation is strengthened by the individual's experience of autonomy, competence, and relatedness. In other words, agency is important as well – especially in the long-run.

The science of change is clear:

When looking at behaviour change and the factors and tools, such as nudging versus motivation, we argue there needs to be a smart interplay of both. What mix is best depends on person, context, and issue in question. It is both the individual and the system that needs to transform.

RESULTS

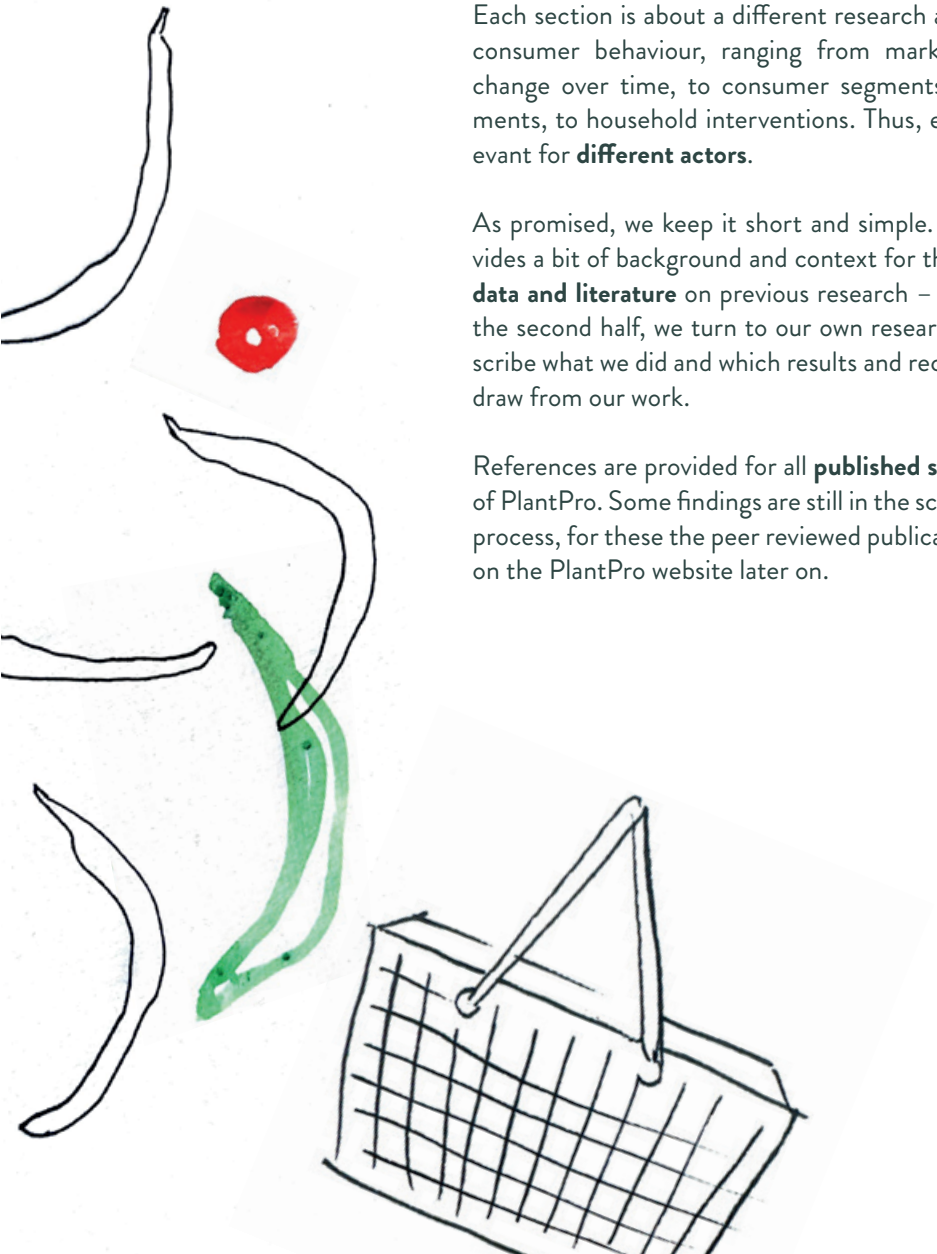


In this chapter, we present **research insights** from the PlantPro project in seven sections.

Each section is about a different research area in market and consumer behaviour, ranging from market and behaviour change over time, to consumer segments, nudging experiments, to household interventions. Thus, each section is relevant for **different actors**.

As promised, we keep it short and simple. Each section provides a bit of background and context for the findings – **other data and literature** on previous research – in the first half. In the second half, we turn to our own research and shortly describe what we did and which results and recommendations we draw from our work.

References are provided for all **published studies and reports** of PlantPro. Some findings are still in the scientific publication process, for these the peer reviewed publications will be found on the PlantPro website later on.



MARKET AND CONSUMER BEHAVIOUR CHANGE

Taking stock and benchmarking change: the plant-based market development and trends in consumer perception and behaviour

A few years ago, Europe's plant-based food and beverage market was projected to grow rapidly over the coming years (GFI, 2023). In the best scenario, alternative proteins were forecasted to claim as much as 22% of the overall protein market in 2035. Every ten servings of meat, eggs, dairy, and seafood worldwide was expected to be in the form of alternative proteins (BCG & BHC, 2021).

Following the Good Food Institute (2024), an international think tank, plant-based products have gone 'mainstream' in Europe as retail sales increase in volume. Germany in particular, Europe's largest market for plant-based products, continues to grow, and the same holds for Spain and France. However, in other parts of Europe, such as the UK and the Netherlands, sales are declining or even stagnated, like in the Italian market (GFI, 2024). Thus, the plant-based market developments within Europe are diverse.

In Denmark, many consumers intend to consume more sustainable food. For instance, in 2023, 48% of Danish consumers reported a decrease in their yearly meat intake (ProVeg International, 2023). In 2021, half of the consumers agreed that the total consumption of meat in Denmark should be reduced (COOP, 2021).

Transforming intention to actual behaviour seems, however, to be challenging for the Danish consumers. A 2024 survey in 9 countries shows that the number of consumers regarding themselves as 'omnivore' (compared to flexitarian and other alternatives) is second highest of all countries, only topped by Finland (Pérez-Cueto, 2024). From 2021 to 2023, 39% of the consumers reported no change in their meat consumption, while 13% said that they were eating more meat - the largest increase of all the European countries surveyed (ProVeg International, 2023). Moreover, it is reported that sales of plant-based alternatives dropped from 2021 to 2023 (Mandag Morgen, 2024). After years of growth, the plant-based market share stabilised around 2% (Fødevarewatch, 2024a) and plant-based alternatives do not yet play a significant role in Danish consumers' diet (DTU, 2024b). Additionally, between 2015 to 2023, the share of meals with meat remains unchanged (with as much as 75% of all meals reported containing meat) – and for families with children the share of meat-based meals even increased to over 80% (Madkulturen, 2024b).

It is assessed that so far, Danish retail offers a limited assortment and little shelf space to plant-based alternatives compared to animal products, and there are hardly marketing efforts in form of promotions for plant-based products (CONCITO, 2023). Taken together, these observations illustrate the challenge of changing food consumption in a more plant-based direction. Some argue that Denmark currently faces a slow or stagnating development in terms of plant-based eating (DTU, 2023).

Pulling in the other direction, though, is the fact that many consumers are open to more plant-based eating. If plant-based products can replace ani-

mal products easily, are tasty, and make the food preparation more convenient, they can make it into everyday cooking (DTU, 2024a). For instance, 24% of the Danish consumers indicate that they intend to buy hybrid products, mixing fresh meat and plants, in the near future as a replacement for traditional meat products (Danish Agriculture & Food Council, 2024). Also, people are willing to consume more plant-based food if it makes it easier to gather family members with different food preferences for a shared meal (DTU, 2024a; Hesselberg et al., 2024). There has been an increase in the consumption of plant-based milk from 2021 to 2024. Measures show that legumes rank as the most-familiar plant-based food in Denmark, followed by plant-based milk (ProVeg International, 2023).

Some argue that the Danish market needs a fresh 'restart' with new plant-based products (Mandag Morgen, 2024) and with greater support from retail and larger businesses.

Recently, in summer 2024, the Danish dairy company Arla launched its new plant-based butter in their iconic Lurpak-brand (Arla Foods, 2024), and Rema1000, one of the biggest retailers in Denmark, announced a 20%-reduction of package size (and price) of minced beef (Fødevarewatch, 2024b). A range of supermarket chains in Europe have set themselves targets for giving plant-based proteins considerable more space (Madre Brava, 2024). Such initiatives can be supportive of the 'restart' that may be needed to further a transition in the Danish market. The Danish Council on Climate Change emphasises the need for collaboration between different actors in the private and public sector (Klimarådet, 2021). In particular, the council emphasises the importance of 'normalising' plant-based eating (p. 4). Therefore, they encourage private and public institutions to implement plant-based food programs in their canteens, making plant-based food available and relatable for the larger share of the population. The Danish action plan on plant-based foods names a broad range of actions to further the sector (fvm, 2023) and has since been followed up by considerable funding.

As part of the PlantPro project the research team tracked self-reported behaviour, intentions, and perceptions of consumers in Denmark throughout the project period. A survey was sent to over 1000 respondents sampled from a panel representative of the Danish population at three points in time: May 2021, October 2022, and May 2024. Note that it was not the same persons answering the survey, but the precisely same procedure of recruitment was used for each time period.

The result of this repeated survey is, however, sobering at best. **Self-reported**

FIGURE 1

Meat reduction."There has been a lot of discussion recently about people reducing meat consumption, and instead changing to a more (but not only) plant-based diet. What is your stance on this?"

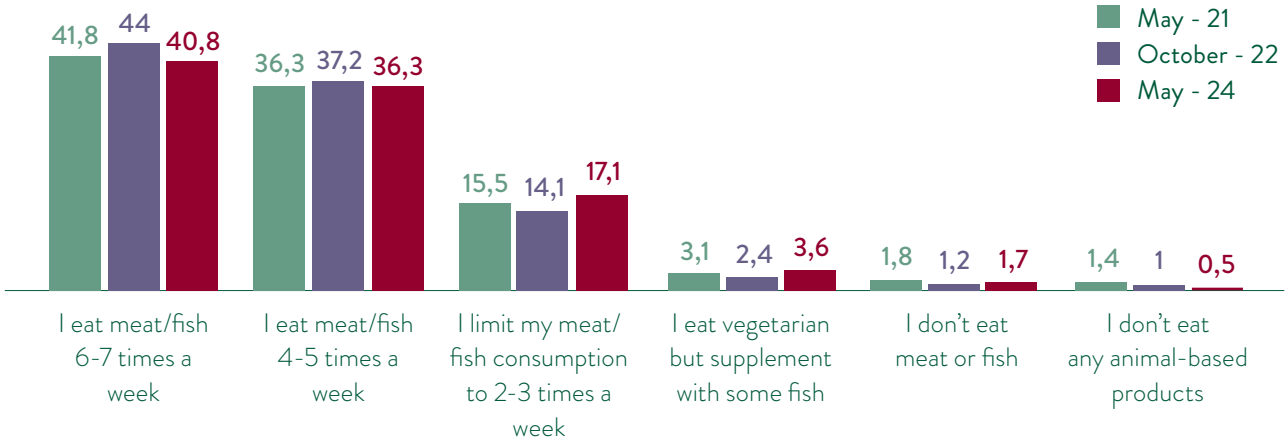


FIGURE 2
Dietary description (in %). "What describes best how you eat"

behaviours and intentions appear hardly changed. Most numbers are not significantly different from year to year. There are only very minor exceptions to this overall result. Note that more graphs are found at the end of the report – here we give only a few examples.

