

NEWSLETTER

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CLIMATE TECHNOLOGIES



INTERVIEW

**A NATIONAL FOOD ACTION
PLAN IS NEEDED**

MEHMET TULBEK



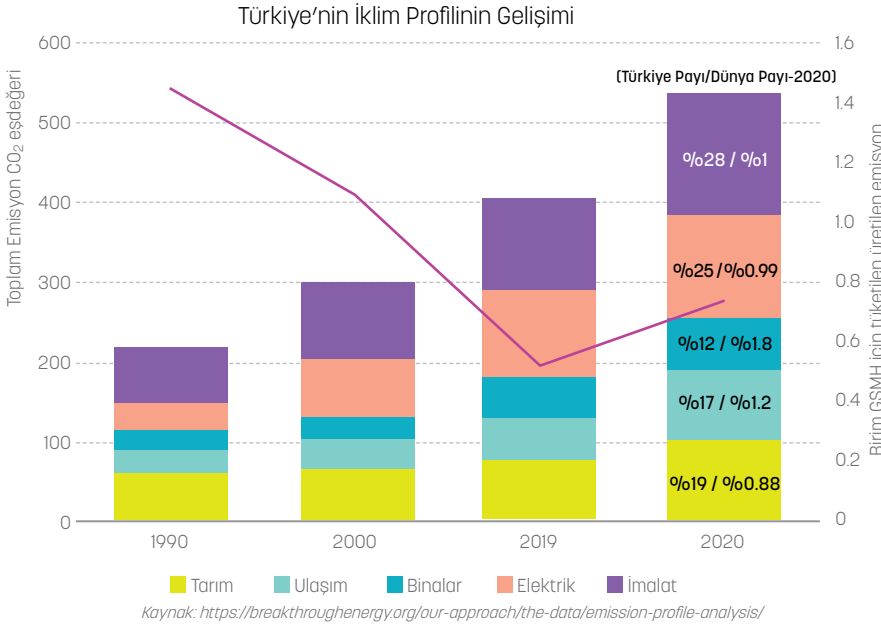
INTERVIEW

**THE MAIN RESPONSIBILITY FOR
CLIMATE CHANGE LIES WITH
PRODUCERS AND REGULATORS**

DOÇ. DR. BORA KAT

YEŞİL DÖNÜŞÜM MESELESİ

Dünya, Soğuk Savaşın sona ermesi ile yaşadığı küresel serbest yatırım ve ticaret döneminden, pandeminin tetiklediği üretimde sınırlara dönüş ve bilahare iklim değişimi kaygılarının belirleyici olduğu yatırım ve ticaretin yeni çerçeve kuralları ile çıktı. Önümüzdeki dönemde ekonomilerin üretkenliği kadar bu üretkenliği nasıl bir iklim etkisi ile sağladığı da belirleyici olacak. Bunun önemli göstergelerinden birisi de ekonomilerin üretimini ifade eden GSMH'nın birim üretiminin karbon salımı maliyeti. Bu anlamda daha az salım ile daha fazla üretim yapabilen ekonomiler önümüzdeki yüzyılın rekabetçi ekonomileri olacak.



İklim teknolojileri olarak adlandırdığımız yeni teknoloji paradigmasını dünyanın geçmişte yaşadığı teknoloji paradigma değişimlerinden ayıran temel özellik ise dönüşüm ihtiyacının sistemik bir inovasyon ve kapsamlı bir altyapı yatırımı olarak belirgenleşmesi olacak. Bir anlamda kademeli bir inovasyon sürecinden çok bilim ve teknolojinin belirleyici olduğu kapsamlı bir dönüşümden bahsediyoruz.

Bu dönüşümün üç ana noktası olduğu söylenebilir,

1. Bugüne kadar örneği olmayan ilk örnek alternatif teknoloji yatırımları
2. Değişen teknoloji paradigmasının sosyal kapsayıcılığı destekler şekilde KOBİ'ler üzerinden geniş kitlelere yayılması
3. Verimlilik gelişimini destekleyecek, alternatif teknolojileri araştırma ortamlarından, gerçek ölçeklere taşıyacak bir inovasyon sistemi

Tam da burada tüm bunları bir çatı altında birleştirerek analiz eden, yorumlayan, çözüm önerileri üreten ve öncül projeler geliştirme çabasında olan TTGV, mevcut programlarıyla yol gösterici olma hedefiyle çalışıyor.

33. yaşımızda "Teknoloji Üreten Türkiye" vizyonumuzla üretmeye, paylaşmaya devam.

DR. A. METE ÇAKMAKCI

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GREEN CEMENT: A SUSTAINABLE REVOLUTION IN THE CONSTRUCTION SECTOR



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In recent years, the global construction sector has been undergoing a paradigm shift towards sustainability with the ‘urgent’ need to mitigate climate change and reduce environmental impact. Green cement, which stands as the pioneer of this revolution, is a ground-breaking solution that offers reduced carbon emissions and enhanced environmental performance, emerging as an alternative to traditional Portland cement. On 16 March 2024, the Ministry of Environment, Urbanisation and Climate Change issued a communique stipulating the use of green cement in public construction works and cement procurement tenders. This communique is regarded as an important step in the construction sector by encouraging the use of green cement with low carbon emissions starting from the 1st of January 2025. In this context, cement containing recycled building materials constitutes an important example of innovation utilised to reduce environmental impacts, conserve natural resources and promote sustainability in the construction industry. However, as the quality and type of recycled materials used can affect the performance of the cement mix, these materials need to be carefully selected and processed. This policy, taken together with the TS EN 197-6 Cement - Part 6: Cement containing recycled building materials Standard, which entered into force last year, is considered as a concrete step towards reducing the environmental impact of the cement industry, while limiting the clinker ratio in cement use in the period between 2025 and 2029.

Analysing the business models related to green cement, it is possible to talk about a scale that brings together many critical stakeholders, enables different parameters to be activated at the same time and covers a wide range of scales. Business models in the green cement sector gain significant dimensions through co-operation partnerships between cement producers and technology providers. Vertically integrated models enable greater control over product quality and environmental standards by influencing the entire value chain from raw material procurement to production and distribution. Collaborative models, on the other hand, develop and commercialise green cement technologies by employing partnerships between cement producers, research institutions and government agencies, thus scaling up to promote knowledge exchange across the sector.



