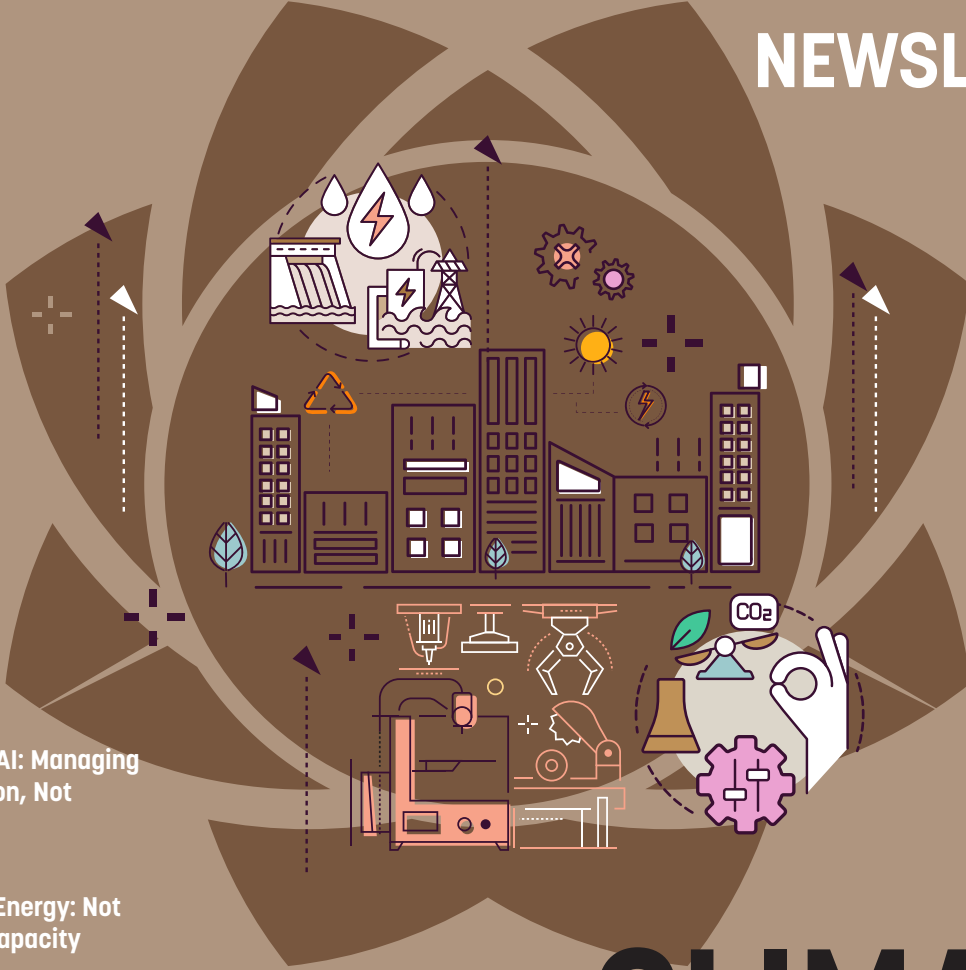


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THE COURAGE TO MANAGE TRANSFORMATION

The world is no longer defined solely by technological advancement; we are living in an era where the will to shape the direction, pace, and impact of this progress is taking form. In this sweeping transformation—spanning from artificial intelligence to energy systems, and from waste to production models—the real challenge lies not merely in developing new technologies, but in turning them into meaningful, scalable, and lasting impact.

In this issue, we trace the contours of a shifting paradigm. This journey—from resource-driven approaches to capacity-based systems, from linear models to a circular economy, and from individual solutions to collective intelligence—reveals the multi-layered and systemic nature of transformation.

The expert insights, field experiences, case studies, and stakeholder perspectives we bring together offer not only a framework for understanding the present, but also a foundation for building the future together. Because we know that transformation does not happen in isolation; it requires shared intelligence, shared responsibility, and shared courage.

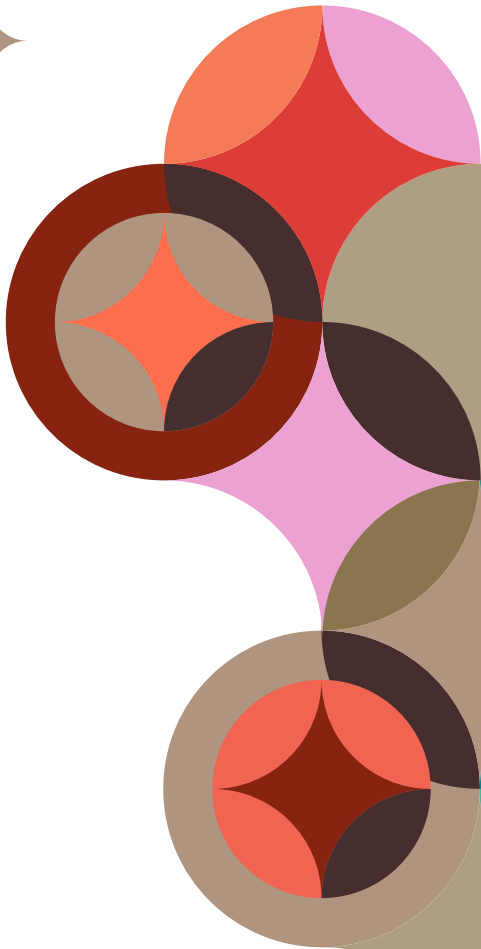
At TTGV, our aim is to strengthen knowledge production by bringing together diverse disciplines and stakeholders, and to create a collective platform capable of turning this knowledge into impact. We see this publication not merely as a compilation of content, but as a collective call to accelerate transformation.

We believe that: “The future belongs to those who design it.”



ESRA YAZDIÇ DEMİR

TTGV Corporate Communications and Media Manager



**EVREN BÜKÜLMEZ**

TTGV Director of Development Programs

KNOWLEDGE MANAGEMENT: QUALITY WITHIN THE ORGANIZATION, TRUST ACROSS THE ECOSYSTEM

In organizations, “Knowledge Management” is one of the most critical managerial tools that connects people and enables the capture and structuring of content. Implementing this systematically is increasingly emerging as a new standard of quality.

Knowledge is the primary raw material for professionals working in innovation agencies such as TTGV. Systematic knowledge management, on the other hand, means sourcing, packaging, and delivering this knowledge to the right person at the right time. In this sense, it can be defined as a “knowledge supply chain.”

For years, TTGV has been generating knowledge, conducting analyses, and producing outputs that shape sectors by activating its network in areas such as technology development, innovation, and the scaling of new technologies. Through its development and demonstration programs, it also showcases the applicability of these processes and highlights their critical importance for enhancing competitiveness.

What makes this approach even more critical today is that decisions in the field of technology are now made in shorter timeframes, under higher uncertainty, and through multidisciplinary collaborations. Therefore, “knowledge management” is not merely about producing reports; it is about asking the right questions, collecting data and experience from the field, validating them, and transforming them into collective intelligence. In other words, institutional memory and future-oriented learning must operate together within the same system.

What should we focus on?

TTGV’s Flagship Projects Program is a concrete example of this approach. Through pre-research and Deep Analysis studies (covering global trends, domestic capabilities, value chain gaps, regulations/standards, and performance–cost thresholds), it provides data-driven answers to the question “what should we focus on?” It then aims to strengthen demand formation by targeting the demonstration of first-of-its-kind projects leading to initial commercial applications through its demonstration/guided project phase approach. This constitutes a knowledge supply chain design that directly links knowledge production to implementation.

The approach of sharing generated industrial knowledge with the ecosystem enables the experience accumulated in individual projects to transform into a “sectoral common asset,” paving the way for reuse and accelerated learning.

Early Stage Seed and Demo, along with Proof of Concept (PoC) steps, ensure that learning does not remain at the level of ideas but is translated into validated outputs and evidence. The clarification of technical requirements and test conditions, the definition of infrastructure needs, and the expected outputs create a measurable learning framework. Thus, “progress based on accurate knowledge” becomes possible for both startups and industrial stakeholders.

Similarly, the Eco-Production Transformation Program and EkoReka aim to expand the data obtained from companies’ journeys in resource efficiency and cleaner production, enhance decision-support capacity, and foster collective learning through mechanisms such as data visualization and benchmarking.

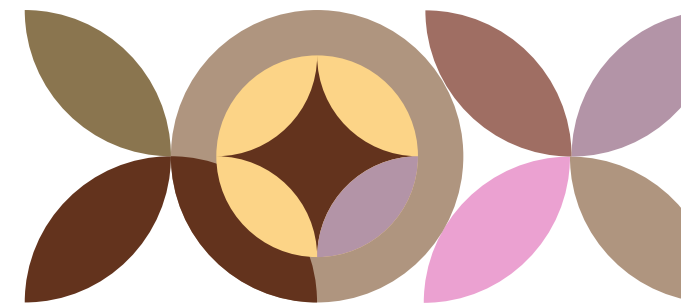
Finally, the Climate Lab Community approaches knowledge management as “collective learning within a network.” Its goal of running 9 Working Groups in 12-week cycles in 2026 creates a production rhythm that transforms discussions into tangible outputs. The Climate Technologies Radar, which will support this rhythm, is also planned to be updated for data- and evidence-based prioritization.

In conclusion, TTGV approaches knowledge management as a discipline within the organization, and as an infrastructure that enables trust, interaction, and co-creation across the ecosystem. This bulletin is part of that very effort: to make the knowledge we produce visible, to share it, and to learn faster together.

“The approach of sharing generated industrial knowledge with the ecosystem enables the experience accumulated in individual projects to transform into a ‘sectoral common asset,’ paving the way for reuse and accelerated learning.”



“The approach of sharing generated industrial knowledge with the ecosystem enables the experience accumulated in individual projects to transform into a ‘sectoral common asset,’ paving the way for reuse and accelerated learning.”



"DIRECTED PROJECT" MODEL IN TECHNOLOGICAL INNOVATION



DR. E. SERDAR GÖKPINAR

Director, Innovative Technology Programmes

"It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness, it was the epoch of belief, it was the epoch of incredulity, it was the season of Light, it was the season of Darkness, it was the spring of hope, it was the winter of despair, we had everything before us, we had nothing before us, we were all going direct to Heaven, we were all going direct the other way..."

A Tale of Two Cities,
CHARLES DICKENS

Human history is a fluctuating process in which periods of stability are followed by sudden ruptures and radical transformations. In some periods, the economic order, institutions, and social structure present a relatively balanced and stable framework; in other periods, these frameworks are shaken, and new technologies, ways of thinking, production models, and power balances emerge. Historical experience shows that major transformations are not only about technological innovations; they also create upheavals that deeply affect institutions, economic relations, and the social order.

Today, we are going through a similar transformation. Developments in digitalization, artificial intelligence, biotechnology, and energy systems not only produce new tools; they also transform the ways we understand the world, make decisions, and create value. However, this progress is accompanied by the intensification of many interconnected problems such as the climate crisis, biodiversity loss, increasing income and wealth inequality, geopolitical tensions, and social fragilities. This period of turmoil we are in can be defined as a phase in which the deepening of crises and the expansion of innovation capacity occur simultaneously.

The way out of this turmoil depends on how three fundamental capacities of humanity will be mobilized: the ability to learn and adapt, the capacity to build institutions, and the power to produce innovation. The technological innovation capacity, nourished by scientific research accumulation and strong R&D ecosystems, continuously expands our problem-solving toolkit by supporting these three areas and creates new fields of possibility.

At this point, alongside many questions that come to mind, one fundamental question is this: How does

scientific knowledge generated through R&D translate into innovation—into tangible economic and social value? As we know very well, the journey of knowledge from the laboratory to social and economic benefit cannot happen on its own; it requires certain processes, institutional structures, and incentive mechanisms. Therefore, it is critically important not only to produce more knowledge, but also to design how this knowledge will be selected, developed, commercialized, and directed toward solving social problems.

Supply- and Demand-Side Approaches in R&D and Innovation

In R&D and innovation systems, two complementary logics work together: in the supply-side (push) approach, researchers and organizations propose projects based on their own curiosity, expertise, or technological opportunities; the support system selects among these proposals and supports them. In the demand-side (pull) approach, the starting point is more often needs defined from the outside: the problem to be solved, the targeted performance, and the success criteria are described; then the actors who can achieve this target are invited.