In 2021, 18.9% of Danish consumers answered that they would describe themselves as 'flexitarian', and this number was similar in 2024 with 17.5%. In contrast, 75.6% of respondents self-identified as a 'meat-eater', and this was at 77.8% in 2024, again remaining largely unchanged (see appendix).

Clearly over a third of respondents did not want to reduce their meat consumption, and this was stable over time – 36.4% in 2021 and 36.3% in 2024; In contrast, 31.2% versus 31.3% (in 2021 versus 2024) of respondents answered that they already only eat low amounts of meat, again with no change (see figure 1).

We also asked how often respondents ate a 'meat-free' lunch or dinner across the 7-day week with about half of respondents stating they did this for at least two days a week for lunch (54.5% in 2021, 54.7% in 2024) and just over 40% stating this was on at least two days a week for dinner (44.1% in 2021, 43.5% in 2024). Thus, there were no changes in the number of days per week that respondents claim to eat lunch or dinner without meat (see appendix).

To the question 'What describes best how you eat,' around 40% of respondents said that they eat meat/fish '6-7 days a week' and about 36% of respondents chose this answer for '4-5 days a week' – similarly in 2021 and 2024; In contrast, 'limiting' this to '2-3 days' was chosen by 15.5% of respondents in 2021 and 17.1% in 2024 (see figure 2).

These examples suggest that there has been no dietary change towards more plant-rich eating during the project period. There is also no change in how the societal debate is perceived. According to this survey, consumers perceive the degree of conflict on the 'plant versus meat' debate similarly in 2024 as they did in 2021 (with an average of 4.5 out of 7 in both 2021 and 2024 - see appendix). They also did not report to know more people who have reduced meat consumption around them, at least on average, and believes about the pro and contra of reducing meat consumption or production of meat did not change (see appendix).

Three observations of change, however, are interesting to note.

First, for the young males aged 18 to 34 in the dataset (n = 612), there is a decrease in the frequency of eating meat-free lunch or dinner. Over time, there were less young males who reported eating a meal without meat. More specifically, in 2021, over half of young males stated they ate a dinner without meat at least two times a week, but this was only about 40% in 2024. Meanwhile, no drop of this kind was seen in the data for young females – here about 2 out of 3 in this age group stated to eat a vegetarian dinner twice a week, in both 2021 and 2024 (see appendix). This might indicate a growing gender gap related to green dietary change, and reflect the gender gap seen in literature as well (Hinrichs et al., 2022).

Second, in 2024, the surveyed consumers tend to be less concerned with envi-

01

There has been a price inflation in food in particular during 2022 and a shift of focus towards the war in Europe. Considering that, it is even surprising that the interest in plant-based food and transitioning to more plant-rich eating is still similarly high as in 2021.

02

That there is hardly a change in consumer intentions and behaviour shows you cannot easily change people and their habits. It is hard to change demand patterns, as this is rooted in upbringing, norms and culture.

03

Policy and market decision makers during the past few years have hardly made decisions that changes the food system and choice environment towards more plant-rich eating. Thus, given it has not been tried, there is potential to change intentions to behaviour.

ronmental issues in their shopping, compared to 2021. There was overall a lower agreement to all statements measuring environmental concern in 2024 (see appendix). This might indicate that environmental motives among consumers are less on the forefront now compared to a few years previously.

Third, on a positive note, the comparisons in PlantPro data[5] indicate that between 2022 and 2024, there tend to be more consumers who state that they look out for a meal with legumes when wanting to eat a meat-free meal (see appendix). This is in line with results from Madkulturen (Madkulturen, 2023), indicating the potential for an increase in legume consumption.

There are different possible interpretations of and reactions to this development – or non-development - in terms of consumer intentions and behaviour. We present three interpretations in the boxes. Behaviour is more complex than one simple explanation. We believe that the explanations can explain some part of our observations.

[5] Here we compare the survey mentioned in the section on 'consumer segments' from 2022 with the 2024 data of the survey described here.

SECTOR TRANSITIONS

Learning from the past: Previous successful cases of change in the food area and how the plant-based sector got to where it is in Denmark

What happened previously and elsewhere does not necessarily mean the same will work today and here. Nevertheless, stakeholders draw from previous success stories and use cases to underline and exemplify what and how change can happen. This makes good sense because it serves to showcase potential pathways and inspire ideas in a hands-on fashion.

Researchers do the same in studying sustainability transitions across sectors. Despite limitations in transferability, there are indeed characteristics and patterns to be found that can help envision how change occurs. Such research might advise stakeholders on what to focus on next.

Transitions research has begun to focus on the food sector during the past decade. Before that, transitions research explored the energy sector. Authors found amongst others that 'culture' and therewith consumer perception and behaviour as well as the informal institutions in which these are formed, play a much larger role relative to the energy sector (Mylan et al., 2019; Tziva et al., 2020). Other work described the increasing polarization of stakeholder opinions and their lobbying and marketing in the media (Clare et al., 2022; Sievert et al., 2022) showing a tendency to a 'meat' against 'plants' division. This polarization reflects discourses found on climate action in general (Lamb et al., 2020). Studying the US market development and the food sector transition, a team of authors concluded that there is a lack of public policy support (Dueñas-Ocampo et al., 2023).

In PlantPro, we took two steps in 'looking back' and learning from the past. First (see Schulze et al., 2024), we decided to analyse four cases in the food sector of Denmark where it was claimed that a certain success is seen in terms of change. These four cases were: organic food consumption, wholegrain intake, healthy eating, and food waste reduction. We set out to identify the factors which might have led to success, using a framework that combined well-known models of behaviour change with the tipping point framework towards sustainability (Lenton et al., 2022). Second (see Aschemann-Witzel et al., 2023c), we studied the plant-based sector development through in-depth interviews with both small and large company representatives, and then discussed and reflected on the resulting insights in further interviews with experts and market stakeholders.

The devil is in the detail, and there is a range of insights from both studies that can be read in the reports and academic publications. When it comes down to what this means practically, there are a few crucial messages we would like to underline:

Collaboration is key. We can observe that establishing collaboration across different stakeholder types is very important for the transition process, as can be seen both in the past years development of the Danish plant-based sector and the previous cases of success in organic food, wholegrain, and nutrition labelling. By establishing strong networks that facilitate collaboration, stakehold-

ers can reduce the risks entailed in action and can share resources, knowledge, and best practices. This calls for all stakeholders to be open to collaboration and conversation.

Policy commitment is a must. It does not need to be there right away to trigger change. However, we can see in various cases that policy makers 'chipping in' at some point, and doing so with sufficient force and resources, is crucial for scaling up and moving the transition to the next level. Cases show that the degree of policy commitment plays a significant role in determining the speed of the transition. Without governmental support, progress may remain slow and fragmented. This calls for policy makers to step up to support once the first seeds of change are sown. And to be balanced, policy support should include both supply and demand side actions.

International knowledge sharing does the trick. The inspiration and encouragement of hearing about cases of change in other countries works in favour of taking more drastic steps. With the assurance that a trend and pattern of change already started elsewhere and thus will be more likely to occur, stakeholders feel more emboldened to take risks and be on the forefront in their own market. This calls especially for NGO´s and policy makers to facilitate such knowledge brokerage and to highlight and exemplify cases of relevance.

Bold single-actor moves can trigger a cascade. We observed two important characteristics in the transition processes. These two characteristics are quite the opposite from each other. The first is the collaboration across all stakeholders, involving multiple actors horizontally and over time – as mentioned above. The second, however, is a single actor acting at a single point in time, which creates a vertical, point-like event. In hindsight, there are often single-actor moves that are attributed quite a contribution to the change that has happened. In various cases, this single-actor move was a bold move by a major retail chain that had far-reaching positive effects. This might be because retailers are crucial connectors between supply and demand and there are only a few players who closely monitor and react to each other. The observation shows that when a large player in the industry takes radical steps towards sustainability, it can inspire others to follow suit. This cascading effect creates momentum for change throughout the food system. This effect calls for stakeholders, especially retailers, to be aware of their power and dare to act - even if alone - if the time is right.

Denmark has seen a drastic turnaround in the narrative surrounding the plant-based sector during the years 2020-2024. The plant-based market in Denmark developed from a thriving but niche sector with little policy support, to a sector backed up by policy makers' positive intentions and funding efforts. The narrative has changed from a sector not in focus to a sector carrying the hopes of a win-win match of policy and economy, including the Danish green transition leadership as well as export potential for both products and knowhow. At the beginning, Danish stakeholders were looking elsewhere for examples and inspiration, but now, stakeholders elsewhere use the Danish case as a blueprint to follow. This is quite a turnaround and the development underlines the relevance of the recommendations given above.

CONSUMER SEGMENTS

What 'the consumer' wants: Consumer segments in the Danish population and their preferences when it comes to plant-based

Without consumers, there is no market. When stakeholders in the food sector discuss the green transition, the discussion at some point inevitably moves over to what consumers want. It needs demand to scale things up. Often, it is said that a part of the barrier is that consumers do not 'walk the talk' in their consumption pattern. There are good intentions expressed in surveys, but at the point of sale, there is a substantial intention-behaviour gap. Stakeholders say that they need to produce what consumers actually buy, not what consumers claim to intend.

Consumer behaviour theories well explain that there can be a gap between attitudes and intentions, and intentions and behaviour. Short-term goals and immediate needs or cravings are more relevant in day-to-day decisions than more long-term environmental or health goals. It can also be because the social surrounding or choice environment makes it difficult to follow up, for example, if others seem to disapprove, or if there are no appealing products or meals to buy.

Consumer segmentation research explores which group of consumers there are in relation to different aspects in focus, and how these groups are characterised and different from each other. Such research insights can help stakeholders navigate the fact that all consumers differ, but that it is nevertheless helpful to think of relevant groups to efficiently focus market activities to one or more selected 'types.' So yes, it is putting 'people in boxes' with a label on it – however, when done right, both companies and public organisations can save resources including taxpayer's money. The aim of consumer segmentation is to 'target' product marketing or public communication to the most relevant group.

When it comes to plant-based food trends, segmentation research studies have distinguished consumers by their self-reported current consumption (e.g., de Boer et al., 2017; Kerslake et al., 2022), their stated intention to change (e.g., Hielkema & Lund, 2021), and by their underlying attitude and beliefs (e.g., Gonera et al., 2021; Haugaard et al., 2023). Across the state of research, it becomes crystal clear that there are groups of 'greens' on the one hand and 'non-greens' on the other (as phrased in a review by Verain et al., 2012). However, a varying number of further 'in-betweens' can be identified, which differ depending on the question asked and the data included. Given that those who are green are likely already enacting the new behaviour, and those who are not green are difficult to convince, what is interesting is to better understand those groups in-between the two extremes in order to find out what kind of market and policy action might trigger change.