Impact Area of the Green Cement

The healthy functioning of the value chain in green cement is extremely important in terms of reducing carbon emission values and developing effective and efficient technologies in this direction. The green cement value chain covers stages such as raw material extraction, production, distribution and end-use applications. In contrast to conventional cement production, which relies heavily on limestone mining and high-temperature kiln processes, green cement intends to reduce both energy consumption and CO₂ emissions by using alternative raw materials such as fly ash, slag and recycled aggregates. Furthermore, advances in production technologies such as carbon capture and utilisation (CCU) and carbonation processes further enhance the environmental qualities of green cement, sequestering CO₂ emissions and minimising waste. In terms of distribution, adopting sustainable logistics practices such as railway transportation and public transportation minimises the carbon footprint as well as reducing negative environmental impacts. Finally, green cement includes a variety of applications in construction projects ranging from residential buildings to infrastructure projects, enabling it to offer a sustainable alternative for stakeholders connected to the construction sector without jeopardising product performance and durability.

Financing of The Green Cement

Another important parameter of good management of green cement processes is linked to the right financing approaches. The topic of financing green cement poses various challenges and offers opportunities to investors and stakeholders. While the anticipated costs of green cement production plants can be higher than conventional plants, the long-term cost savings and environmental benefits offer attractive incentives for investment. Financing mechanisms for green cement projects often involve a combination of public and private finance, including government subsidies, venture capital and corporate partnerships. Furthermore, innovative financial instruments such as green bonds and carbon credits offer alternative sources of financing for green cement initiatives and promote sustainable practices, aligning investor interests with environmental objectives. Moreover, the increasing emphasis on environmental, social and governance (ESG) criteria by institutional investors and asset managers has resulted in increased interest in green cement projects as part of sustainable investment portfolios.

Consequently, green cement constitutes a transformative force in the global construction industry by offering a sustainable alternative to conventional Portland cement. In this context, it has a role in significantly reducing critical environmental challenges. By adopting innovative business models, optimising value chains and leveraging appropriate financing mechanisms, the green cement sector serves as a major cog in the transition to a low-carbon future. As stakeholders become more attuned to sustainability, especially in the value chain dimension of the construction sector, green cement will be a beacon of hope for a more resilient and environmentally conscious building environment. In a period when reducing carbon emission values is extremely vital, it is very critical and necessary for both the world and Türkiye that sectors such as the cement sector, which produce very intensive quantities, can quickly adapt to green transformation.

THE MAIN RESPONSIBILITY FOR CLIMATE CHANGE LIES WITH PRODUCERS AND REGULATORS



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One of the leading roles in the process of combatting and adapting to climate change is obviously played by the economy. Countries that approach sustainable economic policies with a focus on climate change are also developing new structures with this awareness. **We discussed the policies of Türkiye, opportunity offering sectors and adaptation with Assoc. Prof. Dr. Bora Kat, Lecturer at METU Earth System Sciences Graduate Programme and Senior Scientific Programmes Specialist at the Directorate of Research Support Programmes of TÜBİTAK, who carries out his studies with a focus on climate economy.** Emphasising that climate change will affect developing countries even more, Kat pointed out that the main responsibility in this area lies with large producers.

What is environmental economics? Where does it intersect with climate change?

The economy, in its most general definition, can be defined as the sum of the activities of production, distribution and consumption of goods and services and the relations between these activities. In economics, these activities are handled in relation to three basic agents (producer, consumer and state). Liberal economic theory is based on the assumption that provided the necessary conditions are fulfilled in the markets, resources will be used in the most efficient manner and an equilibrium can be reached in which producers/consumers can realise their objectives at the highest level and supports this situation with a holistic theoretical infrastructure.

On the other hand, some of the assumptions foreseen for this equilibrium system, which has an impressive mathematics in theory, are not met in practice, resulting in what we call market failures. The most important of these are externalities, which can be defined as gains and costs incurred outside the market system. In the case of externalities, efficient allocation of resources becomes impossible. From the production aspect, negative externalities lead to overproduction and positive externalities lead to underproduction. Greenhouse gas emissions, which are the main cause of climate change, are among the negative externalities that create non-market costs and this externality needs to be corrected in one way or another. This is precisely the main intersection point of climate change and environmental economics.

Environmental economics is of course not a branch of economics limited to the climate change. Environmental and natural resources economics, which are often used interchangeably or together, is a science that also deals with how the production-consumption activities I have just mentioned and the policies towards these activities have an impact on natural resources and the environment in general. The most prominent of these effects is the changes in temperature, precipitation and air flow regimes that occur beyond natural cycles, in other words, climate change. Therefore, in recent years, environmental economics has mainly focussed on the economic impacts of climate change and the policies developed to prevent this change from reaching an irreversible point.

Until very recently, the reality of climate change was being

“The main threats to the transition to a low-carbon economy can be listed as the failure of technologies for the capture of emissions and technologies for the utilisation of hydrogen, for which intensive research is ongoing, to achieve the expected performance or to reach the targeted levels in terms of cost later than envisaged.”

questioned, and opinions were presented that the changes we are experiencing are simply part of the natural cycle of the planet. Today, however, we have extensive scientific data supporting this change and we know that this change is a human-induced change, unlike any other climate cycle experienced in history. Unfortunately, today we are witnessing these changes clearly even in a very short period of time such as a human lifetime. We can clearly observe the increase in the number of extreme weather events we have encountered in recent years. These events also affect economic activities either directly or indirectly. For example, their impact on agricultural production affects the quality and price of agricultural products, employment and added value in this sector, savings and expenditures of households that derive their income from this sector, incentives for this sector, tax revenues from this sector, and thus, in a cascade, many sectors, consumers and even the state; similarly, changes in rainfall regimes affect the amount of electricity generated from dams and the distribution of generation over the year, electricity prices, and thus the economic activity of other manufacturers in the sector and, of course, consumers and the operations of the system operator.

Of course, there is also the economic impact of policies that attempt to slow down environmental impacts and bring them back from the irreversible threshold. In other words, changes in the price and production balances that will emerge in the near future within the framework of concepts that have recently entered our economic system and daily life, such as the emission trading system and carbon tax at the border, and their reflections in the context of producers, consumers and the state are among the main issues addressed by environmental economics.