I would like to work on this topic.
Can you review my project
proposal and support it?

There is a need to work on this
issue. Let's define it as a project.
Who will do it?

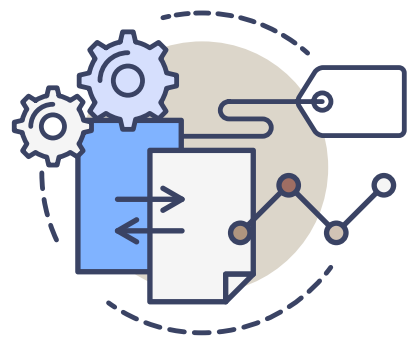


Attention:
Not competing
alternatives, but
complementary
approaches



These two mechanisms are not rivals or alternatives to each other, but a balance of “discovery and direction” that must coexist. While supply-side mechanisms produce new knowledge, capacity, and options, demand-side mechanisms concentrate these options toward social and economic goals.

Globally, demand-side designs are institutionalized under different conceptual names: problem-oriented, mission-oriented, challenge-driven, outcome/performance-oriented, and demand-side innovation policies. The naming of programs also reflects this logic: “mission/outcome-oriented programs” such as DARPA, ARPA-E, or BARDA in the U.S.; Horizon Europe Missions in Europe; ARIA in the United Kingdom; the Fraunhofer model in Germany working with industrial demand; the EMBRAPA approach in Brazil based on agricultural needs; large-scale “mission-like” industrial policy tools in China progressing through target and sector alignment; and in Turkey, TÜBİTAK 1007 based on public needs and similar practices in the defense ecosystem can be given as examples of this approach in different forms. Even various “open innovation” activities in the private sector can be evaluated within this scope. There is no single correct terminology; what matters is that the program is structured in a way that clearly defines the need and enables multiple solution pathways.



“While supply-side mechanisms produce new knowledge, capacity, and options, demand-side mechanisms concentrate these options toward social and economic goals.”

TTGV's Role

The Technology Development Foundation of Turkey (TTGV) is a public-private sector partnership that has been operating since 1991 with the motto “a Turkey that produces technology,” supporting the technology development and innovation activities in the private sector. As an “innovation agency,” TTGV is not only a structure that provides support; it is also a dynamic and agile organization that learns from implementation, shares what it learns, and transforms this accumulation into new approaches.

Within this framework, TTGV assumes the role of a model developer that develops tools and mechanisms to respond to changing needs, experiments with different practices, and renews itself based on results. Effectively supporting innovation in periods when change accelerates requires not only flexible and learning-oriented structures, but also the development of new methodologies and the implementation of experimental practices. For this reason, TTGV's role as a model developer also includes program designs directed by performance targets and in which R&D results are transferred more rapidly into practice.

In Turkey, the broad R&D and innovation ecosystem that has developed over the years has generated significant diversity and capacity through numerous institutions, programs, models, and incentive tools. Nevertheless, the need to strengthen the bridge between R&D and innovation never fully disappears. Changing conditions, new technologies, and new societal priorities require this bridge to be continuously reinforced.

In line with this approach, TTGV designed and launched the Directed Projects Program (GÜP) in 2025, in addition to its many other programs, in order to strengthen the link between R&D and innovation in a more systematic and demand-oriented framework in the field of climate technologies, which it has been thematically focusing on since 2023 (without being limited to this field).

Climate Technologies

Climate technologies (Climate tech), in short, refer to technology and solution areas that aim to reduce greenhouse gas emissions and ensure adaptation to the effects of climate change. This field is highly heterogeneous and includes many technologies at different levels of maturity.

R&D activities are still ongoing in many areas, and it is anticipated that some technologies will reach sufficient technical and economic maturity only in the 2030s. Even “green solutions” whose R&D processes have largely been completed—except for some renewable energy and storage technologies—are often more costly than their “dirty” alternatives.

In addition, even if some technologies are technically ready, they may experience rapid scaling problems; due to production capacity, supply chain, or infrastructure constraints, they may not be obtainable even with sufficient financial resources. Moreover, in many cases, technological solutions can be alternatives to one another; which one is more suitable will vary depending on countries' resource structures, infrastructure, industrial composition, and policy preferences. There is no single set of technologies that applies to everyone, because needs, capabilities, and priorities differ. For this reason, the techno-economic parameters of solutions have not yet fully stabilized, and uncertainty remains high. In such an environment, the way forward is to test different technologies in various contexts, evaluate their performance, and systematically learn under which conditions they provide value and to whom.

Therefore, one way to facilitate achieving goals in climate technologies is through problem-driven experimental designs focused on clearly defined needs. The GÜP program has also been designed within such a framework.

Directed Projects Program (GÜP)

The GÜP approach is experiment-driven yet disciplined: it includes taking controlled risks, progressing in stages, and decision-making mechanisms based on learning. The aim is not to conduct technical validation in a laboratory environment, but to ensure that solutions are tested in real use contexts and can move beyond the laboratory.

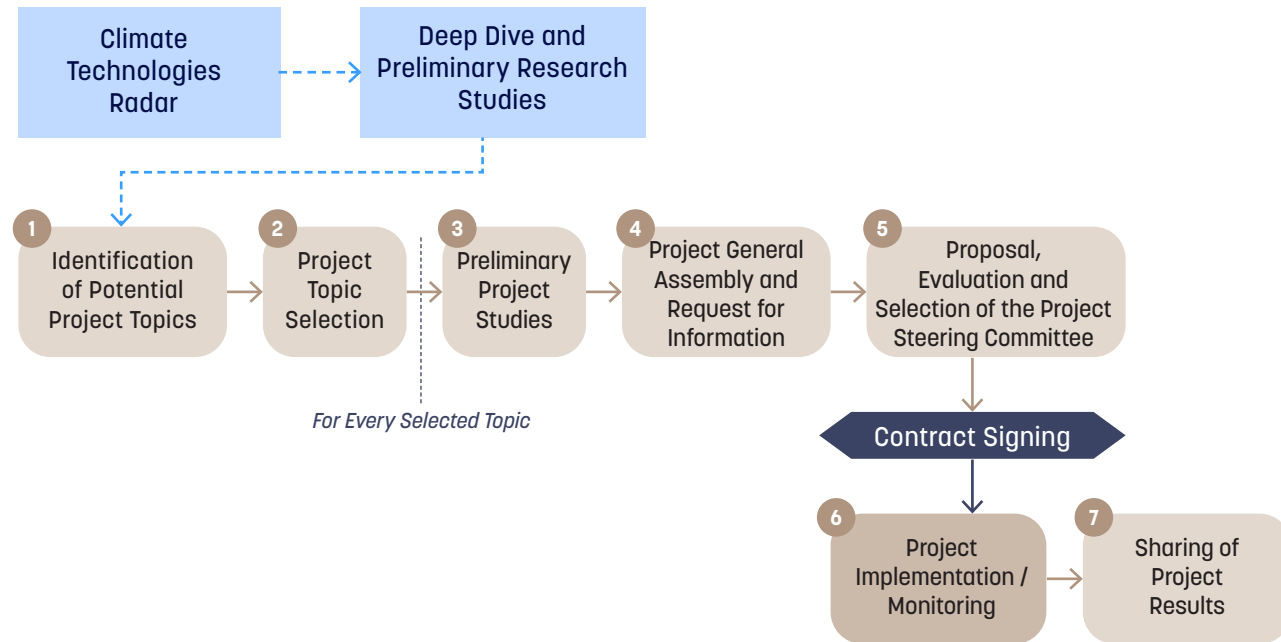
Such a framework focuses on proactive practices that can set an example and create a multiplier effect, while also ensuring the effective and efficient use of resources. At the same time, it supports experimental development work (as defined in the OECD Frascati Manual), and strengthens proof-of-concept activities, thereby bridging the critical gap before potential commercialization.



Main Features of GÜP:

- It is implemented in priority areas identified by TTGV and is built on a model in which TTGV acting as a demand-side actor (“customer”).
- It is not primarily a grant or investment program, but a mechanism for solution development and delivery for clearly defined needs.
- It includes TTGV financing for a well-defined project whose scope is progressively refined.
- It focuses on the post-lab, pre-pilot stage, bridging the gap between validation and deployment.
- It targets either novel technologies or innovative combinations of existing technologies. In this respect, it aims to be the first of its kind in Turkey.
- It aims to validate solutions in the relevant operational environment and to demonstrate their integration within the value chains.

GÜP Program Processes



Before moving on to the stages of the GÜP program, it is necessary to address the pre-GÜP phases. The two main steps at this stage are as follows:

Climate Technologies Radar: A dynamic map is created that reveals opportunities and needs in the field of climate technologies through continuous scanning, interviews, and qualitative research.

Deep Dive / Preliminary Research: Selected topics from the radar are comprehensively examined in their technical, economic, and sectoral dimensions; implementation is not initiated before the subject is fully understood, and the project areas that TTGV can undertake are determined.



The stages of the GÜP program are as follows:

- 1. Identification of Potential Project Topics:** A “long list” is prepared by identifying project topics that can be worked on during that period.
- 2. Selection of the Project Topic:** A “short list” is created with topics selected according to strategic priority and feasibility criteria.
- 3. Preliminary Study:** A preliminary study is conducted for each project topic on the short list, defining scope, objectives, and success criteria.
- 4. Call and Initial Evaluation:** The call is announced, the general assembly (launch) is held, and after information exchange with interested organizations, the organizations to be invited to submit proposals are determined.
- 5. Call for Proposals and Contract:** The proposals of the invited organizations are evaluated and negotiated, and the appropriate Project Implementing Organization is selected and a contract is signed.
- 6. Project Implementation and Monitoring:** The project implementation process is initiated, and regular monitoring and evaluation are carried out in line with the defined objectives.
- 7. Sharing of Project Results:** After the completion of the GÜP Project, the project results are shared. Since the GÜP Program aims to pave the way for the sector and create a basis for scalable and applicable solutions, the dissemination and sharing of its outputs are highly important.

Current Status of the GÜP Program (as of the end of February 2026)

Although GÜP is still at an early stage, it is progressing within a learning process that matures its design through implementation. Within the framework of the procedures and principles established in mid-2025:

- The (pilot) project titled “Development of Alternative Feed Formulation by Using Black Soldier Fly Larvae in Poultry Breeding” was signed with Başkent University on October 1, 2025. The project is currently in the implementation and monitoring phase.
- For the 12 working topics identified for 2025, a launch was held on September 18, 2025, and extensive information exchange was carried out with interested organizations during the period from October 2025 to January 2026.
- With the evaluations conducted in February 2026, the topics and organizations to be invited for proposals were determined.

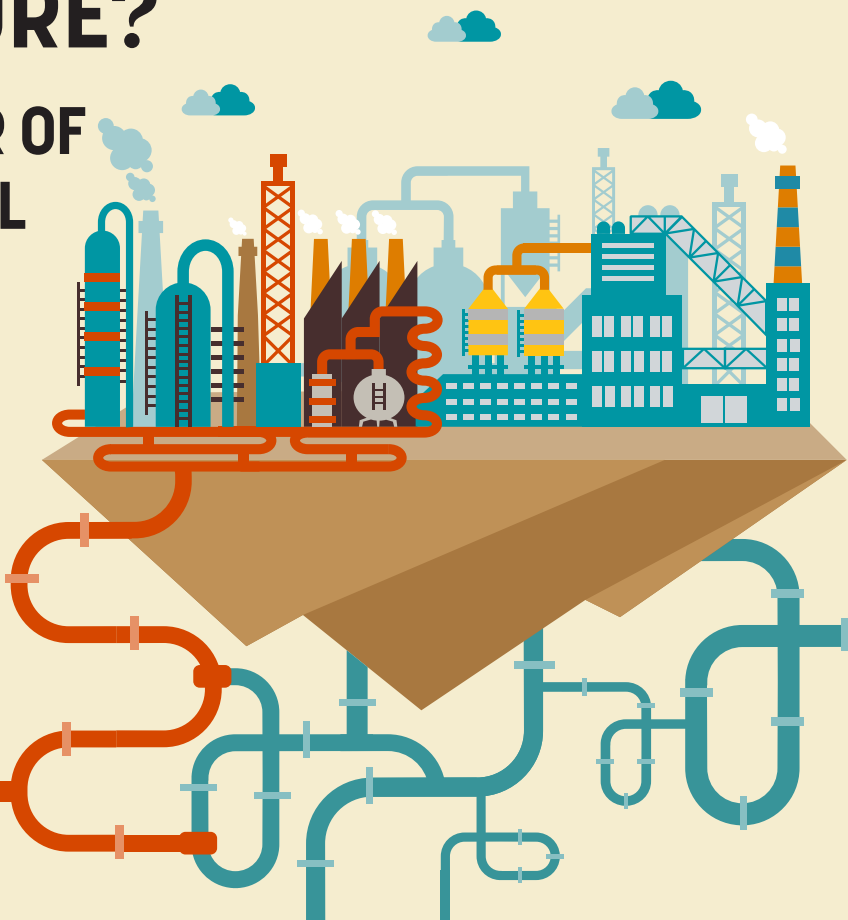
GÜP is a deliberate experimentation aimed at establishing a balance between exploration and direction. In fields such as climate technologies—characterized by high uncertainty and systemic transformation—progress depends not only on conducting R&D, but on asking the right questions, experimenting in the right contexts, and systematically learning from practice. In periods of transformation, the key is not simply to generate more knowledge, but to direct that knowledge toward solving real-world problems through structured, problem-oriented experimentation.