In PlantPro, we took two approaches to understanding consumer segments in Denmark. These two segmentation studies are based on two sets of representative online surveys. First, we focused on groups that differ in which stance they take to the trend towards 'plant-based' (expressed in e.g. attitude and belief, see Aschemann-Witzel et al., 2023b). Second, we focused on groups that differ in preferring one or the other type of category or processing level

What does consumer segmentation research tell stakeholders and market actors wanting to trigger sustainability transitions in society? In the words of Donella Meadows (2008), the renowned systems researcher, the focus should be on those larger groups who are open to change:"... You work with active change agents and with the vast middle ground of people who are open-minded" (p. 164).

among plant-based products (see Schulze & Janssen, 2024).

In the first study that focused on attitudes and beliefs, our segmentation analysis resulted in eight consumer groups. Three of these groups appear rather 'green' – they show for example a high environmental concern, and a lot of them identify as flexitarians. Meanwhile, three other groups are rather 'non-green,' as they are characterised by low environmental concern, with most identifying as meat eaters. Two groups, however, show medium or high environmental concern, but primarily identify as meat eaters. These could be 'potential' consumers. But what do the more detailed findings (read more here Aschemann-Witzel et al., 2023b) imply? From the eight groups, we choose three interesting segments and examples of potential ways to approach these consumers, as explained in the following:

- Firstly, even among the rather 'green' consumers, there is a segment that does not appear to be that much into more plant-rich eating yet. Thus, addressing these consumers in marketing might be the low-hanging fruit approach for companies. What is interesting is that these consumers seem to care a lot about what others think and agree to benefits of meat reduction such as their health. Thus, it could be an idea in the marketing of plant-based food to mention that other peers enjoy and choose plant-based options, and to communicate that more plant-rich eating is a healthy choice according to the nutritional guidelines.

- Second, among the 'potential' consumers, there is a group which is highly environmentally concerned, rather capable of cooking, but these consumers have not reduced meat consumption, nor know many others who have done so. Thus, communicating the extent to which meat reduction reduces own environmental impact could be an idea for companies, as is showing how traditional recipes can be altered into a more plant-rich version.

- Thirdly, even among the rather 'non-green' segments, there are consumers who have less aversion to change because essentially, they are not that involved with food and how it is produced anyway. Thus, if for example canteen food is swapped for more sustainable options, which are equally tasty and cost the same, these consumers would not necessarily mind.

In the second study we focused on groups that differ in their willingness to eat certain meals. We asked about types of meal that differed in share of meat or differed in the type of protein source included in the dish. We found four segments of consumers (read more here Schulze and Janssen, 2024). Here is a sketch of how these groups differ:

- The 'heavy meat eaters' accounted for 26.7% of the sample. Meals with meat were the only type of meal they were willing to eat. Their willingness to eat meals without meat was generally low, and they were not even positive about meals with smaller meat portions.

- In contrast, the 'vegetable proponents' (13.5% of the sample) stated to have a high willingness to eat meat-free meals with vegetables and meals with smaller meat portions. However, their willingness to eat meals with meat substitutes or legumes was low.

- 'Wholefood variety seekers' accounted for 31.0% of the sample. They accepted meals with smaller meat portions, and meat-less meals with vegetables as well as legumes, but they disliked meat substitutes.

- 'Variety seekers' accounted for 28.9% of the sample. Individuals associated with this segment stated to have the lowest willingness to eat meals with meat but were very positive about meals with smaller meat portions. They had a very high willingness to eat dishes with legumes and vegetables and were relatively open to meat substitutes.

Overall, the results showed that providing meals with smaller portions of meat is the most promising approach to support consumer behaviour change.

The results of this study point to a potential step-by-step approach to accelerate the transition towards meat reduction.

In the short term, offering meals with smaller meat portions, for example, in public kitchens or canteens, would be a highly accepted strategy to reduce consumers' meat intake. Hand-in-hand with that, actively promoting meal options with less meat in canteens, restaurants, and supermarkets would be relevant.

In the mid and long term, incremental changes in consumers' food choices could facilitate a more drastic behaviour change by breaking with habituated food consumption behaviours. To support this transition through incremental changes, companies should focus on creating positive taste experiences with meatless meals and offering a variety of plant-based options in supermarkets, restaurants, and canteens. This would also strengthen the feeling of 'autonomy' because it helps empower individuals to make their own choices. Marketing campaigns emphasizing that anyone can cook a meatless meal might further boost confidence among less motivated consumers and thus facilitate behavioural change.
From the state of research overall and our work on consumer segments in Denmark, we condense a few crucial messages which we would like to underline:

There is no such thing as 'the consumer.' We all differ in our priorities and motivations, the abilities and opportunities around us, as well as our current situation in life. Companies and organisations should not look at the 'averages' of consumer studies, but study and address the target group most relevant for their product or message.

Diversity drives large-scale change. Because we all differ, we react differently to different measures towards change. It is important to ensure there is a diverse set of measures (e.g. communication on benefits or easy recipes, price reductions and nudging, products and meals that appeal to different preferences and tastes), so that there is something for everyone.

Start with the low-hanging fruit and then step up. Whether that is appealing to consumers who already have the motivation but not the action yet (as in the first study), or first offering smaller portions of meat (as in the second study), it is important to consider which are first steps and which are steps to take later on in the transition pathway.

NUDGING IN RETAIL

Nudging at the point of sale: How retailers can make small changes that might alter choices on a larger scale

Supermarkets have the potential to influence what consumers choose to purchase and eat. Retail is a powerful stakeholder in the food system. The so-called 'choice environment' is heavily shaped by the decisions that the professionals in retail chains make. This includes which company strategy to pursue, which products to put on the shelves, and how to set the price.

Whether start-ups 'get into retail' with their product is often the make-or-break moment for start-ups that come up with new food innovations. Due to these reasons, a lot of other actors criticise retail chains actions or call upon retail´s power and responsibility in the food system (Devin & Richards, 2016).

Interestingly, only few scientific field experiments have been conducted so far that analysed how supermarkets can increase the sales of plant-based foods and/or decrease the choice of meat in their stores. The existing evidence suggests for example that product placement of plant-based alternatives side-by-side with their meat counterpart effectively increases sales of plant-based alternatives (Coucke et al., 2022; Vandenbroele et al., 2021). Experiments in Danish supermarkets have shown that nudging can be used to trigger choice of fruit and vegetables (iNudgeyou, 2023).

In the PlantPro project we conducted field experiments with retail chains in Denmark. The two studies had different settings, but both focused on increasing sales of plant-based products through nudging instruments. The experiments took place in the summer and autumn of 2023.

Study 1 was conducted in cooperation with the largest Danish online supermarket, nemlig.com. This study investigated the effects of placing plant-based protein foods in different sections of the online supermarket. With A/B-testing over a period of 3 weeks, the placement of plant-based protein foods in the meat section was compared to the placement in the vegetable section. The test was run for two types of plant-based protein foods: (1) legumes (canned and dried legumes) and (2) processed plant-based meat substitutes.

The data from more than eighty thousand online store visits and seventeen thousand transactions provide the following insights for legumes:

- The vegetable section is a promising place for increasing the sales of legumes. The placement of legumes in the vegetable section increased sales of legumes by 55%. When legumes were offered in the vegetable section (the so-called treatment group), 2.9% of transactions included at least one legume product. On the contrary, when legumes were not offered in the vegetable section (the control group), only 1.9% of transactions included legumes.
- The meat section, in turn, is not a promising touchpoint for inducing sales of legumes.

The data from more than twenty thousand online store visits and eight thousand transactions provide the following insights for processed meat substitutes:

- Sales with meat substitutes are generally at a very low level. Less than 1% of transactions included a meat substitute product.
- Placing meat substitutes in the meat section increased sales of meat substitutes by 90% and the number of transactions that included at least one meat substitute product was doubled. However, due to the low absolute numbers of sold products during the test period of three weeks, the increase was not statistically significant.
- Placing meat substitutes in the vegetable section increased sales with meat substitutes by 14% and the number of transactions that included a meat substitute product increased by 70%. However, due to the low absolute number of sold products during

the test period of three weeks, the increase was not statistically significant.

Study 2 was conducted in cooperation with the discount supermarket chain Rema1000. Rema1000 has 412 supermarkets in Denmark and holds a market share of 16%. Study 2 investigated whether the sales of legumes can be increased through point-of-sale campaigns with bundle-placements and recipe inspirations for vegetarian dishes with legumes. Data was collected in 22 stores in two rounds (Round 1: 12 test stores and 10 control stores; Round 2: 9 test stores and 13 control stores).

The results indicate that bundling placements and recipe inspirations have great potential in increasing the sales of legumes. A range of insights are listed below:

- The campaign increased the sales of legumes on average by more than 50%.
- The success of the campaign differed largely across the test stores. The bundling placement was implemented differently across the stores in terms of how the products were presented (shelf or table, product arrangement, etc.) and where the shelf/table was placed in the vegetable section. The largest increases in sales of legumes were recorded in those stores that placed the legumes in a prominent spot.
- Questionnaire data that was additionally collected in one test store and revealed interesting insights, including that customers viewed the promoted vegetarian dishes with legumes as easy and fast to prepare, inexpensive, healthy, and tasty. Customers are generally positive about point-of-sale campaigns for dishes with legumes.

From our two studies in Denmark and the state of research on nudging instruments for increasing sales with plant-based foods in supermarkets, we recommend that supermarkets implement the following measures:

Move legumes out of the niche shelf. Most consumers do not actively search for legumes. Legumes are not top of mind. Therefore, legumes should be placed in store areas where many consumers will happen to notice them, maybe by placing them in more than one spot in the store. This can help boost legume consumption, which is still far too low compared to the nutritional guidelines.

Inspire consumers to choose plant-based foods. Supermarkets should consider becoming a place where consumers find meal solutions, even more than they do today. Supermarkets should make it easy to see how a basic plant product can be converted into a recipe, right in the store, so that consumers can be inspired.

Small steps have small effects. Many small steps can lead to big changes. The interventions tested in PlantPro and previous studies were small in scope and hence had small effects. But they were effective in increasing sales with plant-based foods. Imagine how effective far-reaching changes of supermarket environments might be.

CANTEEN CHOICE CONTEXT

Appealing to the senses and the minds in food service choice situations

A lot of food choices are made in food service settings (e.g. work canteens, cafés, quick service places, etc.). It is thus a crucial setting for trying to increase the consumption of plant-based foods and more plant-rich meals.

The food choice process is influenced by a multitude of factors as outlined by Sobal and Bisogni (2009). They identify the environmental influences to be social factors, resources, and the present context of choice. These three influences are in constant interplay with the personal factors and ideals we have for what 'good food' is in different situations. In the food service context, we classify choice options and foods according to our personal preferences and beliefs, while we negotiate and make trade-offs between different aspects. How much do we expect to like the food? How appropriate is it to eat this in this particular situation? Will it satisfy my hunger? Or will it make me too full? Is it healthy and/or sustainable among current options?

Hence, employing nudging in food service has the potential to change diets at a larger scale (Ensaff, 2021). For example, making plant-based meals the default could have quite an impact across all the meal choices every day (Reisch & Sunstein, 2021).

In food service environments, a certain degree of choice is the norm, and freedom of choice is expected. Therefore, strong policies that restrict the available choice (e.g., a meat-free day) are not neccessarily popular. Nudging, in turn, maintains that freedom of choice and might thus meet less resistance. If a commercial operator or company imposes certain values on a work canteen, there might be conflicts with the diners' personal food choice values, and this can lead to dissatisfaction.