Climate Change Will Affect Underdeveloped Countries Even More

What impact does climate change have on economic growth performance? How can economics contribute or help us to understand this global crisis?

The economic growth achieved through economic activities without taking into account the environmental impacts I have just mentioned during the period that started with the industrial revolution and resulted in climate change continues today, even though it is interrupted from time to time for different reasons. Nevertheless, nowadays, when we have reached the point of no return without the implementation of coordinated, urgent and radical measures and policies on a global scale, studies demonstrate that this growth cannot be sustainable with climate change. The obstacles faced by sustainable growth can be listed as productivity declines brought about by climate change, increasing individual and social health problems, anticipated sharp declines in agricultural areas and crops, etc. Furthermore, there are many studies indicating that there are significant decreases in the economic value of the services provided by the ecosystem, which is also one of the issues addressed by environmental economics.

All these issues I have mentioned are also valid for our

country. Nevertheless, the main point I would like to emphasise is that almost all of the researches indicate that climate change will affect underdeveloped countries and developing countries to a greater extent.

Different Policies Are Needed

How can we benefit from economic models in climate and environmental issues?

In the science of economics, problems that describe both the behaviour of agents in the economy and the relationships between them have been clearly defined. We can construct sectoral models that deal with these problems in an integrated structure or models representing regional/global markets. We decide on the structure of the functions needed in these models and the parameters of these functions based on many data such as production, consumption, trade, savings, investment, tax, added value and other data that take place in the markets. These models have been applied in analysing many different policies for many years. In other words, analyses of a wide range of policies such as foreign trade quotas, newly defined or changed taxes, incentive programmes, shocks caused by exchange rate fluctuations, employment programmes and so on have been carried out by using these models.

On the other hand, for the problems we face due to climate change and environmental problems, strong evidences that these problems emerged as a result of economic activities have started to be presented starting from the last quarter of the 20th century. Then, since the beginning of the 21st century, it has been demonstrated that these effects are now undeniably human-induced. Eventually, it has become clear that different policies are needed to address these problems before they reach a point of no return. Analysing these policies, some of which are designed within the framework of direct restrictions or sanctions and some of which are designed within the framework of market mechanisms, during the development phase or analysing the impacts after implementation, has become possible with the comprehensive updating of these models in which the environmental dimension was handled in a limited manner before 2000.

In conclusion, many policies such as how a carbon tax to be imposed on certain sectors or economic activities will have an impact on the production, consumer groups

and equilibrium prices of different sectors, how different carbon tax values change these equilibria, similarly, the economic effects of an emission trading system and different allocation methods in this system, the sectoral effects of carbon border adjustment can be analysed in detail within the scope of these models.

CBAM has an Accelerating Function in the Transition to Cleaner Technologies

“Transition to a low-carbon economy” has started to be discussed more extensively with the Carbon Border Adjustment Mechanism (CBAM). Based on this, how would you evaluate the way the public and private sectors address climate change?

I have the opportunity to closely observe that CBAM is taken seriously in both the public and private sectors. Although the CBAM constitutes only one of the parts of this process, it is one of the most discussed parts due to its timetable, which requires rapid action alternatives to be addressed and thus serves as a starting point for longer term goals.

We also observe that there are comprehensive studies in which the public sector analyses the impacts that will arise under this regulation, and that the institutions that fund research and development activities in the public sector prioritise the development of technologies/policies that will reduce the impacts of the Green Deal in general and the CBAM in particular.

I believe that the CBAM functions as an accelerator to set short and medium term clean technology transition targets in line with the national declaration of intent, in addition to the long term net zero emission targets within the scope of the models carried out for different sectors, to which I also made contributions in modelling studies. This implies that there is a trade-off in terms of timing and technology options for how producers need to pursue a strategy for long-term net zero conversions. It is a trade-off between leaving the interim transitional solutions, which require less investment but provide short-term advantages, and the actual technological transformations that will enable net zero targets to be achieved at a later date, and starting this transformation today.

For these decisions, which depend on the existing structures of the sectors and technology projections for the relevant sector, economic and sector models developed within the

framework of environmental economics are needed.

The Biggest Advantage of Türkiye is the Field of Energy

What advantages and disadvantages does the transition of Türkiye to a low-carbon economy offer?

I think that the biggest advantage and opportunity ahead of Türkiye is the energy, perhaps because my studies are mainly in this field. In Türkiye, according to the latest published statistics, the largest share in total greenhouse gas emissions, which reached 564.4 Mt CO₂ equivalent by 2021 (the current data announced by TÜİK after the interview was made is 558.3 Mt CO₂), is stemming from energy-related emissions, as it is the case throughout the world. The largest component of these emissions is the electricity sector. In this context, taking into account the potential of our renewable resources and technological developments in this sector both nationally and globally, it is possible to significantly reduce emissions stemming from electricity generation with relatively less cost and effort. A number of recent studies demonstrate that short-term national targets in the electricity sector are easily achievable, while long-term net zero targets can be achieved through flexibility mechanisms such as storage technologies, international transmission capacities and demand side management. On the other hand, the main threats to the transition to a low-carbon economy can be listed as the continued expansion of coal-fired power plants, the failure of technologies for the reduction of process emissions, technologies for the capture of emitted emissions and technologies for the utilisation of hydrogen, for which intensive research is ongoing, to achieve the expected performance or to reach the targeted levels in terms of cost later than envisaged.

The concept of “twin transformation” (green and digital transformation) is on the agenda rather than green transformation. When viewed structurally, it can be difficult to define the position of technology in both the energy sector and industry. How do you think technology is positioned in the transition to a low-carbon economy? What are the examples from the world and Türkiye in this regard?

Yes, practices and academic studies that address green transformation and digital transformation jointly under

the title of “twin transformation” have recently started to gain momentum. Digital transformation, which has gained momentum since the end of the 1990s and reached a very wide scope, contributes to the achievement of green transformation in different dimensions, as in many different economic activities, and it is obvious that this contribution will increase gradually. Opening up these dimensions, first of all, it can be possible to monitor and interpret to what extent climate change has reached and which indicators are approaching critical thresholds thanks to advanced measurement and data collection technologies and analysis tools. On the other hand, the data collected with the help of these technologies and advanced prediction algorithms and decision support systems supported by advances in artificial intelligence, especially in recent years, provide benefits in many different forms from agriculture to the service sector, from operational decisions to strategic decisions, from micro scale to global scale, while enabling more efficient utilisation of resources. For instance, concepts such as “Smart Grids” and “Virtual Power Plants”, which have also recently been put into practice, enable digital technologies to overcome problems in the electricity sector and offer much more economical solutions. We are pleased to observe that there are many initiatives contributing to the twin transformation in our country, especially in the electricity sector, and some of them have been growing rapidly. These initiatives create added value with many different services such as demand forecasting, price forecasting, large-scale monitoring and control systems. In the near future, I believe that micro-scale initiatives will gain significance.