In fields such as climate technologies—characterized by high uncertainty and systemic transformation—progress depends not only on conducting R&D, but on asking the right questions, experimenting in the right contexts, and systematically learning from practice. In periods of transformation, the key is not simply to generate more knowledge, but to direct that knowledge toward solving real-world problems through structured, problem-oriented experimentation.

IS IT WASTE OR A HIDDEN TREASURE?

THE POWER OF INDUSTRIAL SYMBIOSIS



İPEK ÖZTÜRK

TTGV Eco-Production Transformation Program Specialist

Every day, dozens of stories are written in industry. Raw materials turn into products, orders are completed, shifts change... Yet some of these stories quietly end at the production line with the label “waste.” However, every unfinished story may be waiting to be completed in another production process. What is surplus for one company may meet the needs of another just a few kilometers away. But most of the time, these two stories proceed unaware of each other, because production processes are typically evaluated within their own boundaries. What if these stories intersected at a common point? This is where industrial symbiosis comes into play. It connects unfinished stories, transforms surplus into value, and approaches production not as isolated processes but as parts of an integrated whole. It requires thinking of production systems not as individual firms, but as components of an interconnected network. Many flows defined as “waste” actually point to resources that have not been sufficiently utilized within the system. When value creation shifts from the firm level to the network level, by-products, excess energy, and existing infrastructure create opportunities for new economic relationships. In this sense, industrial symbiosis is not only a complement to the circular economy, but also one of the key mechanisms that enables it to materialize in practice.[1]

Where environmental and economic goals converge

From a business perspective, this approach does not only generate environmental benefits. Reusing by-products can reduce costs, access to alternative inputs can decrease dependency on supply chains, and improved resource efficiency can contribute to emission reduction targets. Therefore, industrial symbiosis operates at the intersection of environmental goals and economic realities.

Industrial symbiosis is increasingly becoming not just a choice, but a matter of resilience and competitiveness. However, there are still some entrenched assumptions that hinder this transformation. Misconceptions about its applicability, scale, and requirements can slow down action. Yet experience shows that many of these assumptions need to be reconsidered. [2]

Misconceptions	It is only possible in large and integrated industrial zones.	It is only related to waste management.	Its implementation is complex and requires high investment.	Data sharing between companies is not possible.	It is a “nice-to-have” type of sustainability practice.
Facts	Scale alone is not decisive; what matters is the ability to build connections. Symbiotic relationships can also be established among small and medium-sized enterprises. Many examples show that such collaborations start with need-based cooperation between a few firms and evolve into network structures over time.	Waste is only the visible part of industrial symbiosis. This approach covers not only by-products but also various flows such as energy, water, and logistics. The goal is not individual optimization but creating efficiency at the system level. In this sense, symbiosis represents a holistic resource management approach beyond waste reduction.	Many symbiotic relationships start not with large investments, but by rethinking existing processes. The first step is usually making flows visible and analyzing potential matches. Investment needs typically arise gradually and after proven benefits.	Full transparency is not always necessary. Processes can be designed with confidentiality principles and phased information sharing. The key factor is a governance framework based on trust. Experience shows that, with the right facilitation mechanisms, data sharing can become a tool for creating shared value rather than a risk.	Industrial symbiosis is increasingly becoming a strategic necessity. Considering rising resource pressures, supply chain vulnerabilities, and carbon regulations, companies that act early strengthen not only their environmental performance but also their economic resilience.

Figure 1. Misconceptions and Facts About Symbiosis in Industry



“Experience shows that it is not difficult to produce individual success stories in industrial symbiosis; the real challenge is to transform these stories into a widespread and lasting structure.”

The difference between seeing and realizing

Going beyond conventional thinking is an important step in recognizing the potential of industrial symbiosis. However, identifying this potential and bringing it into practice do not always progress at the same pace. Looking at successful examples around the world, one common element stands out: strong facilitating structures. These structures make potential matches visible, bring stakeholders together, and help clarify the technical, legal, and economic framework. In other words, such matches do not occur by chance; they are the result of planned and supported processes.

Regional studies and pilot implementations carried out in Türkiye point to a similar picture. Programs implemented in different regions reveal a significant technical potential through the analysis of inter-sectoral waste and by-product flows. However, realizing this potential requires systematic data collection, effective matching processes, and the establishment of trust among firms. These experiences demonstrate that Türkiye has both strong production diversity and a

high capacity for symbiosis. [3] In this context, the Technology Development Foundation of Türkiye (TTGV) is positioned as one of the leading institutions in the field of industrial symbiosis in the country.

Through its regional analyses, flow mapping studies, and programs that facilitate inter-firm matching processes, TTGV contributes to translating the symbiosis approach into concrete, real-world applications. [4] Its work goes beyond merely identifying potential; it also supports the establishment of trust-based collaboration mechanisms among firms, strengthens data-driven decision-making processes, and enhances the financial and technical feasibility of symbiosis practices. Experience shows that producing individual success stories in industrial symbiosis is not difficult; the real challenge lies in transforming these into widespread and lasting systems. TTGV's contributions address precisely this challenge, ensuring that symbiosis moves beyond isolated projects and evolves into a systematic and sustainable transformation at the regional level.

A single match can create value, but transformation only occurs when a systematic structure is established. Therefore, the key question is no longer “Is symbiosis possible?” but rather “How can these matches be transformed into a sustainable and scalable system?” The first step toward scaling is making flows visible. By-products, energy, and resource flows that remain within firm boundaries can be revealed through digital matching tools and sectoral mapping systems. However, digital tools alone are not sufficient; what makes them effective is a framework of trust-based collaboration.

Redesigning production systems

Financial considerations are becoming increasingly decisive in scaling these matches. Rising energy and raw material costs, supply chain uncertainties, and carbon regulations highlight industrial symbiosis not just as an environmental preference, but as a strategic tool for financial resilience and competitive advantage. Utilizing by-products can reduce cost pressures, alternative inputs can lower supply risks, and emission reductions

can ease regulatory burdens. In a world where net-zero targets and carbon costs shape investment decisions, competitiveness is no longer defined solely by production capacity, but by how effectively resources are managed. For this reason, *industrial symbiosis goes beyond waste management—it represents a re-design of production systems*. However, this transformation does not happen on its own. It requires systematic collaboration, data transparency, and trust-based mechanisms. The question is no longer whether symbiosis is possible, but how this transformation can become permanent and widespread. Every new match established today is a concrete step toward a more circular, resilient, and competitive industrial future.

Those who can rewrite value chains will also shape the future. The industry of tomorrow will be defined not by those who merely consume resources, but by those who manage them strategically, holistically, and in an interconnected way. The competitive industrial structure of the future will be built on exactly this capability: designing systems at scale and creating shared value.

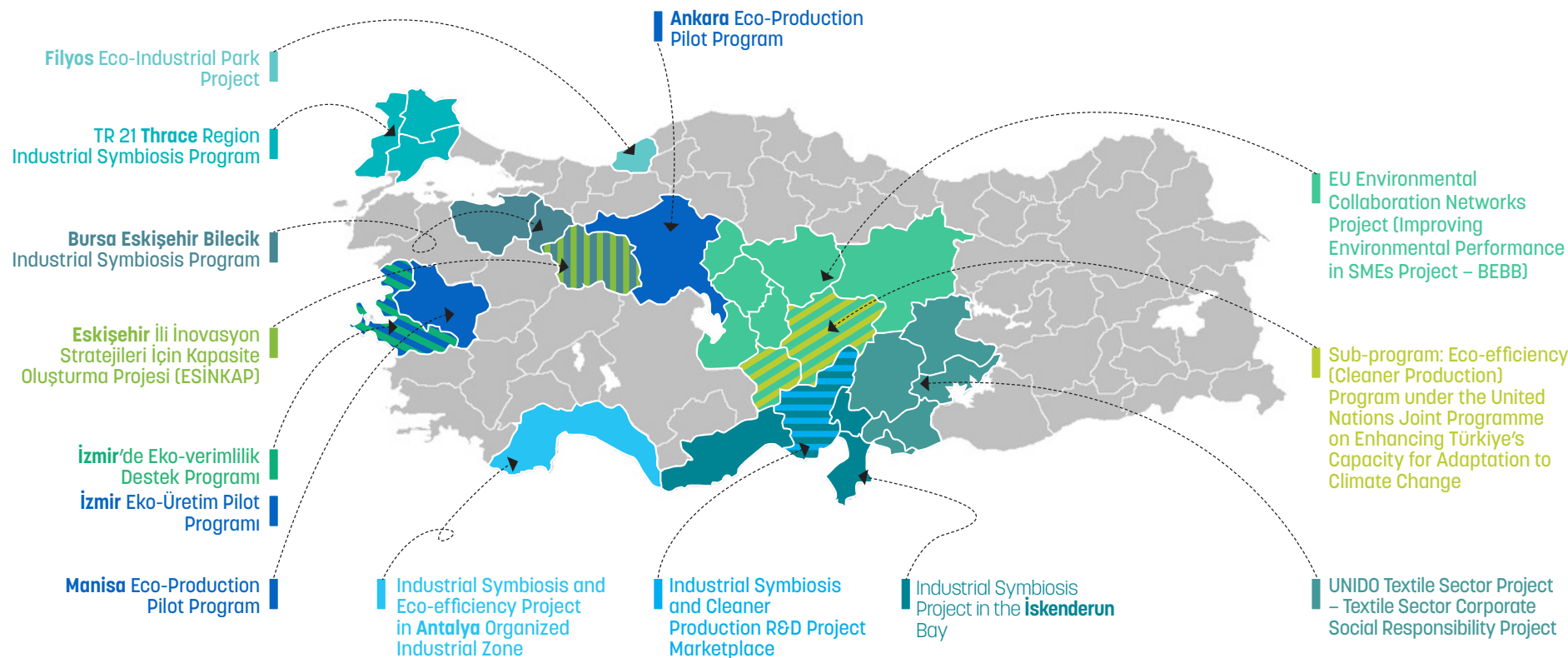


Figure 2. TTGV Environment, Energy and Sustainability Activities Map



“Industrial symbiosis goes beyond waste management; it is an approach to redesigning production systems. However, this transformation does not happen on its own—it requires systematic collaboration, data transparency, and trust-based mechanisms.”

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GREEN TRANSFORMATION: NOT A COST FOR INDUSTRY, BUT A STRATEGIC INVESTMENT



PROF. DR. MEHMET CANSIZ
Secretary General, Ankara Chamber
of Industry (ASO)

INTERVIEW: Esra YAZDIÇ DEMİR
TTGV Corporate Communications and Media Manager



Röportajın tamamına
TTGV'nin YouTube
kanalından
ulaşabilirsiniz.

The rapidly accelerating green transformation process on a global scale is redefining not only forms of production in Turkish industry, but also vision, the understanding of competition, and the perspective on the future. At the center of this new era are knowledge-based policy production, technology-focused projects, and strong institutional structures that prioritize sustainable development. Professor Mehmet Cansız, Secretary General of the Ankara Chamber of Industry (ASO), who plays an important role in this transformation through the bridge he has established between academia, public institutions, and industry, positions green transformation not as a cost item, but as a strategic investment area that provides efficiency gains, competitiveness, and access to new markets.