There is substantial research on different strategies to increase sustainable food choice and sustainable protein sources. However, only a small number of studies have considered consumers' liking of the plant-based foods as part of the research outcomes (Hartmann & Siegrist, 2017; Onwezen et al., 2021). Several recent studies have demonstrated that users believe (Varela et al., 2022) or perceive (Waehrens et al., 2023) that plant-based alternatives are not tasty. Such low expectations can act as a barrier to choice. A literature review on the use of sustainability-related information showed that although sustainability information sometimes has a positive effect on consumer perception, choice, and behaviour, there is also a substantial number of studies that shows no effect or even negative effects (Petersen et al., 2022).

The naming of the product or dish can be a way to attractively frame plant-based options and counteract some of the general negative taste expectations. Previous studies have found a significant increase in plant-based option choice when they are indulgently labelled (Vennard et al., 2019) and when explicit vegetarian labelling is avoided (Bacon & Krpan, 2018). Recent research (Hielkema et al., 2022) found that indulgent labelling only marginally increased vegetarian food choice among meat non-reducers, leading them to suggest that indulgent labelling is a supportive measure, perhaps best used in combination with other nudging measures. In restaurants and work environments, the consumption of plant-based food increases when the plant-based alternatives are perceived as default option (Hansen et al., 2021; Taufik et al., 2022). Similarly, Danish national television demonstrated a significant increase in plant-based choice in their own canteen experiment (DR, 2024).

In the PlantPro project we carried out five experiments involving a choice of dishes. In some of the cases, we collected detailed information about the amount of food participants consumed during the experiment. We also measured aspects of the participants expectations, perception, and liking of the foods. Four of the experiments were carried out in naturalistic, experimental settings in the lab, while one was implemented in two work canteens. We report findings from these studies in the following.

Sensory consumer experiments and their main objectives

Sustainability labelling and degree of processing: Studied how information about sustainability (CO_2-emission equivalents from dish) influences behaviour and hedonic response in a choice situation. The choice was among a set of dishes (two types Bolognese and Fricassee) where the central ingredient was processed plant-based alternatives, unprocessed plant ingredients, and dishes with 50% reduction of meat compared to a standard menu planning. It was carried out in an intelligent Buffet setting with 86 participants.

Virtual Reality experience of food choice consequences and indulgent labelling: The objective was to study a VR intervention, where participants witnessed diverse climate change scenarios as a consequence of their food choices, to specifically target efficacy beliefs via emotionally engaging experiences. In addition, we studied the effect of an indulgent dish labeling on choice and perception. Intelligent Buffet setting with 169 participants.

Pictograms accompanying dishes as nudges in work canteens: Studied how visual nudges in the form of pictograms with sustainability and/or health information affected food choice and experience in two Danish worksite canteens (capital vs. less urbanized area). Intervention over 5 weeks with a total of 31601 used plates as a proxy for number of canteen guests. In addition, 191 persons answered an online questionnaire about their choice and liking.

Tasting before making a decision in burger choice: The study examined if the decision is affected when consumers can taste the product before making their choice. The study also compared perceptions of naturalness, healthiness and expectations and liking of 4 different burgers containing different types of patties (beef, and three plant-based alternatives). This was carried out in a naturalistic café-like environment with 240 participants.

Comparison of 3 different meat reduction strategies and text information: The study compared perception, liking and choice of 4 different curry dishes (100% beef, 50% beef+50% lentils, 100% plant-based alternative and 100% lentils). It also studied if the provision of textual explicit information about the protein rich ingredients in the dish influenced participant's expectations, liking and choice. Intelligent Buffet setting with 142 participants.

Engaging the consumers with experience-based consequences of choice

In one experiment, we used virtual reality to create an emotionally engaging experience of the future effects of our current food consumption (Plechatá et al., 2024). Compared to a more neutral delivery of the same information, the experience-based emotionally engaging VR presentation of the consequences in the future had several positive effects. It decreased the choice of meat dishes in a VR settings, the reported beef consumption in a one week follow-up survey, and decreased intentions to consume meat in the future. A mediation analysis showed that these effects are due to increases in response efficacy and self-efficacy, which are crucial to affecting behavioural intentions. However, the participants did not change their choice of dish towards lower meat dishes (reduced meat or plant-based alternatives) in the buffet. Nevertheless, for the participants that chose meat containing dishes, the amount of consumed meat decreased significantly for the group of participants that received the emotionally engaging VR experience.

We also included a nudge intervention with an indulgent dish labelling that did not yield reductions in meat consumption. However, there were some positive effects on perception of the indulgently labelled plant-based dish. Labeling the vegetarian dish indulgently as "Rich Mediterranean" led to higher health expectations compared to labeling the dish explicitly as "Vegetarian", which is likely related to the mediterranean part of the dish name. When participants were finished eating their chosen main dish, they were given samples of all dishes and were asked to rate how much they liked them (for appearance, smell, taste and texture). In this comparison the explicit "Vegetarian" label resulted in lower liking for smell, taste and texture.

Information about CO2-emission savings

The iBuffet choice study tested the effects of CO2-emission savings and showed that this type of environmental information nudge did not increase the choice of plant-based versions of the dishes. It appears that this type of information cue in this context may have been too complex to affect the decision-making process in a routine food choice. In hindsight, it is difficult to estimate what the importance of saving around 4.5 kg vs 9 kg CO2-emissions is. One should consider that providing diners with complex information appeals to conscious information processing. We speculate that interventions with information that appeals to more automatic and fast thinking could have an effect. For example 'the green choice' combined with an indulgent label.

Even though the experiment did not find any effects of the CO2-emission reduction on choice, another effect of the information was observed. When presented with the CO2-emission reduction information, plant-based alternatives were liked less, while meat and mushrooms were not affected. We speculate that choosing a dish with highly processed ingredients because of its positive environmental impact lead to a feeling of 'I only did it for the environment' in mind of the diner which is not conducive for the appreciation of the meal.

Tasting foods before making decisions

In the experiment with different burgers, we observed that the option to taste a sample of the four patties before making a decision on which burger to eat affected the choice of samples. Sampling also led to a higher satisfaction with the chosen burger type among the plant-based alternatives, but not for the beef version. We hypothesised that an experience that exceeds hedonic expectations increases the likelihood of choosing a patty. For two of the plant-based options (Beyond Meat and MATR), the experience exceeded the hedonic expectations and this increased the choice probability.

Perceived degree of processing and strategies for meat reductions

In both the experiment with the choice of burgers with different levels of processing and in the experiment testing different meat reduction strategies (with curries), there were effects on the type of ingredients that replace meat. For the burger patties, Beyond Meat was rated as less natural than the other patties. While there were positive correlations between naturalness and both ratings of healthiness and environmental-friendliness, perceived naturalness did not impact food choice significantly. In the curry study, the respondents had a lower interest in eating meals with plant-based alternatives compared to meals with either many legumes or vegetables. In addition, the curry with a plant-based alternative as an ingredient instead of meat was the least chosen dish. Thus, overall there is a lower interest in and choice of meals with plant-based alternatives, although not in both experiments.

Overt nudge interventions in work canteens

In two work-canteens of a company, we carried out interventions with small pictograms placed with the target dish which was the plant-based option of the day. During the study period a total of more than 30,000 diners ate in the canteens. The pictograms displayed sustainability information (Environmentally Friendly), health information (Source of Protein), or a combination of the two (see figure 3).

FIGURE 3
The three pictograms used

We measured the amount of target dishes that were consumed every day from both locations. While it was expected for the pictogram indicating the target dish to be both 'Environmentally Friendly' and a 'Source of Protein' to result in the highest amount of target dish consumption, it showed the lowest amount of consumed food. In fact, the longer the intervention ran, the more negative effects it had on the diner's choice of the plant-based dish. One explanation could be that pushing consumers too much with nudges resulted in them doing the opposite of the behaviour we intended. This may be due to psychological reactance (Brehm, 1966; Brehm & Brehm, 1981). Although the implemented nudge does not threaten to restrict the option in the canteen, and the nudge in itself is not an immediate threat to the free choice, the increased focus on plant-based foods in the canteen can in the long run threaten the availability of meat-containing dishes, and thus cause reactance.

The canteen location had a significant effect on consumption, where the mean consumption index was more than 70 grams of vegetarian dishes for the metropolitan city dwellers, while it was just under 15 grams in the less urbanised area. Less than 1% of the guests replied to a questionnaire regarding the pictograms. The most important factor for choice when dining in the canteens was pleasurable sensations. Although only a small sample, there were some key takeaways from it. According to the respondents, the pictograms motivated them to choose the target dish. There was no effect of the presence of pictograms on diners' hedonic ratings. For the general motivations of food choice, employees at the metropolitan location had notably higher environmental motivations compared to the less urban location.

From the state of research overall and our work on liking, choice, and consumption in food service settings, we condense a few crucial messages which we would like to underline:

Sustainability nudges are not enough. To decrease consumers' meat consumption, we need to demonstrate the positive environmental effects in an emotionally engaging manner via experiences and good taste. We cannot rely on providing information on sustainability alone when aiming to change behaviour. In real-life settings, additional factors that affect food choice will water down the positive effects of information that can sometimes be demonstrated in experimental settings.

Good taste trumps other concerns. Consumers seem to prefer a 'clean label' or mildly processed ingredients if there is no tasting involved, but once tasting is involved, taste trumps concerns about naturalness.

Not all consumers want the same thing. Meat-lovers are more likely to swap their meat with something very similar to meat, while flexitarians are more ready to try out plant-based options that are more unique and different from meat.

Explicit labelling can be detrimental. Lastly, we recommend that explicit labelling of the plant-based dish option as vegetarian/vegan is best avoided, especially to appeal to meat-eaters. The explicit labelling can have a negative effect on both choice and liking.

UPCYCLED FOOD PERCEPTION

Towards a circular system: Upcycling as means to avoid food loss and waste and innovate tasty plant-based food products

Upcycling is a both an old and a new concept. For both the old and the new reasons, it is relevant for the acceleration towards more plant-rich diets. Sustainable and plant-rich diets need to draw from a resource-efficient, diverse, and resilient food system that offers a broad variety of ingredients (Aschemann-Witzel et al., 2019; Keating et al., 2014). Many of these ingredients will be former 'side-streams' or currently 'underused ingredients' with potential for human consumption.

Upcycling has become increasingly known in connection to food waste avoidance. The past decade has seen a growing focus on the issue of food waste, both in research, policy discussions, and among businesses. Food waste avoidance is an important sustainable development goal (United Nations, 2015). About 8-10% of GHG are caused by food waste (IPCC, 2019). From an individual food behaviour change perspective, the impact of food waste avoidance is assessed as being the second-most important after dietary change towards more plant-rich diets (Hoolohan et al., 2013).

Upcycled food has become an increasing international trend (Foodvalley, 2024). This is not least because the Upcycled Food Association has been founded in the US and also certifies products (Upcycled Food Association, 2024). An accelerated market development of upcycled food has the potential to contribute to food system sustainability. Research has begun to study consumer behaviour and perception as well as explore marketing and communication for upcycled food (Aschemann-Witzel & Stangherlin, 2021). This consumer research shows amongst others that consumer-citizens environmental awareness and concern is an important driver of choice. Research also shows that the selection of words and phrasing of the benefit in product communication is important, as can be the use of other marketing communication mechanism (Aschemann-Witzel et al., 2022; Lu et al., 2024).