Emphasis on Partnership

What needs to be done to raise awareness in the decarbonisation process in the sectors? How should the public and private sector respond? What kind of a path is followed in terms of policies abroad?

Options for transitioning to a green energy and economy need to be incorporated into national policies. Should this not happen fast enough, it is important for private companies to start forming partnerships with their buyers and product users. In case European buyers need to purchase carbon neutral materials from Türkiye, they need to be open to co-developing and co-operating on these projects. It may also be easier to attract the interest of global financial institutions if the end buyer has a long-term or fixed quantity purchase commitment.



The Main Responsibility Lies with Producers and Regulators

What are your thoughts on the fact that the changes in consumption patterns of individuals will increase the use of climate-friendly products and consequently, production will change?

Individual efforts have importance, of course. In my opinion, the current state of these efforts remains only marginally decisive in transforming the production practices and strategies of goods and service providers, yet they are important in terms of raising awareness, transferring these efforts to new generations and spreading collective consciousness. Nevertheless, I would like to emphasise that the main responsibility must be borne by the regulators as well as the large producers who have benefited from these efforts and continue to do so. It is critical for individuals to come together and collectively make demands and support local governments and policy makers to fulfil these demands. It is also worth mentioning the concept of climate justice here. Climate change does not affect different social groups and organisms to the same extent. When we consider the groups that are most vulnerable to this change, even though they have the least impact on its occurrence, I think it is obvious that the envisaged efforts must be put forward predominantly by the regulators and the groups that actually benefit from the path to climate change.



ALTERNATIVE PROTEIN TECHNOLOGIES



DR. AYŞE SEVER AKDAĞ

TTGV Pioneer Project Program Specialist

Climate technologies assume an important role in minimising the disruptions in the primary needs of humanity such as nutrition due to the climate crisis. As TTGV Pioneer Project Programme, we have carried out one of our deep analysis studies on food and submitted our Alternative Protein Technologies Deep Analysis Report to the public.

It is well known that with the increasing impacts of climate change on daily life, food sustainability and food security have become important issues. On average, 37% of the total protein supply worldwide is derived from animal and 63% from plant foods. In developed countries, the share of animal-based protein is much higher (55-60%). In developing countries, the demand for animal production has been increasing with each passing day due to rising income levels and supportive government policies. According to United Nations (UN) data, the world population, which is currently 8 billion, is expected to reach 9.8 billion in 2050, and global meat consumption is expected to increase by 50% or more, with large regional differences.

How will we get enough protein to feed the entire population?

But how will we get enough protein to feed a growing global population? Are current industrialised livestock farming activities sustainable? The answer to these questions is far from being pleasant. Since industrial livestock farming accounts for 14.5% of global greenhouse gas emissions from anthropogenic sources, which reach 59 billion tonnes of CO₂e annually, and 30% of global methane emissions. Expansion of grazing and cropland for livestock causes loss of biodiversity. More than 40% of total agricultural water consumption is used exclusively for animal feed production. Furthermore, industrialised animal production systems result in soil erosion and loss of soil structure and nutrients, while the leakage of fertilisers, pesticides and other chemicals into ground and surface waters as a result of intensive crop production for animal feed causes widespread water pollution and eutrophication.

Another question is whether industrial animal husbandry activities are efficient? Unfortunately, it is not possible to give a positive answer to this question with the information that a cattle needs to consume 25 calories of food to produce 1 calorie of meat and that 77% of the world's agricultural land is used for animal husbandry, but the share of animal-sourced foods in the total protein supply is low, as mentioned at the beginning.

Finally, the question of whether industrial livestock farming activities are safe may be asked. Currently, 73% of all antibiotics sold worldwide are used in livestock production, and deaths due to antimicrobial resistance are increasing annually. Some animal food production systems are associated with an increased risk of zoonotic diseases. Considering the recent pandemics, it would not be wrong to say that animal husbandry activities pose a threat to public health. Additionally, the fact that tens of billions of animals are raised and slaughtered every year raises concerns about animal welfare.

Sustainability of Food

When factors such as the increase in the frequency and severity of extreme weather events owing to climate change and the rise in geopolitical tensions are added, serious concerns are raised about the sustainability of existing food systems and food supply security.



Furthermore, studies demonstrating that even if fossil fuel emissions were eliminated right away, emissions from the global food system alone would make it impossible to limit warming to 1.5°C underline the need to reduce greenhouse gas emissions from the food system. For these reasons, states have started to put on their agenda the subject of how traditional food systems can be transformed into sustainable food systems. In this field, along with practices such as digital agriculture strategies, the topic of “alternative protein technologies”, which aims to produce protein-rich, sustainable new food and feed sources, comes to the forefront. At the recent COP28, a report prepared by the UN Environment Programme (UNEP) on “alternative proteins” was submitted. In this report, it is emphasised that alternative proteins can play an important role in the combat against environmental problems such as land degradation, deforestation, water and soil pollution, loss of biodiversity, in addition to their potential to create a sustainable and resilient protein balance and reduce greenhouse gas emissions from the global food system.

What Kind of Studies Are There?

Plant protein concentrates/isolates obtained by extraction from various plant sources are used in the alternative protein sector in the development of plant-based meat and fish products as well as plant-based milk, yoghurt, cheese and eggs. Presently, the next generation



“Presently, the next generation of plant-based meat products is no longer only targeting the vegan/vegetarian segment but also the fast-growing flexitarian consumer group.”

of plant-based meat products is no longer only targeting the vegan/vegetarian segment but also the fast-growing flexitarian consumer group. These products are developed using new technological methods and aim to provide a more realistic meat experience by replicating the organoleptic characteristics of traditional meat, such as taste, smell, texture and colour, down to the finest detail. However, the attempt to make plant-based products “look like” animal products places many of these products in the category of over-processed products and raises concerns about their health benefits. Nevertheless, plant-based proteins remain the most advanced of today’s alternative proteins in terms of scale, availability and acceptability.