In this interview, we discussed the present and future of green transformation - from the technological and environmental contributions of **ASO-ILTEK**, the first provincial technological development index prepared by ASO, to the industrial policies of the future.



“The integration of firms’ R&D, innovation, and production investments with green targets is decisive for the permanence of transformation.”

At what stage is Turkish industry in the green transformation process? Where is the critical threshold?

Although Turkish industry has largely moved beyond the stages of awareness and preparation in green transformation, it stands at a critical threshold in terms of integrating transformation fully into production processes. Regulations such as the European Green Deal and CBAM are directing firms to take concrete steps in the areas of carbon management and energy efficiency; however, the link between growth and emissions has not yet been fully broken. In addition, the speed of transformation differs between provinces and sectors. For this reason, the process must be managed with an approach that takes regional and sectoral dynamics into account. Whether this threshold has been crossed can be understood from whether firms are able to activate carbon footprint measurement and reporting infrastructure (MRV), energy efficiency roadmaps, and investment plans simultaneously.

The 2053 net-zero target brings additional investment needs to the agenda in many areas, especially energy and industry. The Climate Law adopted in 2025 and the commitment to reduce emissions by 41% by 2030 compared to the reference scenario show that transformation has now become institutionalized at the policy level. Green transformation is no longer a matter of choice; it has become a development strategy whose direction has been set.

In this new period, carbon is no longer merely an environmental indicator; it has become an economic parameter that directly affects financing cost, export

competitiveness, and access to supply chains. In this process, we are closely monitoring the issue of high investment costs, which is the greatest concern of our industrialists. Within ASO, we prioritize guidance processes that will facilitate our members’ access to green funds, international financing sources, and selective credit mechanisms offered by the state, without leaving them dependent only on their own internal resources.

Within this framework, the most critical threshold is for green transformation to cease being a compliance project and to take its place at the center of the competitiveness and technological development strategy. The integration of firms’ R&D, innovation, and production investments with green targets is decisive for the permanence of transformation. This integration is possible when green transformation investments are not limited only to “compliance” items, but evolve into technology investments that transform production processes — efficiency, digital monitoring, clean production, and low-carbon process innovation.

Not cost, but an increase in efficiency

Is green transformation seen by industrialists as an obligation or as a competitive advantage? In your opinion, what three or four headings will transform industry the most in the next 5–10 years, and what kind of risk awaits industrialists who postpone green transformation?

Today, green transformation is evaluated by industrialists from two different perspectives. Although one segment still sees it as a compliance obligation, for firms that export

and are integrated into global supply chains, transformation is increasingly becoming a competitive advantage. As ASO, in line with the target in our Strategic Plan of “Accelerating the Digital and Green Transformation Process in Industry,” we position green transformation not as a cost item, but as a strategic investment area that provides efficiency gains and access to new markets. This perspective requires addressing green transformation not merely as regulatory compliance, but as a competition architecture that lowers costs, increases efficiency, and strengthens market access.

Four headings stand out as those that will transform industry the most in the next 5–10 years. The first is energy transformation and energy efficiency; rising costs are directing firms toward more efficient and renewable-based production. This field will also directly determine competitiveness because of energy costs and security of supply. The second is decarbonization and the circular economy; carbon reduction and resource efficiency have now become direct parameters of competition. CBAM and supply-chain criteria are making carbon performance part of “price.” The third is the integration of technological transformation with green targets; clean technologies, digital monitoring systems, and R&D investments will determine value-added production. Digital monitoring and data infrastructure are critical accelerators for measuring and managing green targets. The fourth is talent transformation. Another heading as critical as technological transformation is the human resource that will manage these systems. Training “green-collar” employees who can calculate carbon footprints and operate circular-economy models, and certifying the existing workforce in this direction, will become one of the fundamental pillars of the new competition architecture.

We know that in green transformation, a chain is only as strong as its weakest link. For this reason, by bringing our large-scale firms and SMEs together within the same ecosystem, we aim to minimize the carbon permeability of our entire supply chain and prevent our SMEs from remaining outside global markets.

Risks for those who postpone green transformation

The risk is clear for firms that postpone green transformation: difficulty in market access, increases in financing costs, and exclusion from supply chains. Global trade now considers not only price, but also the environmental performance of the production process. For this reason, delaying transformation

means facing higher costs in the future. Moreover, as delay lengthens, it is not only cost that increases; the burden of technology selection, access to financing, and rebuilding supply-chain relations also grows. We see green transformation not as an obligation, but as a planned and data-based strategic investment made in the future.

As the Ankara Chamber of Industry, we support our firms’ transition to energy efficiency, carbon reduction, and clean production applications through TÜBİTAK-supported green transformation projects. With these studies, we aim to strengthen Ankara industry’s green production infrastructure, increase compliance with international environmental standards, and encourage the development of new production and R&D capacity in the field of green technology.

How is Ankara positioned in this transformation compared with Turkey in general?

Ankara has a profile that simultaneously carries a strong technology ecosystem and an SME-weighted industrial structure; for this reason, in green transformation it has “high capacity, but more visible financial fragility.” While Ankara displays a more selective and structural transformation tendency in sectors within the scope of CBAM, a more sensitive picture emerges on the financing side, especially in terms of investment capacity. Although it has a relatively high share in terms of the number of firms in CBAM-covered production, its more limited weight in terms of production value shows that the industrial structure consists predominantly of SME-scale enterprises. This picture reveals that, in Ankara, transformation needs to gain speed not so much in areas such as lack of technology, but in areas such as investment financing, economies of scale, and access to common infrastructure.

Looking at the export composition, compared with the base-metal-intensive structure in Turkey overall, higher value-added fields such as fabricated metal products and machinery and equipment stand out. This is an important advantage in terms of technological adaptation and transformation capacity. However, pressure from input

costs and dependence on bank loans require more careful financial planning in green transformation investments. Therefore, the critical agenda for Ankara is to simultaneously enlarge green financing instruments, measurement-reporting infrastructure, and shareable capacity such as common test/validation that will accelerate efficiency and clean-production investments.

In terms of technology production and implementation capacity, Ankara is in a strong position. The ASO-İLTEK 2025 results show that Ankara ranks first in Turkey in technological development and has further consolidated its leadership, especially in the dimension of technology production. This picture points to a strong ecosystem that can carry green transformation in terms of R&D, innovation, and digital infrastructure. In other words, the capacity exists; what is critical is whether this power can be scaled simultaneously with measurement-reporting infrastructure, efficiency investments, and green financing.

Pressure of transformation and lack of technical capacity

What are the main areas in which SMEs have the greatest difficulty in the green transformation process?

Although SMEs have significant potential in the green



“Ankara holds a strong position in terms of technology development and implementation capacity. The ASO-İLTEK 2025 results reveal that Ankara ranks first in Turkey in technological development and has further consolidated its leadership, especially in the dimension of technology production.”

transformation process, they are in a more fragile position due to their financial and institutional structures. Particularly SMEs within the scope of CBAM feel the pressure of transformation more intensely because of their scale and financing structures.

The most fundamental difficulty is access to financing and investment capacity. A financing structure based on limited equity and dependence on loans can delay investments in energy efficiency, measurement-reporting infrastructure, and new technologies. Yet green transformation makes necessary investments that require an initial cost but provide efficiency in the long term. Especially investments with a medium- to long-term payback period — energy-efficiency equipment, process improvement, waste/recovery systems, renewable integration — can be postponed in SMEs because of financing costs.

The second important area is the lack of technical capacity. In many SMEs, institutional infrastructure has not yet sufficiently developed in matters such as carbon footprint measurement, sustainability reporting, and data management. This makes compliance with data-based regulations difficult. In addition, since carbon data, traceability, and reporting requirements are increasingly becoming standard in supplier evaluations by large firms, this deficiency increases the risk of SMEs losing orders and customers.

The third heading is the strategic point of view. While large firms see transformation as a competitive advantage, some SMEs still evaluate the process as a regulatory compliance obligation. Yet considering rising energy costs and supply-chain criteria, green transformation also means efficiency and market access.

For this reason, the dissemination of exemplary practices and good practices that frame transformation not as “cost” but as “efficiency + market access” carries critical importance.

For SMEs, the most effective accelerator is the presentation, as a “package,” of measurement-reporting consultancy, low-cost green financing, and common test/validation infrastructures.



Not just a ranking study, but a reference framework

As the Ankara Chamber of Industry, how did you decide to develop the ASO-İLTEK index, which measures the technological development levels of Turkey's 81 provinces, and from what need did this index emerge? Based on which criteria and data did you determine the technological development levels of the provinces?

In line with the vision of our Chairman of the Board of Directors of the Ankara Chamber of Industry, Mr. Seyit Ardiç, our decision to develop the ASO-İLTEK index emerged from the need to analyze Turkey's technology-driven development process more accurately and to reveal the spatial dimension of this process based on data. Although Turkey has gained significant momentum in recent years, particularly in defense industry, entrepreneurship, R&D, and innovation, there was a need for a comparable measurement tool to understand how this capacity is distributed across provinces, which cities are leading in technology production, and which regions need more support. In this context, ASO-İLTEK was designed not merely as a ranking study, but as a reference framework that analyzes the technological development levels of provinces in Turkey through reliable indicators and aims to provide strategic input to policy-making processes. In this respect, ASO-İLTEK is a decision-support tool that answers not only the question of "who ranks where?" but also "which province can gain momentum through which lever, and which policy works where?"

Our main approach in developing the index was to evaluate technological development not through a single dimension, but within a multidimensional and holistic framework. Accordingly, ASO-İLTEK measures the technological capacity of provinces under five main

components: Sectoral Structure, Research and Innovation Capacity, Digital Infrastructure, Technology Outputs, and Quality of Life and Workforce Attractiveness. These components make it possible to assess not only a province's capacity to produce technology, but also its ability to sustain and develop this capacity and to attract qualified human resources. Our fundamental approach in the index is to jointly assess the "capacity-output-attractiveness" chain at the provincial level through publicly available, comparable, and regularly updatable indicators. Within this framework, Sectoral Structure represents the place of technology within industrial composition; Research and Innovation reflects R&D and knowledge production capacity; Digital Infrastructure represents the foundational layer of transformation; Technology Outputs represent commercialization and performance; and Quality of Life and Workforce Attractiveness represent the ability to attract and retain qualified human capital.

In this context, the index is based on 37 different indicators obtained from reliable national data sources. The collected data were statistically normalized and weighted using the Principal Component Analysis (PCA) method. Through this method, the index was constructed on a fully objective and scientific basis, free from subjective evaluations.

Innovation-driven transformation in Anatolian cities

What kind of picture do the ASO-İLTEK 2025 results present, and what are the most important contributions of the project to industry?

The ASO-İLTEK 2025 results show that Turkey has made significant progress in technological development; however, this progress is not evenly distributed across provinces, and a clear technological divergence persists. The index reveals that the technology ecosystem is concentrated in certain centers and exhibits a three-tier structure. This structure can be broadly interpreted as: (1) technology production and commercialization centers, (2) industrial provinces with a strong production base but in need of technological deepening, and (3) provinces with limited transformation capacity seeking new areas of specialization.

Within this framework, Ankara and Istanbul stand out clearly in technology production and commercialization. Ankara takes the lead with its research and innovation capacity, while Istanbul plays a leading role in transferring technology to the market with its strong digital infrastructure and global connections. The fact that these two provinces together account for more than 80% of high-tech exports demonstrates the extent to which technological capacity is concentrated.

At the same time, it is observed that traditional industrial centers may lose competitiveness if they do not make sufficient progress in digitalization and R&D. The decline of Eskişehir and Kocaeli from the upper category shows that production strength alone is not sufficient for technological leadership, while Kayseri's rise to the top in technology outputs with its patent and design performance demonstrates the innovation-driven transformation potential of Anatolian cities. This picture indicates that the key threshold for provinces is not "production volume," but the ability to scale technology outputs such as R&D, digitalization, and design/patents together with production.

Another important finding of the index is that digital infrastructure and qualified human resources have become the main determinants of technological development. Differences in fiber infrastructure and digital capacity directly affect the development gap between provinces, while the talent gap in advanced technology fields stands out as a significant risk factor.



"Our main approach in developing the index was to evaluate technological development not through a single dimension, but within a multidimensional and holistic framework."