Many upcycled foods are also plant-based and make use of side streams from production that can enrich foods with fibre or protein. In Denmark, important streams are brewers spent grain (BSG), oilseed press cakes, or side-streams from potato, fruits and vegetables to name a few (One Third, 2024). The company Agrain for example focuses on using BSG and turns these into a variety of products, including flour, crackers, and crisps (Agrain, 2024).

To be upcycled food, three requirements must be met (Aschemann-Witzel et al., 2023a):

1 / the final product is actually food, thus the item is for human consumption,

2 / the food or underused ingredient used to make it is otherwise wasted, and

3 / the process leads to an increase in value in some form or other.

There are two types of upcycled foods in the market, if one characterises them by a) the contribution to the food system that they make, and b) the current consumer perception.

First, upcycled food in an 'alternative use' sense take foods and ingredients that otherwise would be wasted, and re-make them into new, alternative products. Take bread waste for example, when it is turned into a beer brewing ingredient. This avoids food waste of both foods and ingredients. This approach addresses inefficiencies in the system – for example when breads that are ready to eat, end up in the danger of being wasted because the wrong amounts have been ordered.

Second, upcycled food in a 'novel use' sense take underused ingredients which could potentially be used for human consumption, but are currently not used and not well-known by consumers. Take spent coffee or fish skin - most

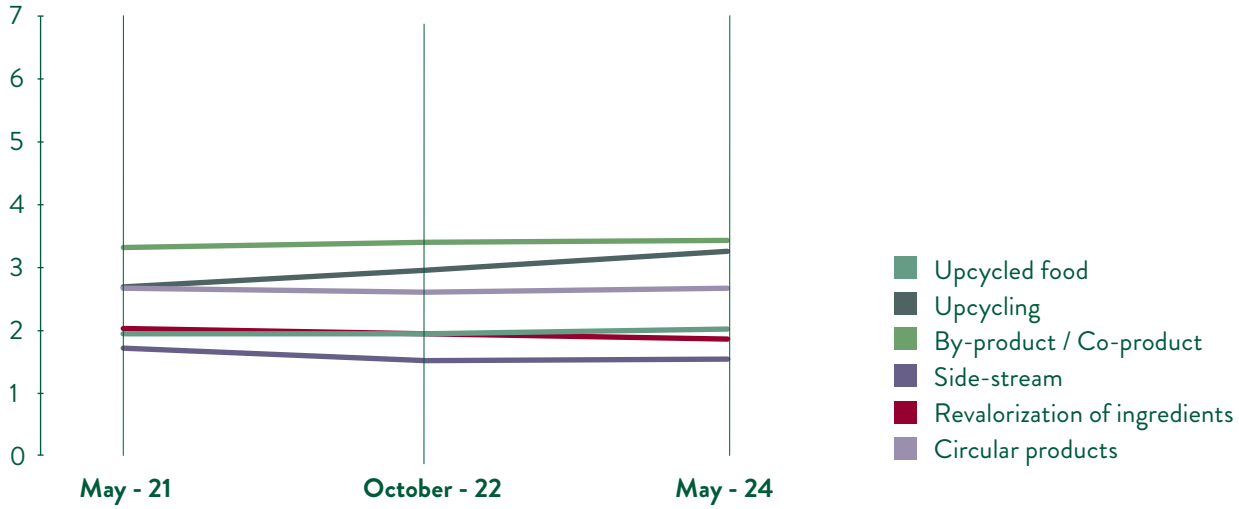


FIGURE 4
Consumers' familiarity with concepts (1=not familiar at all; 7=very familiar)

consumers are not aware of that these could be further processed for food purposes. This approach helps to broaden our food sources and diversify the ingredients we can draw on in a more sustainable food system.

The term upcycling goes back to the ground-breaking cradle-to-cradle (C2C) design concept (Braungart et al., 2007). It is "reuse of discarded materials which results in an increase in 'value'" (Bridgens et al., 2018, p. 146), or "a process of converting materials into new materials of higher quality and increased functionality" (Ellen MacArthur Foundation, 2019, p. 19). Therefore, upcycling is a central concept in the crucial transformation towards a circular bio-economy and needs the development of new, sustainable, and circular business models and industrial ecology thinking in the food system (Braungart et al., 2007; Ellen MacArthur Foundation, 2019; Lüdeke-Freund et al., 2018). In the long run, success of upcycling and circular economy also requires that consumer-citizens begin to see the food system more as a cycle and to 'think' circular.

In the PlantPro project, upcycled food consumer behaviour was studied in two contexts.

Familiarity and attitude over time: We studied whether consumers in Denmark know the concept of upcycling, and how this changed over time. We asked a representative sample of consumers in the repeated benchmark survey (at the start of the project in 2021, in late 2022, and again in 2024) about how familiar different wordings are to them (e.g. 'side-stream' or 'upcycling'), and we measured attitude to upcycled food. Our findings show that attitude towards upcycled food remains largely unchanged from 2021 to 2024. However, consumers' familiarity with 'upcycling' has increased significantly from 2021 to 2024 (see figure 4).

Upcycled food perception: Moreover, we conducted a qualitative pilot study on consumer perception of upcycled food which we called the 'Upcycled food journey.' The 4-week 'journey' consisted of 2-3 weekly emails with a link to material that took between 3-5 minutes to engage with, including information, quizzes, questions, activities, and product cases, whose presentations varied as either text, images, or videos. The goal was to have consumers engage with a concrete example of upcycled food and to understand what it tells them about the current and future food system. Each round of emails

gave examples of upcycled foods that increasingly challenge what one thinks is edible or not. The journey also addressed the nutrient cycle – and that phosphorous from our wastewater can be extracted and used as fertiliser for our agricultural production.

The study was evaluated through qualitative interviews with each participant before and after the journey. The interaction with and responses from participating consumers were very positive and the interviews gave insights into how consumers conceptualise 'circularity' in food systems and understand 'upcycled food.' Participants talked about abstract concepts such as a chain becoming a circle, but also about concrete examples, such as composting and chickens eating leftovers.

From our work on upcycling in food, we would like to underline one major takeaway:

The market trend and consumer awareness are growing. There is a continued interest by a diversity of start-ups to work with side-streams and create upcycled food concepts. The concept aligns well with policy documents calling for circularity in the food system and reduction of food waste, thus one can expect the market conditions for such innovations to improve further. Consumer familiarity is slowly but steadily increasing.

"It's because I think circles are... it's... um, I think it's more homogenous. [...] the circle can go both ways, or it's, what's it called, it doesn't just have to go one way, it can also go the other way. In my circle."

Quote from participant in the study.

"With what I eat and consume, I stuff it into the compost, which then in turn gives me something to grow in, and so it's like a closed system."

Quote from participant in the study.

HOUSEHOLD BEHAVIOUR CHANGE

Observing and triggering household-level changes: How challenges might help bridging the attitude-behaviour gap

Every day, people in Denmark are eating meals at canteens, restaurants, and cafés, or they eat on the go or nibble snacks for a great part of the day. But despite the trend for more out of home eating and a diversification of eating patterns, a lot of food consumption happens in the comfort of our four walls. Whether a single household, a shared flat, or a family sharing a meal, such food consumption is in our hands and not much in the reach of public institutions' food strategies or supermarket nudging.

For the same reason, there is less research about household food decision making about more plant-rich eating. Previous studies indicate that household change requires collaboration between parents and children to be successful (Hesselberg et al., 2024; Pedersen et al., 2012).

Consequently, research studies have been looking into how families negotiate internally. A family should be seen as a 'consumer unit' for whom social relations and cohesion are driving forces (Epp & Price, 2008). Therefore, family members are not willing to push plant-based eating practices through – unless they are supported by other family members. Otherwise, this can have negative consequences for family cohesion. Instead, family members try to find compromises that balance different food preferences, and it is not necessarily the young who want radical change (e.g., deciding to go vegetarian on a whim or as a protest), as many might expect (Hesselberg et al., 2024).

Part of what is at play in these negotiations is the identity. Family members have multiple identities to juggle when it comes to food (Randers et al., 2020). This can be their identity as a caring parent, as an environmentally concerned citizen (e.g., Hesselberg et al., 2024; Longo et al., 2017), or an adolescent shifting between hedonic and climate-conscious consumption (Collins & Hitchings, 2012).

Clearly, everyday actions such as food preparation at home is characterised by a lot of habits and norms, and what we do with food at home has roots in our upbringing and culture (e.g., Beagan, 2015; Carrigan et al., 2023). It is no surprise it is often said most consumers in Denmark have only about 10 different dishes that they do again and again, and many of these are rather traditional (Madkulturen, 2022). Additionally, shared eating tend to make us more engaged in homemade food and increasing the varity of ingredients (Madkulturen, 2024a). Therefore, it seems relevant also to consider the eating environments when developing more healthy and sustainable ways of eating.

In the PlantPro project, we conducted a household intervention study in collaboration with Skanderborg municipality (read more here: Stancu et al., 2025). In the fall of 2021, we recruited consumers living in the region for a study which we called the PlantPro Challenge where we encouraged eating more plant-rich in the household for a period of 4 weeks. From around 200 interested households that responded, we invited 122 to participate – focusing on those who have a motivation for

FIGURE 5
Recruitment poster

FIGURE 6
Danish national dietary guidelines

change but have not yet started to eat more plant-rich. The challenge study was modelled on the idea of the 'Veganuary' campaign (Veganuary, 2022). Just like Veganuary, the challenge took advantage of the fact that consumers often have intentions to change just after the Christmas and New Years period, and therefore the challenge to eat more plant-rich was scheduled between mid-January and mid-February.

How much more and how exactly households ate more plant-rich was up to them to decide. However, the research team provided a box with a variety of products as inspiration and information material twice during the challenge period – at the start and in the middle of the study. These boxes included a poster of the national dietary guidelines, and dry or cooled alternatives such as cans and dried legumes, plant-based dairy and meat alternatives, and a ready-made soup, just to name a few. Households also received regular emails with general tips on more plant-rich diets and recipes that fit the products in the boxes.

The Challenge intervention was theoretically based on the COM-B model. First, it is motivated (M) consumers who react to the call for action. We ensured through the recruitment survey that these were households who yet had a gap between their attitude or intentions and their actual behaviour. Second, the challenge campaign provided the trigger and opportunity (O) to change, because households committed themselves through the sign-up, and then received products and tips during the study. Third, receiving products and tips, but also the family engagement and local exchange via social media among participants supported an increase in capability (C) for participants. All of these factors were expected to contribute to behaviour change (B).

So, how was this scientifically evaluated, and what was the outcome? The experiment compared dietary behaviour and perceptions from before to after. The same questions on frequency of consumption of different food categories and vegetarian meals for lunch and dinner were asked in a survey during

the fall, at the time of the intervention in the beginning of the year, and two months after the intervention. This survey also included questions on perceived barriers to more plant-rich eating (as for example, how easy it is to find products for this) and a measure of capability (self-efficacy of meat reduction). As a further step in the evaluation, in-depth interviews were conducted with a range of household members after the challenge was over.