Along with biotechnological developments, “biomass fermentation” technologies, where proteins such as algal protein, mycoprotein, etc. are derived, and “targeted fermentation” technologies, where target proteins such as milk, egg, collagen, heme, etc. are produced, have been attracting a lot of attention in the alternative protein sector in the recent years. Although studies on metabolic design of microorganisms, raw material design and bioprocess improvement for more efficient production of fermentation-based proteins continue rapidly, the difficulty of “scaling up” constitutes the biggest obstacle to the production of these proteins. It is expected that the potential to use alternative and low-cost raw materials (food waste, agricultural waste, domestic/industrial

waste, etc.) in fermentation processes will not only make it possible to reduce production costs but also contribute to waste management. The company titled Quorn produced a meat-like product for the first time with the protein obtained by biomass fermentation from a filamentous fungus species called *Fusarium venenatum*. So far, 3 companies (Perfect-day, Remilk, Imagindairy) that produce whey protein as a targeted fermentation product have received FDA approval. While the company titled Impossible Foods produced soya leghaemoglobin by modifying yeast microorganism, the company titled New Culture (USA) produced non-animal casein protein which received “Generally Recognised as Safe” (GRAS) status for the first time. Furthermore, it is known that some companies (Solein, Air Protein, etc.) that produce fermentation-based proteins with microorganisms that can use gases such as CO₂, CH₄, H₂ have been commercialised. These examples can be multiplied; according to Good Food Institute (GFI) data, there are currently 104 companies interested in fermentation-based protein production worldwide.

Cultured meat is obtained by developing and differentiating stem cells extracted from the muscle tissues of animals in bioreactors provided with a suitable growth environment and transforming them into mature muscle cells and larger muscle tissues. The first cultured meat was produced by Prof. Mark Post in 2013 and served as a hamburger patty, costing \$330,000

for about 142 grams (5 ounces). This development is regarded as a milestone for cultured meat production and the starting point of the industry. Currently, there are approximately 170 companies involved in the production of cultured meat & seafood by cell culture and many of them have been making significant progress in product development and increasing production capacity. One of the current research topics in this field is the development of growth media containing purely plant sources. Progress has been also made towards producing not only muscle, but also fat with the same technology, resulting in more flavourful products. Food safety agencies in several countries (Singapore, USA, Australia and Israel) have assessed that cultured meat is safe for consumption. Despite these advances, however, cultured meat production processes are still in their early stages and require pharmaceutical-grade raw materials at extremely high costs. There are still scientific and practical challenges to be overcome before the culture meat can be produced at commercially viable scale and cost levels and made available to consumers. For example, the supply of raw materials and fermenters is still insufficient. Furthermore, environmental footprints need to be verified when industrial-scale production is undertaken. Additionally, “food” is strongly tied to culture and identity in many countries and therefore there is likely to be strong resistance to the acceptance of new foods such as cultured meat. For example, the Italian parliament approved a bill in 2023 to ban the sale or import of cultured meat.

Insects are believed to offer an opportunity to utilise food waste and convert these products into proteins, thus providing the possibility to increase protein supply without the need for additional resources. Nevertheless, the use of insects as human food (entomophagy) is hampered by several factors, such as the difficulty of cultural acceptance. Therefore, at a time when the availability of fishmeal is declining and the sustainability of soya production is being questioned, the main use of insect proteins appears to be as a feed ingredient or pet food ingredient in poultry, pig and seafood farming. However, for the time being, insect meal (~1400 Euro/tonne) is similar in cost to fish meal, but more costly than soya meal (~460 Euro/tonne). Therefore, it would not be wrong to conclude that there is a long way to go. There are major insect producers in Europe (France is leading the way), the United States of America and Asia.

With the combination of different technologies, it is expected that over time there will be consolidation among alternative protein companies and hybrid alternative protein end products with improved functionality, taste and texture will be developed using ingredients produced by using these different technologies. However, the bioavailability of alternative proteins can vary depending on their origins and how they are produced and processed. For this reason, it is well known that further research (toxicological testing, determination of scores such as DIASS / PDCAAS, etc.) is needed to understand their nutritional adequacy and effects on human health.

What are the Projections?

The future market growth of alternative proteins and their ability to compete commercially with subsidised conventional sources depends on the scale-up of these technologies, the reduction of production costs, and acceptance by consumers (food consumption has socio-cultural, socio-psychological, ethical, social and religious dimensions). To solve the scaling problem, which is seen as the biggest bottleneck in the production of alternative proteins, alternative protein producers need to be ensured that the market is profitable and reliable. At this point, in addition to private investment, it is desired that governments provide research funding for alternative proteins, offer commercialisation financing and improve regulatory approval processes/legal frameworks. Each country, region, geography and culture will develop its own strategies and roadmaps on how to integrate alternative proteins into existing protein value chains. In Türkiye, it is important to work on additional protein sources that can support the growth of the circular bio-economy. The key to creating a fair and sustainable food system, ensuring our food security and not falling behind in the rapidly developing field of biotechnology is to develop our alternative protein sector that can enable more protein production with fewer resources and to support the entrepreneurial ecosystem operating in this field.



A NATIONAL FOOD ACTION PLAN IS NEEDED



MEHMET TULBEK

Chairperson of Canada Saskatchewan Food Industry Development Centre

INTERVIEW : Esra YAZDIÇ DEMİR

TTGV Corporate Communications and Media Manager

The climate crisis and the decrease in agricultural areas facing the population growth and the difficulties in access to food have left countries with the question “What should we do?”. While alternative proteins emerged as the answer to this question, it also revealed the depth of the fields to be studied in climate technology.

As the Technology Development Foundation of Turkey (TTGV), we have prepared the “Alternative Protein Technologies Report” by going deeper into agriculture, food and forestry, one of the five vertical areas we work in. Within this framework, we had an interview with one of the most influential names in the world, Mehmet Çağlar Tulbek, the Chairperson of the Food Industry Development Centre of Saskatchewan, Canada, on the future of alternative proteins, how they are received in the world, legal processes, cost analyses, cultural differences and common misconceptions. Tulbek underlined the necessity for Türkiye to have a national action plan on food safety and explained the need for alternative proteins and the reasons for this.