The most important contribution of ASO-İLTEK to industry is that it provides a data-driven analytical infrastructure that strengthens decision-making processes. This study offers a guide for industrial organizations and policymakers to objectively evaluate the technological position of provinces and to develop more targeted and effective strategies in areas such as digital infrastructure, R&D investments, and technology-oriented development.

From an industrial perspective, the most critical gain is that firms can compare their position with similar provinces, identify where they lag behind based on data, and prioritize their investments (efficiency, R&D, digital infrastructure, human resources) in a more rational manner. For policymakers, it provides a common reference set that enables resources to be designed not based on "equal distribution," but on a "targeted support" approach.

What is the role of ASO-İLTEK within the green transformation and the technology ecosystem?

ASO-İLTEK serves as a “bridge” that makes the link between green transformation and technological transformation visible, bringing data, prioritization, and investment decisions onto the same ground. Green transformation and technological transformation are not separate processes; on the contrary, they are two fundamental development dynamics that complement and reinforce each other. Progress in areas such as low-carbon production, energy efficiency, digitalization, and resource efficiency is directly related to the level of technological infrastructure, R&D capacity, and the maturity of the innovation ecosystem in provinces. Therefore, measuring technological development also serves as an indirect indicator of green transformation capacity.

The findings of ASO-İLTEK show that provinces with strong R&D infrastructure, advanced digital capacity, and qualified human resources are in a more advantageous position to adapt to and produce green technologies. Advanced manufacturing technologies, digitalization, automation, and data-driven production infrastructure play a critical role in reducing the carbon footprint of industry and maintaining international competitiveness. In this context, the index reveals with concrete data which provinces are more ready for green transformation and where technological capacity needs to be strengthened. Thus, the areas of intervention that will generate the highest impact in green transformation (R&D, digital infrastructure, talent, technology outputs) can be defined more clearly at the provincial level.

In addition, by analyzing the spatial structure of Turkey’s technology ecosystem, ASO-İLTEK enables the identification of policy areas that will support a more balanced distribution of technology-driven development across the country. For green transformation to be successful, technological capacity must be strengthened not only in certain centers but across all industrial regions. In this respect, the index aims to contribute—both for central government and local actors—as a guiding tool for planning technology- and sustainability-focused investments and supports in a more effective and targeted manner. From an industrial perspective, the value of this approach lies in enabling firms to better understand their regional ecosystem and to plan their green transformation investments (efficiency, digital monitoring, clean technologies) in a more rational order.

In this respect, ASO-İLTEK is a strategically important analysis and policy development tool that contributes both to strengthening Turkey’s technology production capacity and to accelerating the green and sustainable transformation of industry.

ASO Technology Base

In light of ASO-İLTEK data, you emphasize that strategies and policies should be developed specifically for each province. So, what projects is the Ankara Chamber of Industry working on to further advance Ankara’s technological development?

As the Ankara Chamber of Industry, we are implementing holistic projects that encompass production, R&D, green transformation, and ecosystem integration in order to further advance Ankara’s technological development. At the forefront of these projects is the ASO Technology Base Project. Our approach here is to accelerate the pathway from “knowledge to product, and from product to export” by bringing Ankara’s strong R&D capacity together with production scale.

The ASO Technology Base is a next-generation industrial and technology ecosystem project that aims to transform Ankara into a globally competitive center for technology and innovation. Within the scope of the project, a comprehensive technology center is being established where technology firms are integrated with R&D infrastructure, qualified human resources, and university collaborations. Designed with incubation centers, research infrastructures, and a green campus approach, this structure will serve as an innovation hub where knowledge is both produced and commercialized. When it reaches full capacity, it is expected to host more than 800 companies, create over 18,000 qualified jobs, and generate more than 1.5 billion dollars in high-tech exports annually. This structure aims to consolidate Ankara’s dispersed innovation capacity under a single ecosystem approach and to accelerate commercialization, scaling, and access to global markets.

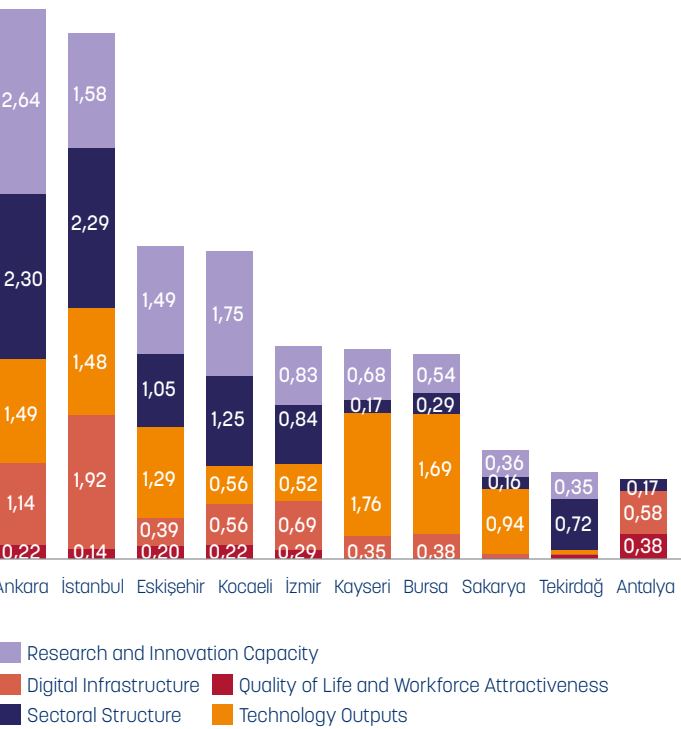
R&D Centers Platform

Another important project is the establishment of the R&D Centers Platform to strengthen coordination among R&D centers operating in Ankara, increase knowledge sharing, and enhance the capacity for joint project development. Through this platform, we aim to strengthen the culture of collaboration among firms, encourage joint R&D projects, and more effectively mobilize Ankara’s institutional research capacity, especially in advanced technology fields. The practical outputs of the platform are to transform collaboration from an “intention” into a “functioning” model through mechanisms such as a joint project pool, shared test/validation and laboratory access, supply chain matching, and talent pool sharing.

As the Ankara Chamber of Industry, we also prepare numerous analytical, strategic, and roadmap-oriented reports at both national and international levels to support the technological transformation of our industry. These studies provide concrete policy recommendations aimed at improving digitalization, green transformation, R&D capacity, and competitiveness, while also laying the groundwork for projects that strengthen international collaborations. In this context, our participation in the European Digital Innovation Hubs (EDIH) network, supported by the European Union, has been a highly strategic achievement in accelerating the digital transformation of Ankara’s industry and facilitating SMEs’ access to advanced technologies. In this way, our SMEs can more systematically access services such as digital maturity assessments, pilot applications, training, and consultancy, thereby reducing the cost and risk of transitioning to advanced technologies. Through these efforts, our goal is to establish a data-driven, internationally recognized institutional knowledge infrastructure that guides the technology-based development process of Ankara and our country.

The main objective of all these projects and initiatives is to elevate Ankara’s strong R&D infrastructure, qualified human resources, and industrial capacity to a higher level, positioning our capital not only as Turkey’s but also as one of the leading technology production and innovation centers in the region. In pursuing this goal, our priorities are to strengthen measurement and data infrastructure, expand investments in efficiency and clean production, and scale green financing channels in a way that is accessible to industry.

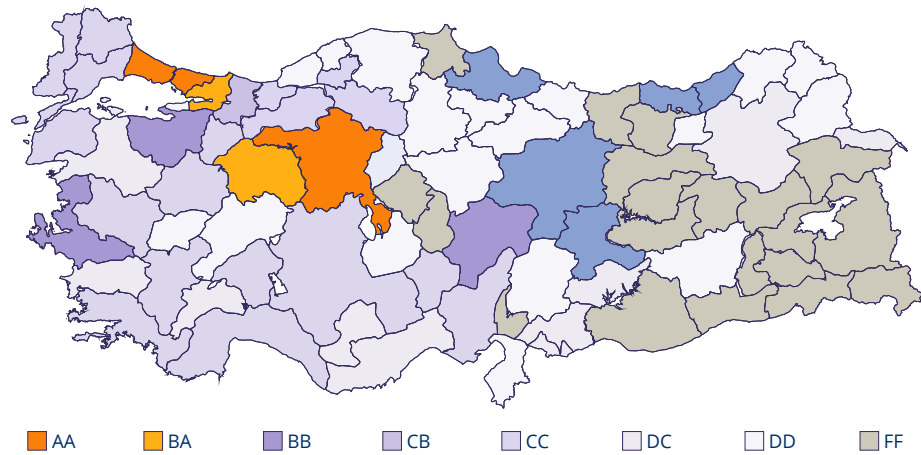
Determinants of Technological Development
Contribution of Sub-Indices to the Overall Index



“The main objective of all these projects and initiatives is to elevate Ankara’s strong R&D infrastructure, qualified human resources, and industrial capacity to a higher level, positioning our capital not only as one of Turkey’s but also as one of the leading technology production and innovation centers in the region.”

ASO-İLTEK 2025 Sonuçları

İl	Derece	ASO İLTEK (Skor)	ASO İLTEK (Sıralama)	Sektörel Yapı (Sıra)	Araştırma ve Yenilikçilik Kapasitesi	Dijital Altyapı	Teknoloji Çıktıları	Yaşam Kalitesi ve İş Gücü Çekiciliği
Ankara	AA	1,000	1	1	1	2	3	11
İstanbul	AA	0,962	2	2	3	1	4	23
Eskişehir	BA	0,675	3	4	4	10	5	16
Kocaeli	BA	0,666	4	3	2	8	8	13
İzmir	BB	0,539	5	5	5	5	9	24
Kayseri	BB	0,526	6	17	6	14	1	56
Bursa	BB	0,525	7	13	8	12	2	48
Sakarya	CB	0,401	8	18	10	36	6	32



What strategies, policies, and practices should be adopted in light of ASO-İLTEK findings?

The ASO-İLTEK 2025 results show that the most important priority in Türkiye's technological transformation is to ensure that the concentration of advanced technology and R&D capacity in certain centers is distributed more evenly across the country. One of the key strategic goals for the coming period should be to integrate the knowledge and innovation capacity generated in strong technology hubs such as Ankara and Istanbul with the production ecosystem of Anatolia through data-driven and place-based policies. For this to happen, knowledge produced in central hubs must flow to other regions not by intention, but through concrete mechanisms. Tools such as joint R&D programs, industry-university matching platforms, open access to pilot production and testing infrastructures, and scalable supply chain matching mechanisms can accelerate this transfer.

Technology policies should not follow a one-size-fits-all approach; instead, they must be shaped according to each province's economic structure, sectoral competencies, and development potential.

In practice, provinces can be grouped into:

1. Technology production centers
2. Industrial provinces forming the production and supply backbone
3. Transforming provinces seeking new areas of specialization

Differentiating support mechanisms based on these clusters will create greater impact.

In regions with limited industrial infrastructure, supporting new activity areas such as logistics, digital services, and technology-oriented sectors will help establish a more sustainable and realistic foundation for regional development. This approach is crucial to ensure that technological transformation progresses in alignment with local dynamics.

At the same time, increasing R&D investments, strengthening digital infrastructure, and developing a qualified workforce are critical priorities for sustaining technological leadership. Today, production capacity alone is not sufficient; provinces

that successfully transition to digitalization, innovation, and high value-added production clearly stand out in the technology race. Success in these three areas requires not only budget allocation, but also programs that are regularly monitored through concrete performance indicators (such as R&D intensity, qualified employment, digital access, and technology outputs) and continuously improved through feedback mechanisms.

In addition, supporting entrepreneurship in deep technology fields, strengthening financing mechanisms, and increasing national capacity in strategic technology areas are among the key policy priorities for the upcoming period. In this context, effective collaboration among the public sector, private sector, and research institutions will be one of the most important drivers of enhancing Türkiye's global competitiveness in technology production. The critical point here is to design complementary financing packages: patient capital for early-stage deep tech ventures, transformation loans/guarantees for SMEs, and export-oriented financing instruments for scaling phases.

To build a more balanced, sustainable, and competitive structure in Türkiye's technology-driven development process, it is essential to implement a holistic policy approach that takes regional differences into account, accelerates R&D and digital transformation, and mobilizes local potential. This is where the real value of ASO-İLTEK emerges: it enables resources to be directed not through "equal distribution," but through a data-driven approach of "the right tool, to the right place."