The study was a mixed-methods study combining quantitative and qualitative consumer data and looked at the 'how' of the change. We also used the representative national survey (the benchmark in the project mentioned earlier) as a control group.

The most important insights from the study are as follows:

Participants significantly shifted diets. Results of the study showed that participants changed the frequency of consumption for food categories between before and two months after the intervention. They were eating less frequently from the animal-based categories and more frequently from the plant-based categories.

Participants perceived less barriers and more competence. Results also show that participants perceived less barriers to more plant-rich eating two months after the campaign. Perceiving less external barriers and thus more opportunity can support lasting change. In addition, we found that perceived self-efficacy to reduce meat consumption explained successful dietary change. Perceiving more own, internal competence and thus more ability also supports lasting change.

Marketers can use a 'challenge' campaign to help consumers across the 'gap.' The findings suggest that a challenge style campaign can contribute to dietary change. Such a campaign or elements of the idea can be conducted by a single market actor or by several market actors in collaboration, with a potential for lasting change among customers.

OVERVIEW OF RESULTS FROM RESEARCH AREAS

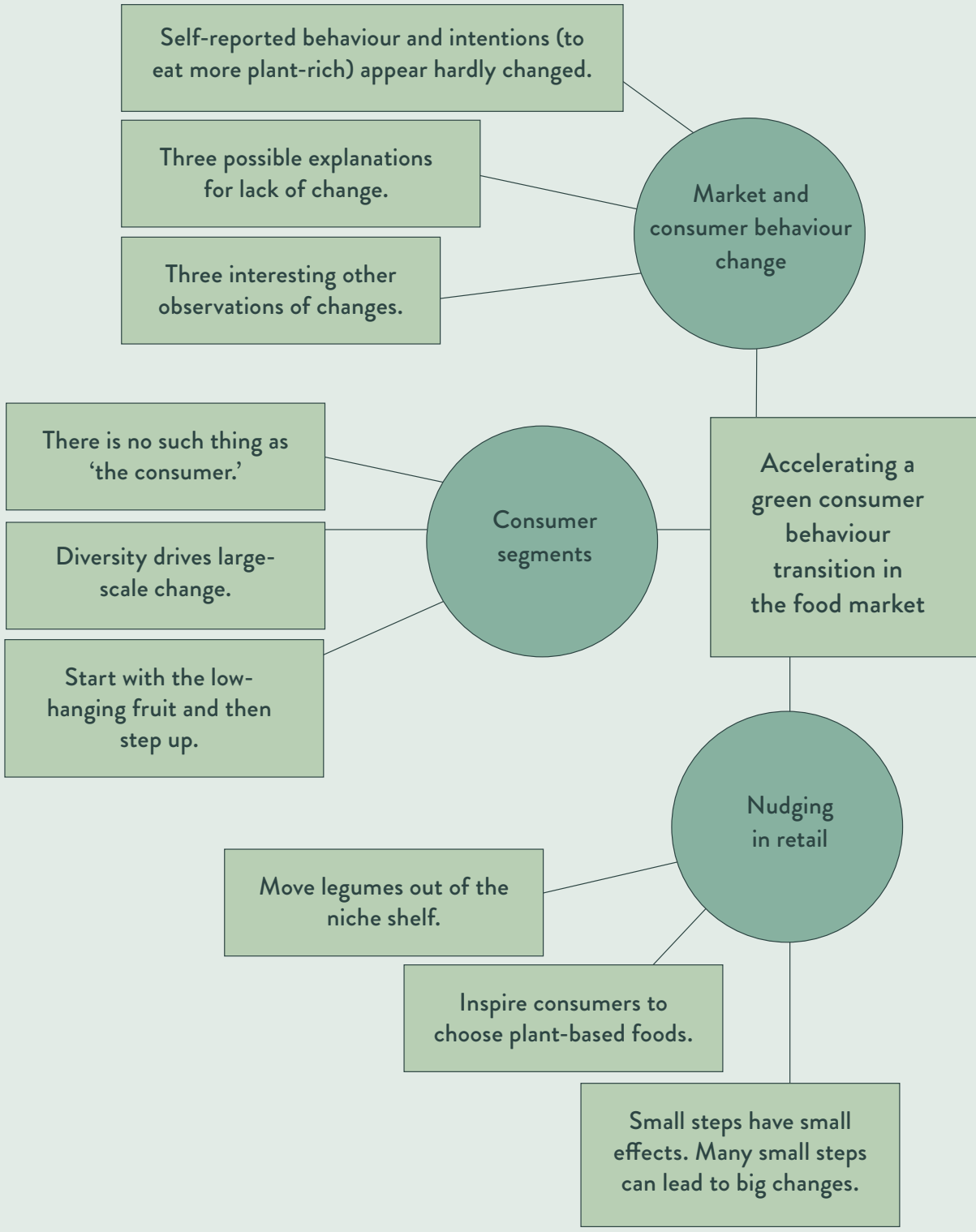
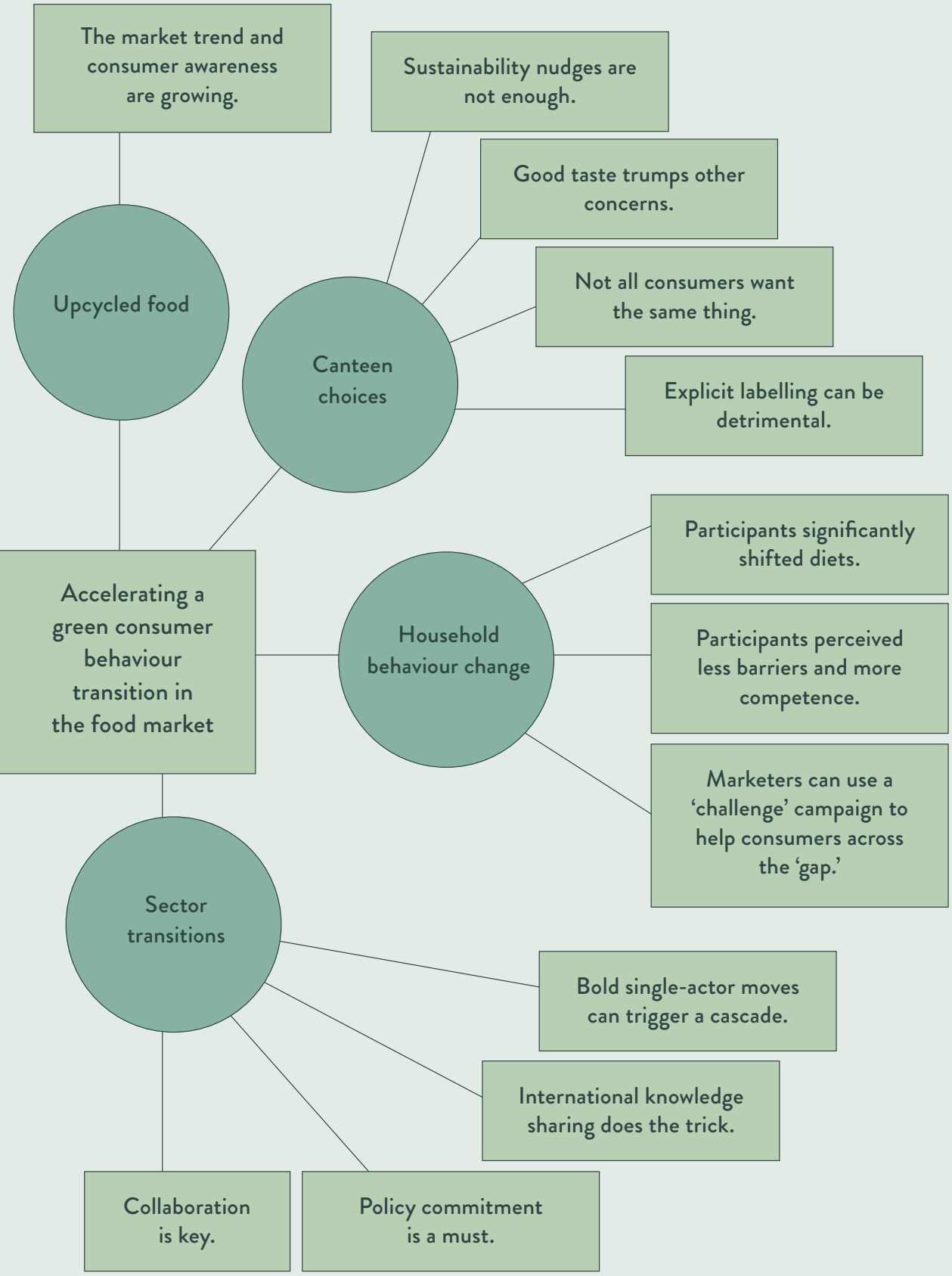


FIGURE 7
Overview of results


The market trend and consumer awareness are growing.
Sustainability nudges are not enough.
Good taste trumps other concerns.
Upcycled food
Not all consumers want the same thing.
Canteen choices
Explicit labelling can be detrimental.
Participants significantly shifted diets.
Accelerating a green consumer behaviour transition in the food market
Household behaviour change
Participants perceived less barriers and more competence.
Marketers can use a 'challenge' campaign to help consumers across the 'gap.'
Sector transitions
Bold single-actor moves can trigger a cascade.
International knowledge sharing does the trick.
Collaboration is key.
Policy commitment is a must.

ABOUT THIS DOCUMENT

This report is an outcome of the PlantPro project (grant nr 0224-00044B) funded by Innovation Fund Denmark. It constitutes the catalogue of results and recommendations with which the project finalizes. We refer to the already published studies of the project, but not all studies are yet also published in peer review – for these findings, consult the website or contact the researchers directly.

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Acknowledgement and transparency on involvement
This report is a joint product of the research team in the project. Only university employees from AU, CBS and KU were involved in the development of conclusions and the writing of this report. All researchers involved in the project research are listed in the following, with the researchers who actively co-wrote this report in bold: **Jessica Aschemann-Witzel, Meike Janssen, Michael Bom Frøst, Julie Hesselberg, Maureen Schulze, Michelle Tulloch, Maartje Mulders, Shirin Ziaei**, Catalin Stancu, Alice Grønhøj, Gabriele Torma, Simone Lykke Tranholm Mouritzen, Marianne Thomsen, Marijke Hiltje Hielkema, Elisavet Angouria-Tsorochidou, Adéla Plechatá, Michael Atchapero, Guido Makransky, Maja Michalewska and Merve Tengilimoğlu-Metin. Armando F. J. Perez Cueto Eulert, now at Umeå University, Sweden, was at KU and part of the team when the project was applied for, granted and in its first year. Thanks goes to Armando for his major role in making this project happen!