Alternative Protein is a Need

What is the future of alternative proteins? Why does the world need it?

Alternative proteins are particularly important for consumers because the need for such products is growing rapidly as a result of demographic changes. Let's consider this in three stages.

The first consideration is the interest in alternative products. The number of people consuming these products is increasing.

The second consideration is that the world population will be approximately 9.5 - 10 billion in 2050. Alternative protein emerges as products that will fill the gap in terms of food and feed people better.

The third consideration is that producing alternative proteins has a lower carbon emission in terms of energy transformation, carbon gas emission and environmental impacts compared to conventional products. This is an important point especially for general consumers. It is seen that new consumers consume products with lower carbon emissions. When we ask consumers in Northern Europe, North America and Canada, they respond that they prefer to consume more ecological products.

Which products or technologies do you think will dominate the future of alternative proteins?

The use of natural, plant-based, soy, pea, broad bean, bean, oily seed proteins transformed into different products. Re-evaluation of cereal proteins from oats, wheat, barley and others. Extraction of protein products such as fodder plants such as alfalfa, which we call feed protein, shelled products such as hazelnuts, peanuts and



You can find the video of our interview with Mehmet Tulbek here.

plant proteins such as mushrooms and the use of proteins derived from the leaves of plant products.

Finally, the utilisation of proteins in food waste. When we look at it, the protein coming from soy, mushroom and wheat is different. These are extracted and fractionated and used as alternative proteins.

The second main heading is the proteins used and produced in the field of fermentation and bioengineering. Studies on the production of protein by using sugar or sorbitol, the raw material of sugar alcohol and using it as a result of some microorganism production activities.

A number of studies are also being conducted for the production of culture proteins. In this process, cell culture based on replication is mostly employed. That sector will also show serious development.

These technologies can be categorised under three main headings: one that is extracted entirely from the raw material, one that utilises microorganisms and converts carbohydrate sources into protein, and another one based on the production of cell-derived protein. Each of these technologies has different costs, durations and yields. Prices are also shaped according to the yield and transformation cost. Today, the most suitable proteins seem to be soya and pulses, i.e. grain proteins, but as new technologies are developed, other proteins will also be accessible at affordable prices.



The Supply Chain Should Be Shortened

There is also the issue of acceptance and cost of these products for the consumer. Alternative products are more expensive today. What is the reason for this? How will it be in the future? What are the factors affecting consumer acceptance?

Alternative proteins are very expensive in certain countries. The first reason for this is that the raw material is not always processed where it is produced. It is processed elsewhere and sold elsewhere. When we look at the supply chain, the supply chain of products is very complicated.

In Saskatchewan, we produce a significant amount of peas, chickpeas and grains, but these products are not always processed here. The products are sent to other provinces, the United States or China as raw materials. They are processed there. It is divided into three as protein, starch and fibre. Then it goes back to North America. After this process, the company that purchases the product turns it into meat and turns it into a kind of meatball with some forming technologies. The products are offered to the market in this manner. However, the supply chain for such products is very complex.

The situation is the same in Türkiye, because the raw materials come from the United States, China and Europe. When they are returned to Türkiye, when customs clearance and nationalisation prices are taken into consideration, they are again increased to a certain cost and when a vegan product is made, the cost is quite high. The same type of problems exist in Canada and the United States.

One of the biggest conditions for the costs of these products to be identical is to shorten the supply chain. In the event that the supply chain is shortened and the transformation and introduction of the manufactured product to the market is carried out in nearby regions, both the price will decrease and the carbon emission will be lower accordingly. When a general cost analysis is made, the countries where the prices are the closest are the European Union countries. Because the distances and supply chain are the closest to each other in the European Union.

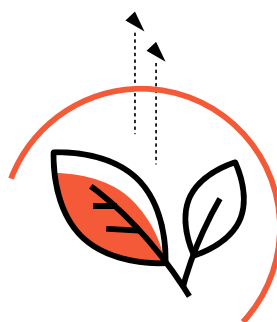




The Consumer Preference that Needs to be Discussed Before the Culture

Culturally speaking, are there any other countries that have similarities with Türkiye in terms of alternative protein?

We need to talk about taste and consumer satisfaction before the culture. If the consumer likes a product and likes its taste, this product is kept in the market. For instance, when I came to North America for my PhD many years ago, the hummus market was a very small market of 10 million dollars in 2000-2001. When we look at the sector today, we see 10-15 types of hummus even in a supermarket. In the North American market, hummus today constitutes a market worth 2-2.5 billion dollars. If a product is appreciated by the public, it will survive. The reason why vegan burgers are not very popular is that consumers still do not like the taste of the product. However, there is a different group... When looking at oat, almond and soya milks, this market has been growing by 10-15 percent every year. Oat, almond-based cheese products have been growing. Traditional milk consumption in Canada has dropped by 35 percent. Accordingly, alternative milk consumption has increased.



“We need to talk about taste and consumer satisfaction before the culture. If the consumer likes a product and likes its taste, this product is kept in the market”.

INTERVIEW

The situation is different in culture meat. No matter how much we culturally oppose it, countries take a position against these products, especially since culture-type products are of tissue culture. In this type, cells are obtained from the animal by biopsy and meat, milk and casein are produced using that cell. Throughout the world, there is a stance against this practice. For example, cultured meat is banned in Florida. In Italy and Türkiye, where more traditional views prevail, different stances prevail.

What if we look at these products from the perspective of bioavailability...

When these products are soya-based and soya plus wheat-based, they are almost the same quality as meat. Protein quality, satiety can be high, and there may even be some fibre products that you do not normally encounter in meat. If the consumer likes the product, it takes it to another level. We have seen these in vegetable-based milks and hummus products. Unfortunately, there is no such consumer acceptance in meat products. But if a good product comes out, a product with a good texture and taste, we will see that growth in meat products as well.

Then you do not agree that alternative proteins are not the equivalent of conventional proteins.

I disagree, because PDCAAS, which combines different proteins, can match meat and milk proteins in terms of protein quality. Quality can be improved. The important issue is that the product is accessible in terms of price.