What kind of collaboration model between the public sector, private sector, and civil society would be more effective?

The findings of ASO-İLTEK show that technological development is only possible through a strong ecosystem approach in which the public sector, private sector, and civil society act in coordination. Therefore, the most effective collaboration model should be based on a governance approach where each stakeholder actively contributes according to its own capabilities, grounded in data and aligned around shared goals. What makes this governance effective is the definition of common objectives through measurable KPIs, regular data sharing, and the establishment

of continuity through a secretariat/coordination mechanism that accelerates implementation on the ground.

In this framework, the role of public institutions is to establish the policy framework that supports technology and innovation, to incentivize R&D and digital transformation investments, and to implement mechanisms that reduce regional development disparities. The private sector, as the main implementing actor, should increase R&D investments, strengthen collaboration with universities, and take the lead in commercializing technology. Civil society organizations and professional associations should act as bridges between these actors, playing a complementary role in supporting knowledge sharing and joint projects. In short, the public sector should provide the "foundation and incentives," the private sector should drive "implementation and scaling," and civil society should ensure "trust, networks, and collective learning."

For more effective collaboration, it is particularly important to establish coordination platforms at the provincial level where universities, chambers of industry, development agencies, and local governments work together. Through these platforms, each province's technological development strategy can be defined through collective intelligence, enabling more efficient use of resources and a more balanced distribution of technological capacity across the country. The agenda of these platforms should include concrete areas such as identifying priority technology fields, creating a joint project portfolio, ensuring access to test/validation infrastructures, sharing talent pools, and enabling joint access to financing channels.

Ultimately, the most effective model for a sustainable and competitive technology ecosystem is an institutionalized, continuous, multi-stakeholder collaboration structure—supported by the public sector, driven by the private sector, and strengthened by civil society.

TECHNOLOGY STORYTELLING: NUMBERS CONVINCE, STORIES MOBILIZE



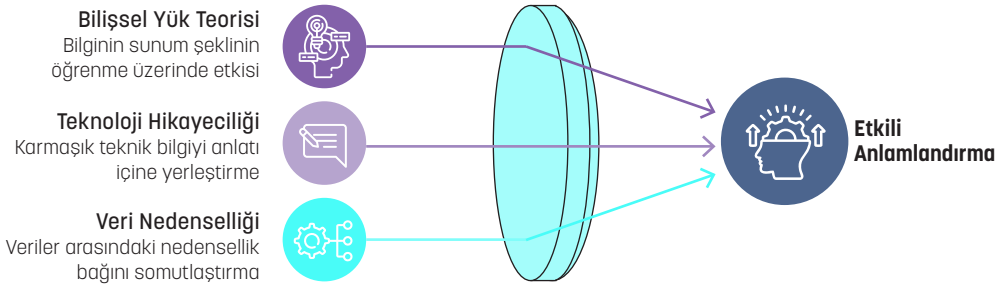
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TTGV Marketing and Communications
Specialist

Technological progress is inherently a complex and uncertain process. However, an innovation being merely technically successful is not enough for it to be accepted by society or industry. According to innovation diffusion theories, the speed at which a technology is adopted is directly related to how well it is understood and how clearly its advantages are perceived. At this point, **“Technology Storytelling”** emerges as a powerful communication discipline that places dry technical data into a strategic framework of meaning.

1. Cognitive Load Theory and Sensemaking

The human mind has a limited working memory capacity when processing abstract data. Cognitive Load Theory, developed by John Sweller, emphasizes the impact of how information is presented on learning and comprehension. Heavy jargon used in technical reports increases “extraneous cognitive load,” weakening the bond the stakeholder forms with the technology.

Technology storytelling serves as a “sensemaking” tool here. Placing complex technical parameters within a narrative allows the brain to process information with less effort and transfer it to long-term memory. A story clarifies the systematic structure of complexity by materializing the causal link between data points.



2. Technical Components of Data Storytelling

In academic literature, an effective technology narrative is defined as the synthesis of three elements: Data, Visualization, and Narrative. This tripartite structure ensures that information is not just transmitted, but gains persuasive power:

- **Rational Foundation (Data):** Builds evidence-based trust.
- **Cognitive Support (Visual):** Allows complex patterns to be noticed quickly.
- **Contextual Framework (Narrative):** Answers the “why” and “how” of the data, moving the technology’s impact onto human and operational ground.

3. Materializing Technology: The “Made to Stick” Principle

The “sticky information” principles formulated by Chip and Dan Heath emphasize the importance of Concreteness in technology communication. For experts in climate tech, terms like “reducing carbon intensity” are measurable and clear. However, this terminology can make it difficult for stakeholders like investors or the public to find a concrete equivalent for the project.

Strategic storytelling materializes these data points using the “Hero’s Journey” framework. Here, the hero is not the technology itself, but rather an industrial zone where smoke no longer rises from chimneys, a farm where the soil is revitalized, or an autonomous system cleaning ocean pollution. This transforms “cold” data into a “warm” success story.

Increasing Cognitive Load (Data Only):	Materializing Impact (Technology Story):
Focuses on technical parameters	Focuses on human and operational change
(e.g., “DAC unit improves energy efficiency by 25% via X-Sorbent technology”).	(e.g., “We aren’t just filtering air; we are paying our debt to the atmosphere by turning carbon into stone”).
Result: The listener understands the data, but the rational bond remains weak.	Result: Technology is positioned as a “vehicle for change,” creating psychological ownership.

Conclusion

Narrative Unity in the Innovation Ecosystem

Ultimately, technology storytelling is not about “decorating” technical data; it is about accelerating the spread of innovation by making the value created by that data understandable to everyone. This bridge ensures that information is not just known, but accepted.

For organizations targeting transformation, this discipline creates a multiplier effect in three dimensions:

1. **Distribution of Intellectual Capital:** Strategic narratives allow complex data to become a common language for all stakeholders, fostering an “open innovation” climate.
2. **Building Trust and Legitimacy:** Stories centered on “why” a change is made and its human-focused outcomes create psychological ownership among stakeholders. Numbers convince, but stories mobilize.

4. Strategic Output of Impact-Oriented Communication

For institutions aiming for technological transformation, storytelling is an “impact reporting” methodology. Through this discipline:

1. **Ecosystem Trust:** Stakeholder trust is reinforced by making complex processes transparent and understandable.
2. **Knowledge Transfer:** The “communication gap” that occurs when transferring academic knowledge to industry is closed.
3. **Mobilization:** Technology ceases to be just an “output” and becomes an inspiring “agent of change”.

3. **Ensuring Sustainability of Impact:** While technical reports may be shelved, the story of transformation is etched into corporate memory and cultural codes. This positions the institution as a “visionary leader” and “orchestrator” of transformation.

In the innovation world of the future, lasting marks will be left not just by those who produce the best technology, but by those who can storytell the impact of that technology in the most accurate, transparent, and inspiring way.

THE TECHNOLOGY ARCHITECTURE OF THE GREEN TRANSFORMATION

Hydrogen, Carbon and Beyond: Türkiye's New Areas of Competition



PROF. DR. ORHAN AYDIN
President, TUBITAK

INTERVIEW: Esra YAZDIÇ DEMİR
TTGV Corporate Communications and Media
Manager

A new page is opening in Turkey's journey of technology and innovation. While TÜBİTAK President Prof. Dr. Orhan Aydın emphasizes that they have moved in R&D support from the question of "how many projects?" to the question of "what kind of impact?", he points out Turkey's potential to become not only a practitioner in areas such as hydrogen, carbon management, and water technologies, but also a country that develops solutions and exports models.

In this new period, in which climate technologies have turned into a strategic leverage area, TÜBİTAK's public scale and TTGV's field-close and focused approach create a strong complementary structure. The uninterrupted support chain extending from idea to commercialization shapes not only technology, but also competitiveness, transformation, and the claim to regional leadership.

TÜBİTAK has been running a wide range of support mechanisms for both academia and industry for many years, periodically revising them in line with evolving needs. Could you provide information about TÜBİTAK's new-term support strategy?

TÜBİTAK's new-term support strategy is fully aligned with the 12th Development Plan and the 2030 Industry and Technology Strategy. It is built on a holistic approach to strengthening the R&D ecosystem and aims to develop qualified human resources, strong university–industry collaboration, and high value-added production capacity in line with Türkiye's National Technology Initiative goals.

One of the most concrete indicators of this vision is the scale and distribution of the support budget. For 2025, the budget has been balanced across Industrial R&D Programs, Academic R&D, and scientist training programs—covering the entire innovation chain from basic research to commercialization.

The strategy also focuses on nurturing talent from an early stage. Through support mechanisms spanning from middle school to postdoctoral levels, it aims to engage young people with science and technology early on, specialize researchers in critical technology fields, and encourage reverse brain drain. Research competitions, mentorship, and internship programs are designed to involve young talents directly in R&D processes.

At the same time, TÜBİTAK is strengthening collaboration among universities, public institutions, and industry to ensure that knowledge is transformed into products, solutions, and economic value. In this context, targeted calls are being planned in strategic areas such as artificial intelligence, advanced materials, semiconductors, energy technologies, green transformation, and space technologies.

A new model in capital investment

At the same time, we place great importance on making our support processes more predictable, faster, and more accessible. The 1707 Order-Based R&D Program, which strengthens SME–industry collaboration, is launched three times a year, enabling firms to plan their R&D and innovation activities without timing uncertainty. Similarly, by completing our transition in the entrepreneurship ecosystem from a grant-based structure to an investment-based model, we have moved to a system where we make direct capital investments in startups through our BiGG and BiGG+ funds.

We provide support mechanisms that enhance the R&D and innovation capacity of our industrialists and SMEs, while accelerating green and digital transformation. Through the resources allocated under the Türkiye Green Industry Project and new calls, we aim to strengthen the competitiveness of the private sector.

On the international front, we aim to reinforce the position of Turkish researchers in global R&D networks through science diplomacy and multilateral collaborations, increase access to international funding, and sustainably enhance Türkiye's visibility in the global science and technology ecosystem.

With this new support architecture, we are shifting our focus from "how many projects are supported" to "the economic and technological impact of supported projects." Beyond scientific excellence, we are building a vision for Türkiye based on scalable innovation and commercialization, aiming to position our country among those that produce, export, and shape global competition in technology.



"Our strategy includes bringing young talents together with science and technology from middle school to the postdoctoral stage, specializing the research workforce in critical technology fields, and encouraging reverse brain drain."

TTGV is a critical solution partner

As TTGV, how do you position the climate technologies you have recently focused on within Türkiye's science and technology policies? We also observe an increase in dedicated calls and support for climate technologies within TÜBİTAK programs—could you provide information on these focused support models?

Climate technologies are a strategic leverage area for Türkiye's sustainable growth and competitiveness goals, as they are globally. In this context, TTGV's clear focus on this field and the innovative mechanisms it has developed are highly valuable. The missions of TÜBİTAK and TTGV are complementary—especially in the field of climate technologies—setting a strong example of public–civil society collaboration. This alignment directly contributes to the transformation of the national innovation ecosystem.

One of the most concrete examples of this collaboration is the 1831 Green Innovation Technology Mentorship Program, implemented under the Türkiye Green Industry Project carried out with the World Bank. In this program, TTGV acts not only as a stakeholder but as a critical “solution partner” with its strong methodology, field expertise, and institutional capacity. The mentorship, capacity assessment, roadmapping, and solution-matching services provided by TTGV play a decisive role in enabling industry to adapt quickly and effectively to the green transformation process.



“TÜBİTAK today directs its R&D resources toward areas that strengthen Türkiye's scientific capacity, reduce external dependency in critical technologies, and enable our industry to compete globally in the future.”



A new framework in the project

Building on the success of this model, we are designing a new architecture in which projects matured through TTGV's early-stage support mechanisms are integrated into TÜBİTAK's large-scale programs. For example, a climate technology initiative developed under TTGV's Pioneer Projects Program could receive investment support through TÜBİTAK's 1832 Green Transformation in Industry Program or be integrated into solution platforms developed under the 1833 SAYEM Program. In this way, the ecosystem can operate as a “continuous rather than fragmented” structure across institutions.

At the same time, as TÜBİTAK, we are strengthening our support for climate technologies not only on the industrial side but also in academic research. We are directing research capacity toward priority areas such as environmentally friendly production, waste recovery, carbon capture, hydrogen production and storage technologies, and battery materials by shaping the scope of our calls accordingly.