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APPENDIX

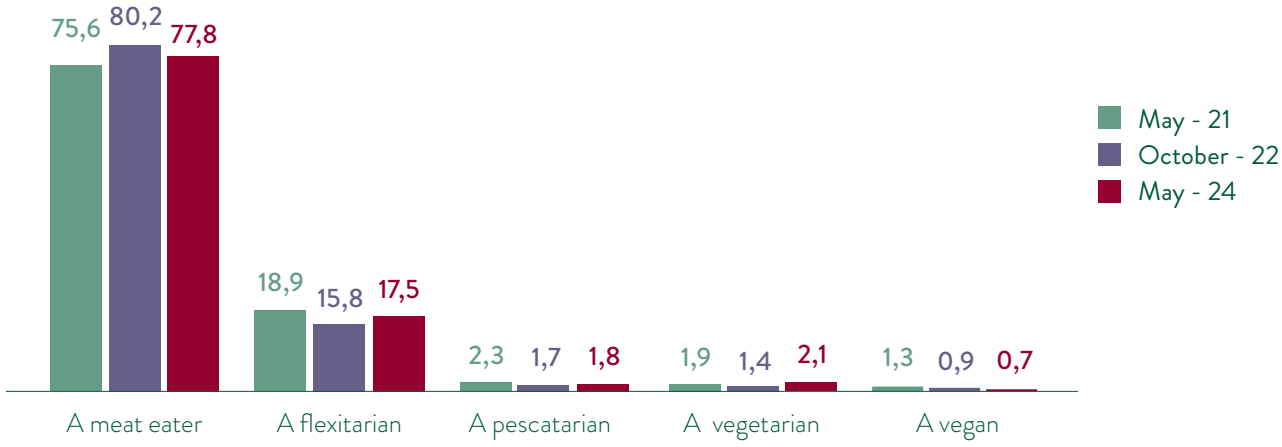

FIGURE 8

Eating style (in %). "I would describe myself as..."

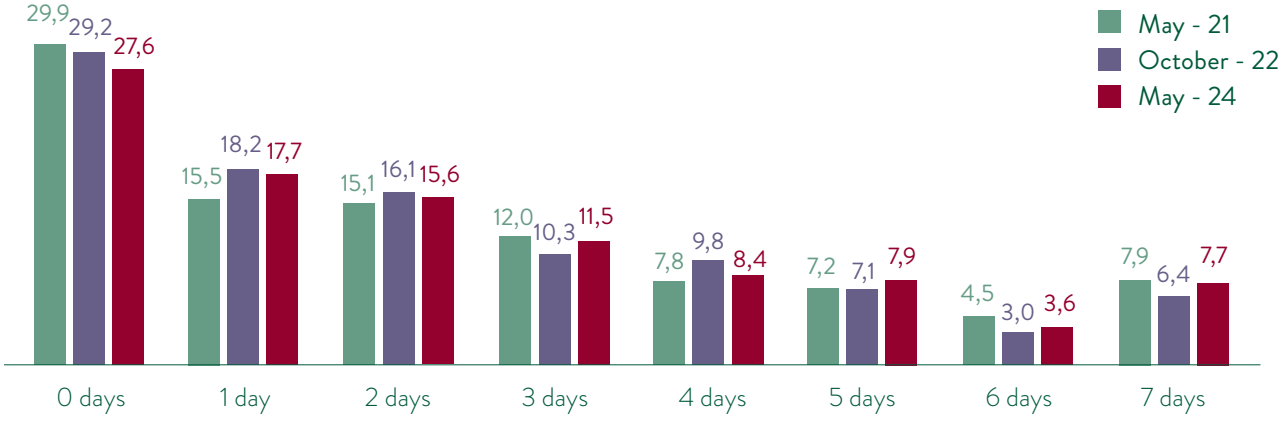

FIGURE 9

Meat free lunches (in %). "How many days per week do you eat lunch without meat?"

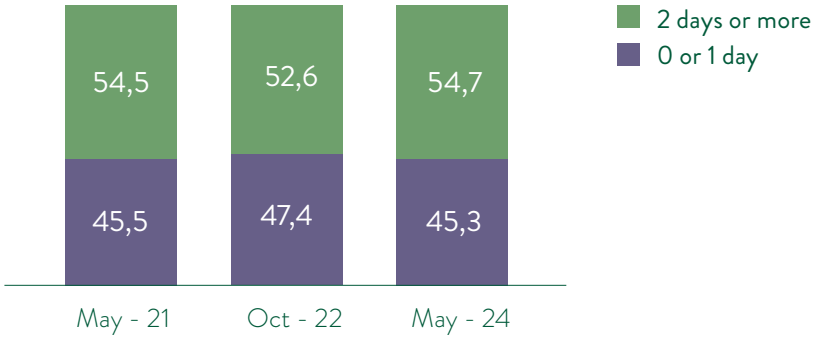

FIGURE 10

More or less than 2 meat free lunches per week (in %). "How many days per week do you eat lunch without meat?"

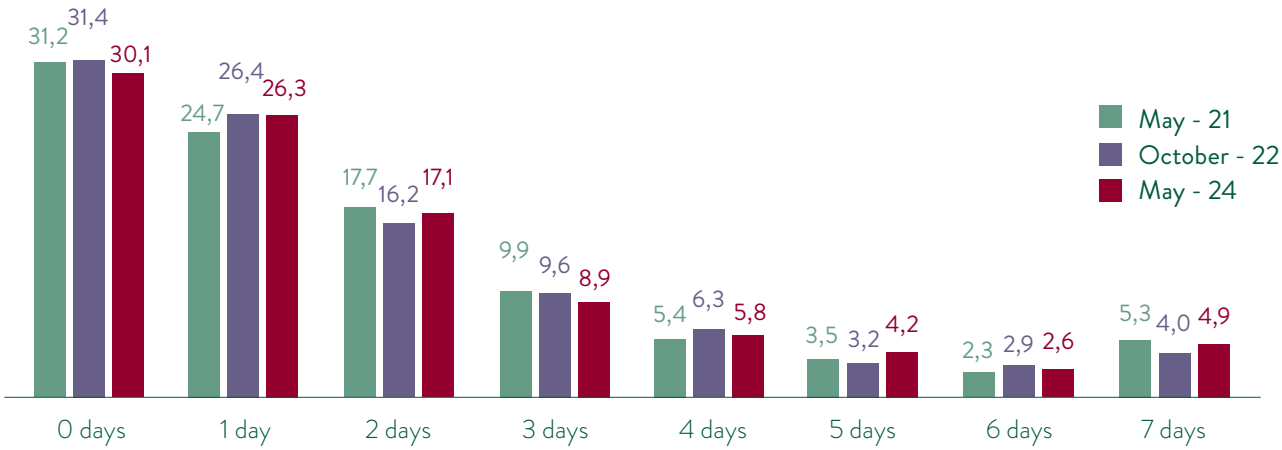

FIGURE 11

Meat free dinners (in %). "How many days per week do you eat dinner without meat?"

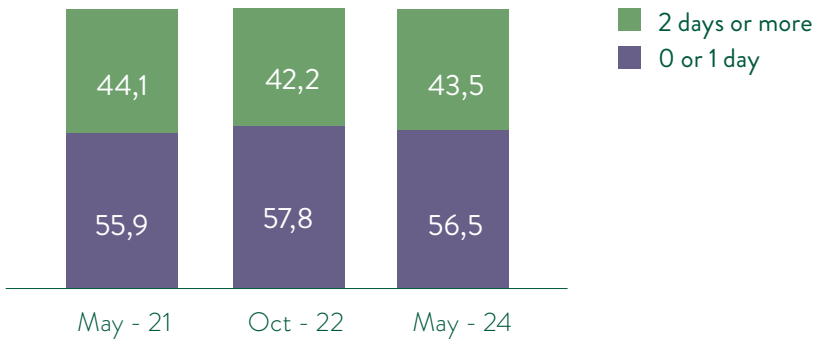

FIGURE 12

More or less than 2 meat free dinners per week (in %). "How many days per week do you eat dinner without meat?"

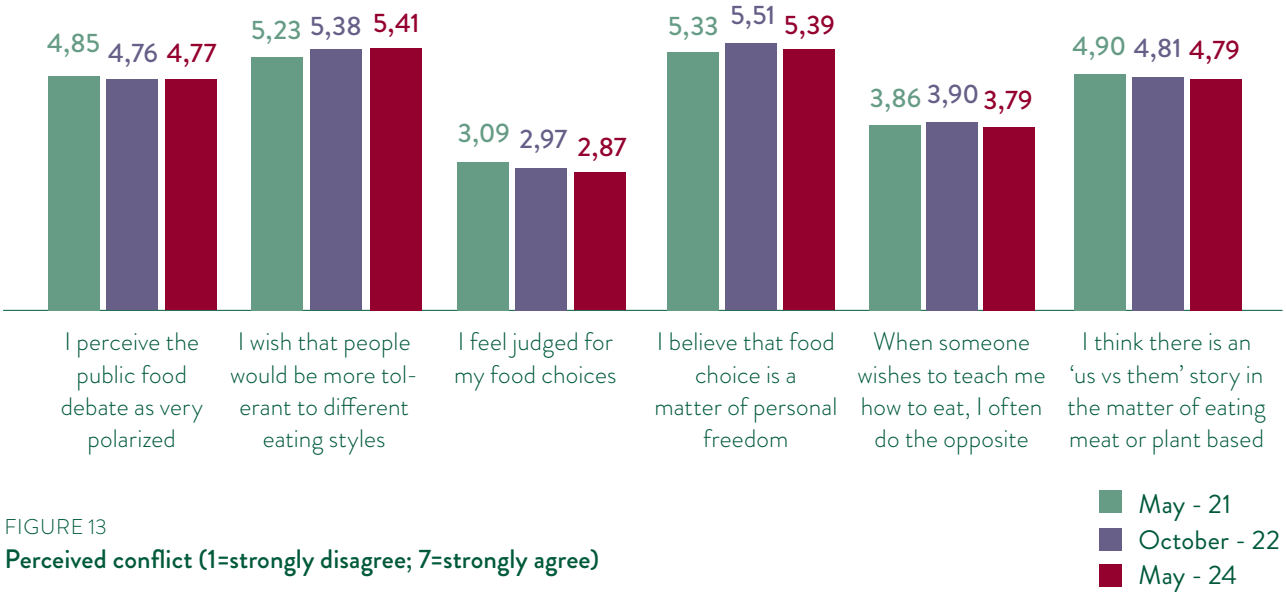

FIGURE 13

Perceived conflict (1=strongly disagree; 7=strongly agree)

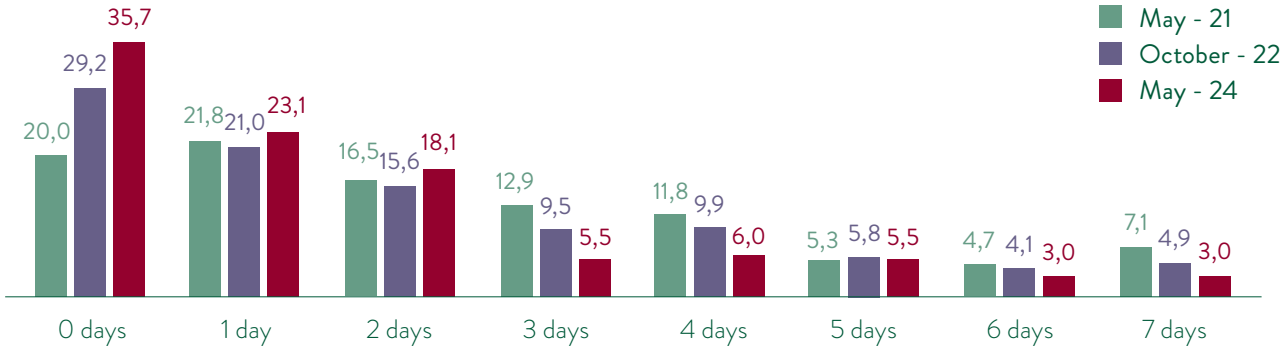

FIGURE 14

Meat free dinners for males between 18-34 years (in %). "How many days per week do you eat dinner without meat?"