What are the challenges that the alternative protein field will face given the legal regulations? For example, Italy has banned cultured meat. Türkiye's adverse stance against cultured meat is well known. How would you interpret the attitudes of countries towards this field? How do such attitudes affect future biotechnological developments?

Plant-based alternative proteins or fermented alternative proteins have been developing significantly. There is no restriction in terms of regulation. But there is also competition for them. In the United States, the position of soy is much stronger than other proteins. It may take time for lentils and peas to reach that position. However, in general, when alternative proteins are fermented or



plant-based, their production is encouraged. The United Nations the World Health Organisation and agricultural organisations have serious incentives on these issues. In general, the products that will take time to regulate are cultural ones. After all, politically, people want to protect farmers. Maybe we will not see this, but in 2050, the area we produce in the world will not be enough to feed people. Different vertical production systems will be needed. It is difficult to sustain general agriculture in the long term. Take a look at Shanghai, Jakarta, where 30-35 million people have to eat something. It is difficult for these people to reach a food every day by transportation. That is why, bioengineering technologies are needed.



What is the most realistic approach to alternative proteins in the case of Türkiye?

The products we produce need to be extracted, converted into protein within the framework of vertical integration, and consumed and exported throughout the country in a short supply chain. Although Türkiye produces, it is also a significant importer. In case we can transform these products at the right costs and add different products behind them, we can not only sell them to the domestic market but also export them at the same time. Despite all the production Türkiye does, it also imports numerous products. Therefore, I am not in favour of these products entering the sector rapidly without a cost analysis.



Food security must be considered as crucial as the national defence security

Do you find the public and private investments in this field sufficient?

Türkiye is investing in alternative proteins, but there is an important factor here: food security. Food security must be considered as crucial as the national defence security. Because, if we do not have agricultural security in food, we do not have long-term national defence security. The members of the United States House of Representatives also state this. Food security can be used as a diplomatic tool. These issues need to be considered above politics. A national food action plan is needed.

“Food security must be considered as crucial as the national defence security. Because, if we do not have agricultural security in food, we do not have long-term national defence security.”



WHY GREEN TRANSFORMATION IN INDUSTRY IS NECESSARY?



BEYZA AKYOL
Eco-Production Transformation
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Recently, a colour, which is frequently encountered conceptually, has started to create an agenda in our lives in different ways. Green production, green industry, green financing, green collar... At the centre of all these new definitions lies the concept of “green transformation”, which includes the actions of creating an environmentally sensitive model and ensuring its sustainability.

Green transformation, which aims to shape the future of societies not only through its environmental but also economic and social dimensions, plays a critical role in combating global problems such as climate change, resource scarcity and environmental degradation. This transformation involves taking important steps to reduce harmful impacts on the environment and use natural resources more efficiently, particularly in sectors such as industry, energy production, transportation and agriculture.

Experts emphasise that around 1 billion people worldwide are exposed to air pollution, which increases the risk of premature death. The carbon dioxide concentration was detected at 421 ppm, which surpassed the previous record of 415 ppm. Activities such as fast fashion, high water consumption, excessive consumption of raw materials and increase in the amount of waste, use of disposable plastics, microplastic pollution, land use changes disrupt the ecological balance of the world and create a more polluted and unsustainable environment. In this direction, green transformation efforts become an important step in combating not only carbon emissions but also air pollution.

Sustainability for the Industry...

The concept of “sustainability”, which stands out in the green transformation, is defined as meeting our own needs without compromising the ability of future generations to meet their own needs. Sustainability aims to fulfil today’s needs while not jeopardising tomorrow’s resources, and this approach must be supported by policies and practices implemented by individuals, communities and governments. In the present day, sustainable industrial applications have been gaining more and more importance both to support environmental sustainability and to provide an economic competitive advantage. More and more companies and managers recognise sustainability as a strategic priority with significant business risks and opportunities, and incorporating sustainability into the strategy setting process of companies is deemed a prerequisite for the effective management of sustainability.





The concept of circular economy, which offers a sustainable growth model by encouraging the reuse, reprocessing and recycling of resources and replacing the traditional “produce-consume-dispose” model in green transformation, has emerged. The circular economy is an economic system that aims to keep products, materials and resources in use in the economy for as long as possible and to minimise waste generation. Industrial symbiosis, which has emerged through this approach, is a process in which different industries cooperate with each other and make use of wastes or by-products as resources for each other. Similar to symbiotic relationships in natural ecosystems, these studies aiming to increase inter-industry efficiency and reduce environmental impacts have become an indispensable part of green transformation by supporting sustainability.

Is Green Transformation a Preference?

When the distribution of carbon emissions throughout the world is analysed, it is observed that the industrial sector has a large share. According to reports by organisations such as the International Energy Agency (IEA) and the International Intergovernmental Panel on Climate Change (IPCC), the industrial sector accounts for approximately 24% of overall carbon dioxide emissions. Industry causes a significant amount of greenhouse gas emissions, especially due to energy-intensive production processes and fossil fuel use. Strategies such as increasing energy efficiency in the industrial sector, switching to renewable energy sources, adopting sustainable production techniques, and using carbon capture and storage technologies play an important role in reducing these emissions. Considering both national and international regulations, green transformation emerges as a necessity rather than a preference.

The Paris Climate Agreement, which was adopted at the United Nations Climate Change Conference (COP 21) in

Paris in 2015, aims to limit the increase in global average temperature to 2°C (3.6°F) relative to pre-industrial levels, or even to 1.5°C if possible. The roadmap for the achievement of this goal was set out in the Sustainable Development Goals (SDGs) adopted by the United Nations in 2015. These goals have been designed to tackle global challenges and create a more just, peaceful and prosperous world. Given the current progress, it would not be wrong to state that we are trailing these goals a little bit behind. According to the SDG clean energy report, the world continues to move towards sustainable energy goals, but not rapidly enough. According to the report, at the current pace, about 660 million people will still lack access to electricity by 2030 and close to 2 billion people will still be dependent on polluting fuels and cooking technologies.

The Green Deal Action Plan, which focuses on the reduction of the greenhouse gas emissions of the European Union, aims to reduce emissions of the European Union by at least 55% by 2030 compared to 1990 and to become carbon neutral by the year 2050. Fit for 55, which consists of a series of proposals aimed at revising and updating Union's legislations and introducing new initiatives to ensure that European policies are in line with the climate targets adopted by the European Parliament, intends to provide a coherent and balanced framework for the European Union to achieve its stated climate goals.