In short, we are not limiting our collaboration with TTGV to current programs; in the coming period, we aim to establish a multi-layered and holistic partnership model that covers the entire climate technologies value chain. This approach will position Türkiye not only as a practitioner of green transformation, but also as a country that develops, shapes, and exports it.

Technology capacity investment

How is TÜBİTAK prioritizing technology areas to support Türkiye's green transformation and carbon neutrality goals? In your view, which climate technologies stand out in terms of the country's competitiveness? Which areas should academia and industry focus on, and what critical gaps need to be addressed?

In line with Türkiye's 2053 Net Zero vision, TÜBİTAK determines its priority technology areas based on scientific depth, national technology development capacity, and strategic R&D needs. The core guiding question is: “Which areas should TÜBİTAK's R&D budget be directed to today, and why?” This perspective enables a systematic structuring of R&D priorities.

The first dimension of prioritization focuses on “science-driven R&D areas (TRL 1–4)”. The goal here is to strengthen the scientific foundation that will provide long-term technological independence. Key priority areas include next-generation battery chemistries, electrocatalyst materials for hydrogen production, high surface-area nanomaterials for carbon capture, green chemistry processes, and biotechnological transformation technologies. While these areas may not immediately create markets, they build the knowledge and technology base that will enable future strategic markets.

The second dimension focuses on “industrial R&D and pilot-scale technologies (TRL 4–6)”. At this stage, TÜBİTAK aims to strengthen the “intermediate layer” that enables the transfer of scientific knowledge from universities to industry. Priority areas include scaling waste recycling technologies to pilot level, process improvements in carbon-intensive sectors such as chemicals, cement, and iron–steel, material innovations for the circular economy, and industrial automation solutions that enhance energy efficiency. Rather than directly creating markets, TÜBİTAK invests in building the technological capacity that will make markets more competitive.



In this framework, the expectation from academia is to continue producing original and in-depth scientific knowledge at TRL 1–4 levels in these priority areas. From industry, the expectation is to increase investments in pilot applications, demonstration lines, scaling efforts, and technology validation processes that will enable commercialization.

In summary, TÜBİTAK directs its R&D resources toward areas that strengthen Türkiye's scientific capacity, reduce external dependency in critical technologies, and enable industry to compete globally in the future.

A 10-year critical period

Are there areas where Türkiye could become a “game changer” or “trendsetter” in climate technologies over the next 10 years? If so, what are these areas?

The next decade will be a critical period in which climate technologies form a new axis of global competition. Türkiye has the potential not only to follow but to shape this transformation, thanks to its manufacturing capabilities, strong engineering base, and dynamic human capital. In this context, the right question is not “Which technologies will Türkiye develop?” but rather “What role can Türkiye play in global value chains?”

First, **hydrogen technologies** represent a major strategic opportunity. Türkiye is investing in R&D for hydrogen production, storage, and conversion, while also holding the potential to become a green hydrogen corridor between the Eastern Mediterranean and Europe over the next decade. This role is strategically important not only for energy security but also from a geopolitical perspective.

Second, in **carbon management**, Türkiye could emerge as a regional model developer. Its experience in carbon-intensive sectors such as iron–steel and cement creates an opportunity not just to adopt technologies, but to design and export low-carbon industrial transformation models. In the coming years, exporting technology and solution models to regions such as the Balkans, the Middle East, and North Africa appears feasible.

Third, **water technologies and climate adaptation solutions** stand out as a clear opportunity area. Water stress is one of the most pressing challenges in Türkiye’s geography. Innovations in wastewater recovery, industrial water efficiency, smart irrigation, and agricultural water management could position Türkiye as a regional provider of technology and solutions in this field.



“Our production experience in carbon-intensive sectors such as iron and steel and cement can enable Türkiye to move beyond being merely a technology user, to a position where it designs low-carbon industrial transformation models and exports them to neighboring countries.”

Another critical area is climate technology entrepreneurship. Türkiye’s young population, increasing R&D capacity, the TEKNOFEST ecosystem, and a growing entrepreneurial culture could position the country as a hub where climate tech startups are born and scaled across the Middle East, North Africa, and Central Asia. This is not a direct technology domain, but rather an ecosystem role that can elevate Türkiye into a regional “innovation hub.” In summary, what will make Türkiye a game changer in climate technologies over the next decade is not just individual technologies, but the strategic roles it assumes around them. Hydrogen, carbon management, and water technologies are key focus areas; however, Türkiye’s real value lies in taking on roles such as regional leadership, exporting solution models, and acting as a reliable technology partner. As TÜBİTAK, we will continue to strengthen our scientific and technological capacity in line with this vision.



“Hydrogen, carbon management, and water technologies are key focus areas; however, Türkiye’s real value lies in assuming roles such as regional leadership, exporting solution models, and acting as a reliable technology partner in these fields.”



TÜBİTAK and TTGV have long stood side by side in Türkiye's technology and innovation journey—TÜBİTAK with its comprehensive support for academia and industry, and TTGV with its tailored support models designed for the evolving needs of the private sector. In your view, what have been the critical elements of the existing and future collaboration between these two institutions?

As TÜBİTAK, we represent the inclusive power of the public sector, large-scale support capacity, and a policy-making role, while TTGV brings the dynamism of the private sector and its ability to produce focused solutions into practice. The alignment of these two institutions is a critical factor for the success of Türkiye's national technology initiative.

The key elements of our current and ongoing collaboration can be summarized under four main pillars:

First, ****integrated process management****. Technology development requires continuity. The integration of projects matured through TTGV's early-stage support mechanisms (such as the Pioneer Projects Program) into TÜBİTAK's support programs (1507, 1812, 1831, 1832) enables efficient use of resources and allows projects to

progress seamlessly "from idea to commercialization."

Second, ****data- and knowledge-driven policymaking****. The analyses and evaluations generated by TTGV from the field serve as important inputs in shaping our national strategy. Mutual information sharing strengthens evidence-based and agile decision-making processes.

Third, the ****combination of qualified financing and guidance****. As seen in the 1831 program, while TÜBİTAK provides funding, TTGV's mentorship and solution partnership services enhance the institutional capacities of firms. Providing funding alone is not sufficient; how that funding is managed and guided is equally critical. This model supports not only project execution but also the organizational strengthening of companies.

Fourth, ****human capital and cultural integration****. The qualified human resources developed through TÜBİTAK's TEKNOFEST and Scientist Support Programs, combined with TTGV's entrepreneurial culture, create a strong synergy that enhances the innovation capacity of the ecosystem.

In summary, the TÜBİTAK–TTGV collaboration is a successful model that brings together the strength of the public sector and the capabilities of the private sector under a shared vision, continuing to create long-term value for Türkiye's technology and innovation journey.

These two institutions, with their different yet complementary structures, have demonstrated in many cases that they can create strong synergy for Türkiye's technology and innovation ecosystem. What are your recommendations to further strengthen this collaboration and synergy in the coming period?

The public strength of TÜBİTAK and the flexible, focused structure of TTGV create a strong leverage effect within Türkiye's technology and innovation ecosystem. In the coming period, we see four main priority areas to elevate this synergy from the level of "cooperation" to a "strategic partnership."

First is a ****fully synchronized support architecture****. Beyond aligning the content of support programs, it is critical that their timing is designed to complement each other. Structuring TTGV's early-stage supports (Seed/Pioneer Projects) in a sequential and gapless timeline with TÜBİTAK's scaling programs (1507, 1831, 1832) would prevent entrepreneurs from losing time in search of funding and allow them to focus on developing their technologies.

Second is the development of ****hybrid financing models****. In capital-intensive areas such as green transformation, public grants or private funds alone may not be sufficient. By combining TTGV's investment funds with TÜBİTAK mechanisms such as BiGG+,

"blended finance" models that integrate grants and venture capital should be implemented. This approach could play a critical role in attracting international climate funds to Türkiye.

Third is ****integration from local to global****. Evaluating the ecosystem solely at the national level is no longer sufficient. A joint "export corridor" should be established to carry technologies—developed through TTGV's on-the-ground demonstrations and pilot applications—to global markets, leveraging TÜBİTAK's engagement in international networks such as Horizon Europe. This would accelerate the internationalization of Turkish technologies.

Fourth is ****data-driven policy design****. Both institutions hold highly valuable datasets. Transforming these into a shared "Technology Monitoring Platform," through anonymization, would enable national science and technology policies to become more data-driven, measurable, and agile. Insights derived from field data would also guide policymakers in identifying and addressing regulatory bottlenecks.

In summary, TÜBİTAK and TTGV are well positioned to strengthen their long-standing collaboration culture through these next-generation approaches, advancing toward a strategic partnership that will continue to shape Türkiye's technology and innovation journey.

A NEW ERA IN ENERGY: CAPACITY, NOT RESOURCES



EDİZ KAAK ÖNEM

TTGV Öncül Proje Programı
Program Uzmanı

The most critical misconception in the energy transition is the attempt to identify the right resource.

Today, the energy world is not going through a period of uncertainty, but rather a process of restructuring. The fossil fuel-based system is being replaced by a new structure increasingly shaped around electrification. As the share of electricity rises rapidly across many areas—from transportation to industry, from buildings to urban infrastructure—this transformation is redefining not only technological, but also economic and geopolitical balances.

Data from the International Energy Agency shows that this transformation is accelerating across many areas, from electric vehicles to renewable energy investments. However, interpreting this picture solely as a story of progress would be incomplete. While the energy transition eliminates existing dependencies, it also introduces new forms of dependency.

Critical minerals, advanced materials, and complex supply chains form the foundation of the new energy system. This clearly demonstrates that defining energy security solely in terms of resource ownership is no longer sufficient.

Energy independence is now determined not by underground reserves, but by the capacity built above ground.

Uncertainty Is Not a Risk, but a Strategic Domain

One of the most common misconceptions about the energy transition is the assumption that the winning technology of the future can already be definitively determined today. However, the current landscape suggests otherwise. While different chemistries compete in battery technologies, hydrogen stands out in specific use cases; energy storage solutions are diversifying, and systems are evolving toward increasingly hybrid structures.

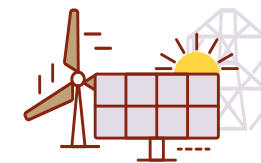
This is not a weakness; it is a natural outcome of transition periods. Uncertainty is not a problem to be eliminated; when managed effectively, it becomes a competitive advantage.

Therefore, the real challenge is not to eliminate this uncertainty, but to manage it effectively. Because those who gain an advantage in the energy transition are not those who select the right technology first, but those who generate experience, learn, and adapt rapidly.

For this reason, taking early action in certain areas is of critical importance. Areas such as electric mobility, charging infrastructure, energy storage systems, smart city applications, heat pumps, and industrial electrification are not only fields of technological development; they are also domains of strategic learning.

Each implementation carried out in these areas—whether successful or unsuccessful—creates a body of knowledge that will determine long-term competitiveness.

For this reason, in many cases, the cost of experimentation is lower than the cost of waiting.



“Those who gain an advantage in the energy transition are not those who first choose the most correct technology, but those actors who produce experience, learn, and adapt rapidly.”

Those Who Manage the Transition Shape the Future

Energy storage technologies lie at the center of this transformation. The increase in renewable energy generation alone is not sufficient; this energy must be balanced, reliable, and available when needed. This makes storage not an option, but a fundamental component of the energy system.

Similarly, electric mobility represents not only a change in vehicle technology, but a broader ecosystem transformation extending from battery production to recycling, and from software to infrastructure. The stage at which countries and companies position themselves within this transformation directly affects their long-term competitiveness.

Türkiye has significant potential in this process. Strong renewable energy resources, an advanced industrial base, and a skilled workforce can create a meaningful advantage when combined with the right strategies. However, transforming this potential into value depends not only on resources, but on the capacity to convert knowledge into innovation.

In this process, countries that remain passive will continue to be technology consumers, while those that act early will move into the upper tiers of the value chain.

At this point, the most critical requirement is the establishment of an effective coordination mechanism between academia, industry, and the public sector. Without a structure that enables the transfer of scientific knowledge into practice and practical experience into policy design, it is not possible to achieve scale and speed in the energy transition.

The winners of the energy transition have not yet been definitively determined. However, the nature of the process is clear:

It is not those who wait, but those who manage the transition who will gain the advantage.