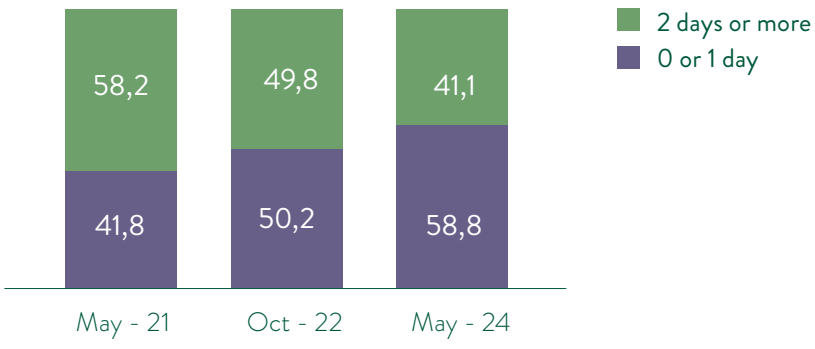

FIGURE 15

More or less than 2 meat free dinners per week for males 18-34 (in %). "How many days per week do you eat dinner without meat?"

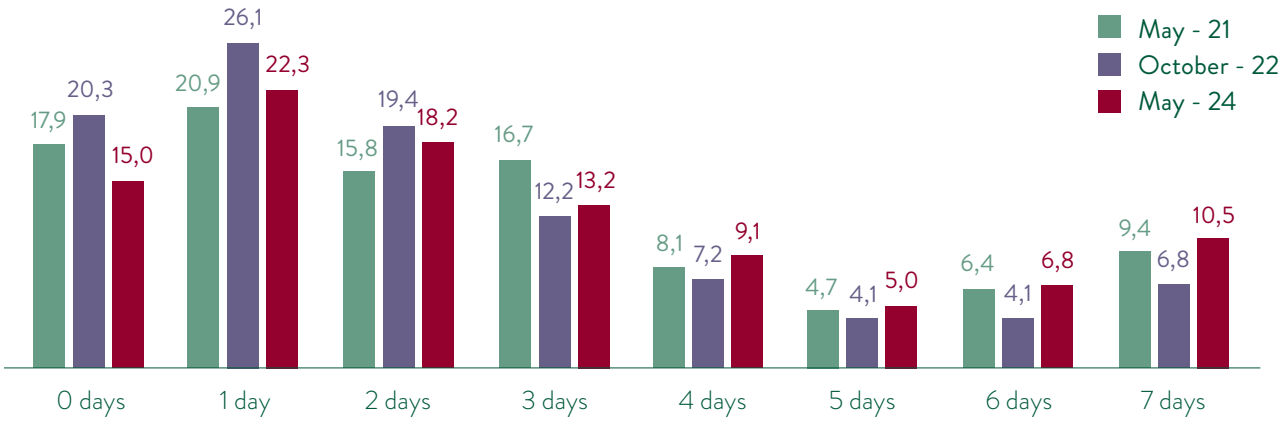

FIGURE 16

Meat free dinners for females between 18-34 years (in %). "How many days per week do you eat dinner without meat?"

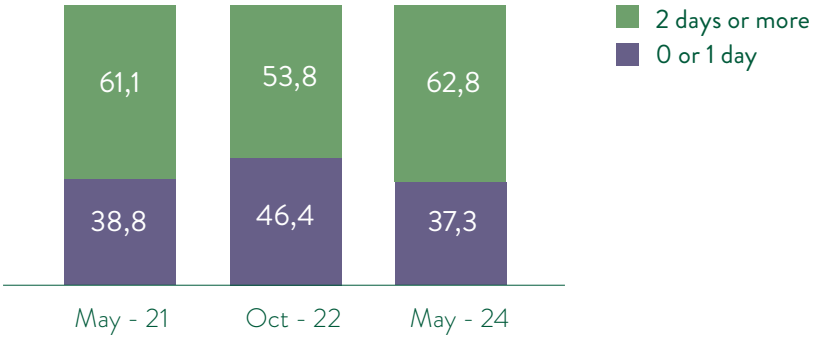

FIGURE 17

More or less than 2 meat free dinners per week for females 18-34 (in %). "How many days per week do you eat dinner without meat?"

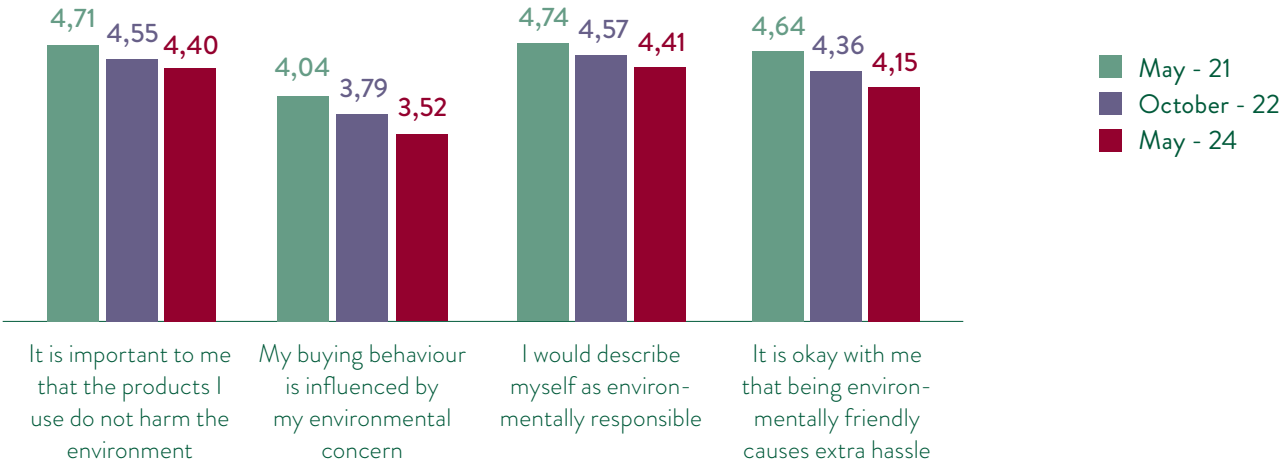

FIGURE 18

Environmental concern. (1=strongly disagree; 7=strongly agree).

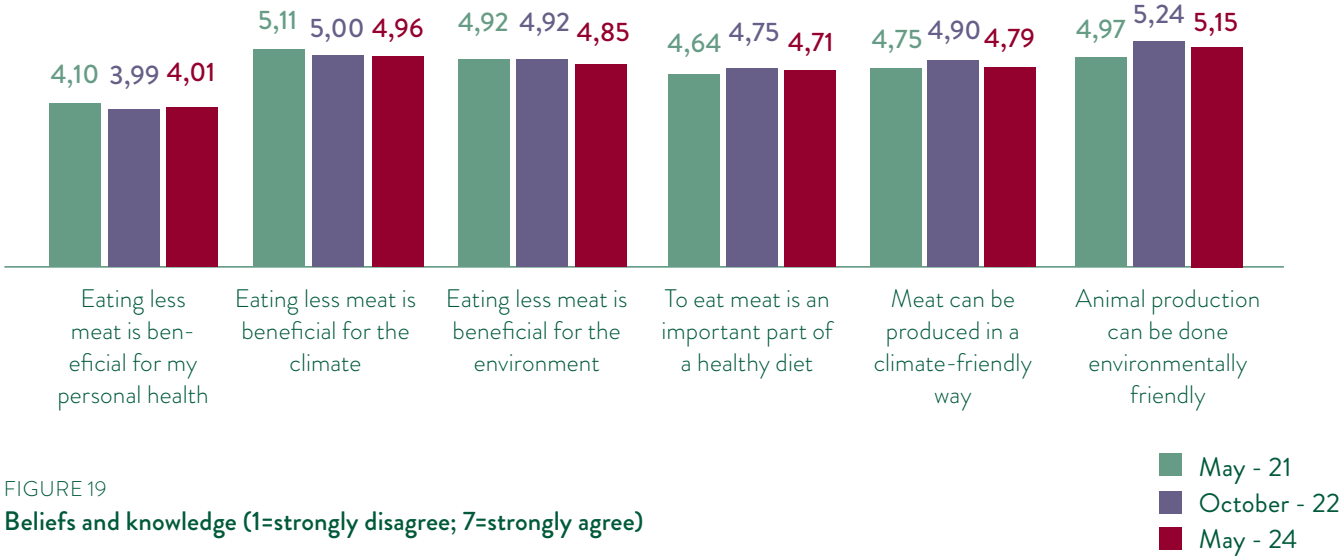

FIGURE 19

Beliefs and knowledge (1=strongly disagree; 7=strongly agree)

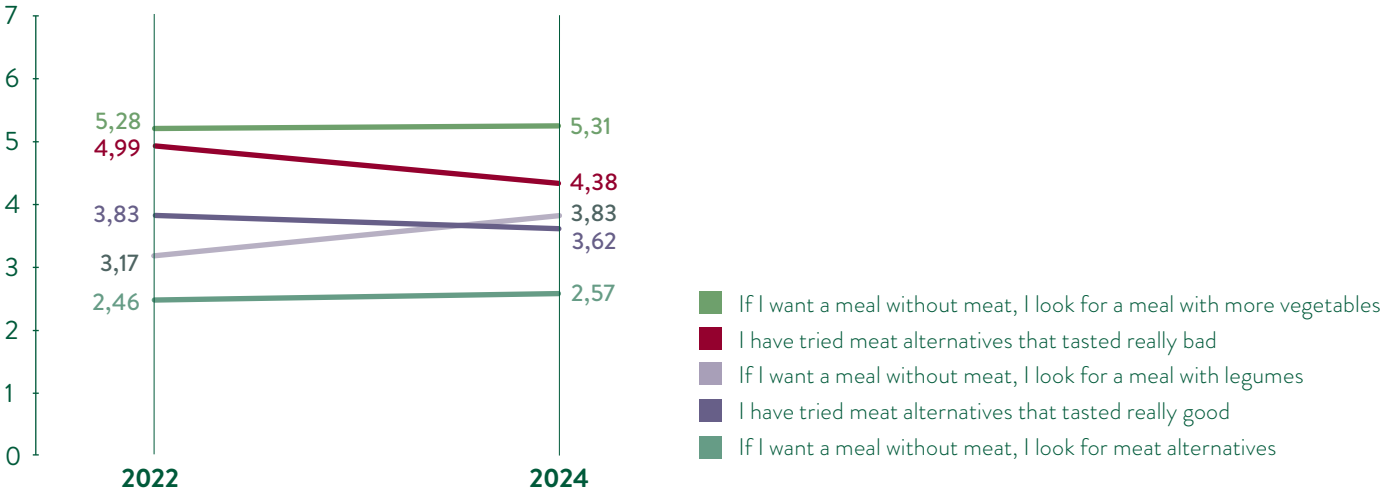

FIGURE 20

Meat alternatives (1=strongly disagree; 7=strongly agree)

FIGURE 21

Meat reduction in network. "How many people do you know who have reduced their meat consumption or who do not eat meat?" (1=nobody at all; 7=almost all I know)

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