The objective of the European Union to become a carbon-neutral continent by 2050 within the framework of the “Fit for 55” package constitutes one of the pillars of the Green Deal Action Plan. To this end, the EU renders the Emissions Trading System more ambitious. Free of charge allowances in the Emissions Trading System (ETS), which was introduced in 2005 and is used to regulate carbon emissions, will be gradually phased out from 2026. The National Emissions Trading System, on which studies have been carried out in Türkiye for a long period of

time, is expected to be piloted by EPIAS in October 2024 and become mandatory in 2026. The ETS, which enables companies that obtain credits equal to the amount of reduced emissions to generate income by selling these credits in the market, thus encourages companies to invest in innovative and cleaner technologies.

In order to prevent carbon leakages, the EU has established the new Carbon Border Adjustment Mechanism (BCAM), which includes the imposition of carbon taxes at the border on products such as iron, steel, cement, aluminium, fertiliser, hydrogen and electricity from third world countries. This mechanism imposes additional taxes on products coming from countries with lax carbon regulations, while ensuring a competitive equilibrium between local producers and foreign producers. Türkiye started the transition period for the Carbon Border Adjustment Mechanism on October 1, 2023 and global producers and importers of aluminium, cement, electricity, fertiliser, hydrogen, iron and steel in the European Union started to report their emissions on a quarterly basis as of January 31, 2024. Following the transition period, the implementation period will begin in 2026. European Union companies cooperating with industrialists exporting to the EU will be subject to additional taxes up to the emissions of the product they purchase, and companies will seek new and cheaper supply chains or some of the high taxes paid by EU companies will be reflected to the manufacturers. At this point, the loss of customers of many suppliers and the formation of new supply chains emerges as a great risk for industrial companies. It is an inevitable reality that this system, which will initially start in 6 sectors, will grow by adding different sectors to it.

Green Financing

Another concept that has emerged within the scope of green transformation is the “green asset ratio”, which refers to the ratio of green or sustainable investments in the portfolios of financial institutions to their total assets. This ratio demonstrates the amount of investments made by banks, investment funds and other financial institutions in environmentally sustainable projects and technologies. For example, electric car loans utilised in vehicle loans are evaluated within this scope.

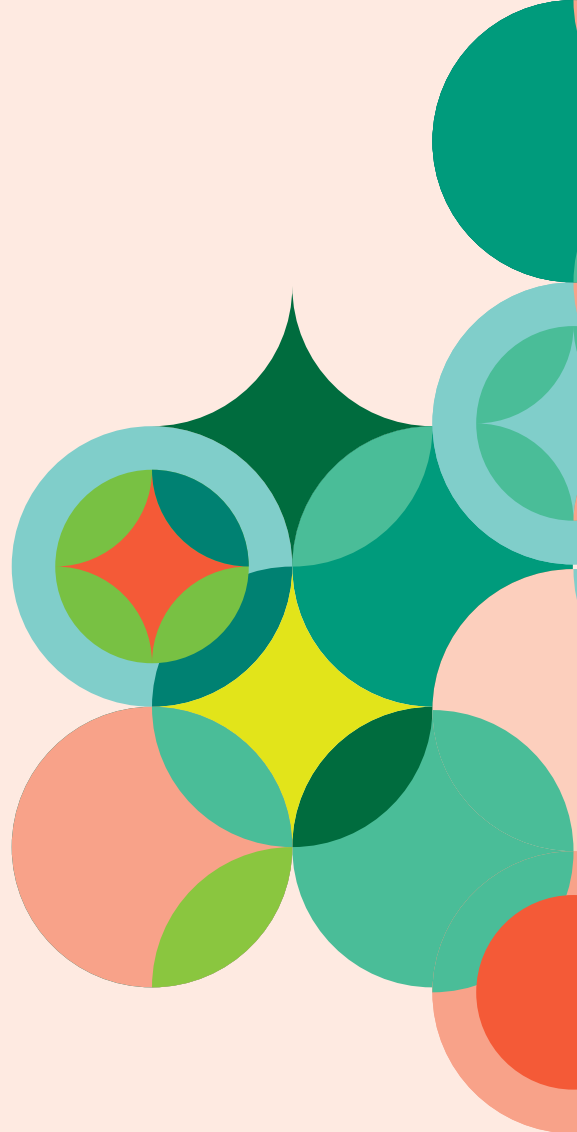
The “Draft Communique on Green Asset Ratio”, which is aimed to make a significant contribution to the

development of green finance markets and the financing of green economic transformation, was submitted for public opinion in our country. In this respect, it is aimed to introduce an obligation for banks to report their green asset ratio to the Banking Regulation and Supervision Agency (BDDK) in certain periods. Energy efficiency and emission reduction projects of industrial enterprises in sectors such as energy, manufacturing and construction will be prioritised in this context. Banks and financial institutions require SMEs to declare their carbon footprints in order to calculate credit-related emissions.

Furthermore, the Refinitiv Sustainability Index, which provides comprehensive information to investors, analysts and other interested stakeholders, is an index that evaluates the performance of companies according to environmental, social and governance (ESG) criteria. This index was designed to objectively measure and report the sustainability performance of companies. Companies that can prove their ESG performance on this platform become advantageous in finding investors.

On December 29, 2023, the Turkish Sustainability Reporting Standards entered into force, making it mandatory for companies to report sustainability-related risks and opportunities according to certain criteria. In this context, large companies, banks subject to the regulation and supervision of the Banking Regulation and Supervision Agency, financial institutions, companies operating in Borsa Istanbul Markets are obliged to submit sustainability reports. These reports, which are nowadays mostly prepared voluntarily for brand image, stand out as a factor that accelerates companies for green transformation. Many large brands demand product carbon footprint and sustainability reports from the suppliers they work with. Today, the discourses in the form of “it would be good if you do it” turn into actions in the form of “if you do not do it, I will not work with you”.

Consequently, it can be seen that the industry, whether at the level of large enterprises or SMEs, has no chance to stay away from green transformation. Industrial companies falling behind in this transformation will face negative situations such as environmental damages, international sanctions and trade barriers, financing problems, technological backwardness. Companies that act early, prepare themselves, change, and adapt green transformation to their processes and strategies rapidly will benefit from this process in every aspect.



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