The conclusion is clear: Energy independence is not a matter of resources, but of capacity—and this capacity will be built not by those who wait, but by those who manage the transition.

THE CRISIS CANNOT BE SOLVED IF CLIMATE SOLUTIONS DO NOT LEAVE THE LABORATORY

Climate solutions are won not by
good intentions, but by real data

PROF. DR. MİHRİ ÖZKAN
University of California
Department of Electrical and
Computer Engineering

INTERVIEW: Esra YAZDIÇ DEMİR
TTGV Corporate Communications and Media
Manager

In the struggle against the climate crisis, what is now being discussed is not great promises, but concrete solutions that find a response in the field. Technologies developed in laboratories can create only limited impact as long as they do not meet social life and are not applied in the real world. Today's most critical threshold is not only for climate solutions to be scientifically possible, but also for them to be applicable, scalable, and capable of being implemented fairly.

According to Professor Mihri Özkan of the Department of Electrical and Computer Engineering at the University of California, for science to remain within laboratory boundaries is not enough to create a real transformation against the climate crisis. Emphasizing that studies must be shaped on the basis of sound scientific data and engineering realities, Özkan states that real success emerges at the point where science can move simultaneously and in coordination with policy, industry, and society.

The details of the interview we conducted with Özkan—who holds the title of the first female academician to receive the “Inventor Award” in the history of the University of California and who was selected as an “Invention Ambassador” by the National Academy of Inventors (NAI)—are as follows:



“In my opinion, the most critical breaking point today is the issue of climate solutions leaving the laboratory and being integrated into society in a scalable, applicable, and fair manner. Because many technologies are scientifically possible; however, their widespread adoption at the economic, political, and industrial scale is still the biggest bottleneck.”

I define the role of technology in combating climate change not only as “producing solutions,” but also as the strongest leverage humanity has to redesign energy, production, and consumption systems. Today, the climate crisis is no longer merely an environmental issue; it is a process of transformation that directly affects every field, from economic sustainability to global security, and from health systems to industrial policies.

Technology performs two critical functions here. First, it makes possible systems that will reduce carbon emissions — for example clean energy storage, next-generation batteries, carbon capture technologies, and efficient electric transportation infrastructures. Second, it develops smart and resilient systems that will ensure adaptation to climate impacts that have now become unavoidable.

In my opinion, the most critical breaking point today is the issue of climate solutions leaving the laboratory and being integrated into society in a scalable, applicable, and fair way. Because many technologies are scientifically possible; however, their widespread adoption at the economic, political, and industrial scale is still the greatest bottleneck.

At this point, the role of academic research is very large. In my own work as well, this approach forms a fundamental axis. For example, our studies in CHEM that analyze the energy requirements and real emission impacts of direct air capture (DAC) technologies show that climate policies must be shaped not “only with good-intentioned targets,” but with realistic engineering data. Likewise, our research on sustainable artificial-intelligence hardware aims to reduce the invisible footprint of digitalization on the climate.



Knowledge produced in academia cannot be translated into the language of policy.

However, the second part of your question is very important: Is there a sufficient bridge between academia and climate policies? Frankly, this bridge is still lacking and needs to be strengthened. Knowledge produced in academia often cannot be translated into the language of policy; on the policy side, it takes time for scientific realities to turn into applicable roadmaps. Therefore, scientists need not only to publish, but also to contribute directly to policy processes. In this context, I took part as a U.S. Delegate at the United Nations Climate Panel in the summer of 2024 and delivered a presentation on the future of carbon capture technologies at the international climate meeting in Vienna. Such platforms are very valuable in terms of strengthening the link between science and decision-making mechanisms.

As a result, technology is at the center of the climate struggle; however, real success will come at the point where we can scale scientific innovation together with policy, industry, and society. The greatest need today is to accelerate interdisciplinary collaboration and to make science an integral part of decision-making processes.

Digital technologies are an important part of the climate strategy

What are the technical and economic barriers to the widespread adoption of sustainable production technologies?

Sustainable production technologies are no longer an “alternative,” but a mandatory transformation for the future of industry. However, there are significant technical and economic barriers to their widespread adoption.

From a technical perspective, one of the biggest challenges is ensuring that solutions that work at the laboratory scale can be implemented at industrial scale with the same efficiency. For example, next-generation battery materials, carbon capture systems, or low-emission production processes may be scientifically promising, but integrating them into large-scale factories requires substantial engineering infrastructure. Criteria such as durability, longevity, safety, and performance become much more complex in real-world conditions.

Another major technical barrier is the difficulty of reducing emissions in energy-intensive sectors. In areas such as cement, steel, and chemicals, production

processes inherently require high energy. Therefore, simply transitioning to clean energy is not sufficient; processes must also be redesigned, and complementary technologies such as carbon capture must be deployed.

As seen in my work on direct air capture (DAC), the real impact of climate technologies must be evaluated together with their energy requirements and system-level emissions. Otherwise, solutions that appear beneficial may result in higher-than-expected carbon costs.

In terms of economic barriers, one of the biggest challenges is high initial investment costs. Sustainable production technologies are often more expensive upfront because they require infrastructure transformation, new equipment, new supply chains, and skilled labor. This creates a significant barrier, especially for small and medium-sized enterprises.

Another critical issue is the lack of strong market incentives and regulatory frameworks. If carbon pricing, tax incentives, or green financing mechanisms are not clear, companies may delay transformation due to short-term cost pressures.

In addition, sustainability is not only an issue in production but also in digital infrastructure. Today, artificial intelligence and data centers are growing rapidly, and their energy consumption is reaching significant levels. Therefore, my work on sustainable AI hardware shows that digital technologies must also be part of the climate strategy.

In conclusion, the main barriers to sustainable production can be summarized as scalability, energy efficiency, cost, infrastructure transformation, and the lack of policy incentives. However, these barriers can

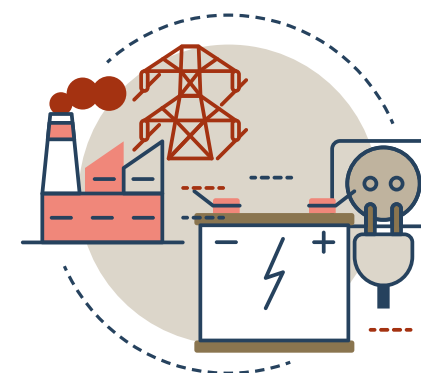
be overcome through the right investments, strong public-private cooperation, and science-based climate policies. The next decade will be the most critical period in determining the pace of this transformation.

In next-generation battery technologies (solid-state batteries, new electrolytes, etc.), the development that excites me the most is that batteries are now being redesigned not only for higher energy density, but also as safer, longer-lasting, and more sustainable systems. Solid-state batteries, in particular, are at the center of this transformation.

The main promise of solid-state batteries is that they significantly improve safety by reducing the flammability and thermal runaway risks associated with liquid electrolytes. This technology enables the development of safer battery architectures while increasing the range of electric vehicles. When combined with high-capacity solutions such as lithium metal anodes, it also has the potential to create a leap in energy density.

Another exciting development is the rapid progress in new electrolyte chemistries and interface engineering. In batteries, the main challenges often arise not from the materials themselves, but from the interfaces where they interact. Solving issues such as lithium dendrites, capacity loss, and short-circuit risks depends on the intelligent design of these interfaces.

In my work, topics such as fast charging, in-operando diagnostics, and safe electrolyte design stand out.



The most critical threshold in the transition of solid-state batteries from the laboratory to industry will be the maturation of these systems in terms of both performance and manufacturability.

Safer and more sustainable—but how?

The second part of your question is very important: how should the balance between safety and sustainability be established?

In my opinion, the way to establish this balance is to evaluate batteries not only as “more powerful” but as more responsible systems throughout their entire life cycle. In other words, for a battery to be sustainable, it is not only about providing longer range; it means having a low environmental impact throughout all stages, from raw materials to production, from usage to recycling.

For example, some high-performance electrolytes may contain rare or toxic components. Therefore, while ensuring safety, material sustainability, recyclability, and supply chain risks must also be taken into account. In addition, battery management systems are also part of this equation. The AI-based “mission-aware” battery diagnostics approaches we have developed ensure safer operation of batteries while extending their lifetime and reducing resource consumption. This directly contributes to sustainability.

As a result, the most exciting development in next-generation battery technologies is that safety, performance, and sustainability are now being addressed together as three fundamental pillars of the same goal. The batteries of the future will not only store energy; they will also serve as safe and responsible carriers of the clean energy transition.

Are electric vehicles really “zero carbon,” or are we simply shifting emissions to another point?

This is a very important and frequently asked question. The short answer is: Electric vehicles are “zero tailpipe emission” vehicles because they do not produce

emissions from the exhaust, but it is not scientifically accurate to call them completely “zero carbon.” This is because a vehicle’s carbon footprint is generated not only during driving, but throughout its entire life cycle, from production to the energy source.

In electric vehicles, emissions are mainly concentrated at two points: battery production and the source of the electricity used. Battery production is an energy-intensive process, and if it is carried out using fossil fuel-based energy, the initial carbon cost can be high. Similarly, if the electricity used to charge the vehicle comes from coal or natural gas, emissions are effectively “shifted to another point.”

However, the critical point here is that electric vehicles make emissions manageable from a centralized source. In internal combustion engines, emissions are released directly into the atmosphere from each vehicle’s exhaust. In electric vehicles, emissions depend on the electricity generation system, and as this system transitions to renewable energy, the carbon footprint of vehicles automatically decreases.

Therefore, electric vehicles, especially when supported by a clean energy grid, provide significantly lower total emissions in the long term compared to internal combustion vehicles. Today, many studies show through life cycle analyses that electric vehicles are more advantageous in terms of carbon emissions in most regions.

In my own research area as well, sustainability assessment is not limited to the question “Does the technology exist?”; it is necessary to calculate the real climate impact of the technology at the system level. This is why reducing emissions in battery technologies—through improvements in safety, recycling, material sourcing, and production processes—is critically important.

As a result, electric vehicles alone are not “zero carbon”; however, when considered together with the right energy policies, clean electricity infrastructure, sustainable battery production, and recycling systems, they are one of the most powerful tools for decarbonizing the transportation sector. The main issue is to implement the technology together with the right system transformation.

How can the carbon footprint of battery technologies used in electric vehicles be reduced?

It is one of the most critical steps for making transportation truly sustainable. Because the climate advantage of electric vehicles largely depends on how batteries are produced, how long they last, and how they are recovered at the end of their life cycle.

Several key strategies stand out for reducing the carbon footprint:

First, producing batteries with clean energy. Battery production is a highly energy-intensive process. If factories operate with renewable energy, the initial carbon cost can be significantly reduced. This is one of the areas where the sector can achieve the fastest gains.

Second, transitioning to less critical and more sustainable materials. The extraction of raw materials such as lithium, nickel, and cobalt creates environmental and geopolitical challenges. Therefore, there is a growing shift toward materials that are more abundant, lower-cost, and more ethically sourced.

Third, extending the lifespan of batteries. The most sustainable battery is the one that operates safely for a longer time. Advanced battery management systems and AI-based diagnostic technologies play an important role here. In our work, developing new metrics that predict battery health based not only on “state of charge” but also on real mission conditions increases both safety and lifespan, thereby reducing resource consumption.

Fourth, recycling and the circular economy. Battery recycling is no longer just an option; it is a necessity. Recovering critical metals both reduces the carbon footprint and ensures supply chain independence.

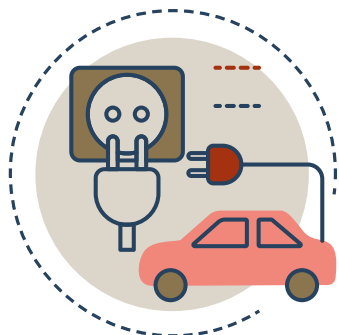
So, are there alternatives to lithium-ion batteries on the horizon?

Yes, there are strong candidates, but in the short term lithium-ion technology will continue to dominate. This is because the system is mature and has a large industrial infrastructure.

However, several technologies stand out:

- Solid-state batteries are among the strongest candidates, with the potential to improve safety and increase energy density.
- Sodium-ion batteries stand out as a low-cost and sustainable alternative, as they rely on a much more abundant element than lithium, especially for short-range vehicles and grid storage.
- Lithium-sulfur and anode-free batteries may create a future range revolution by offering very high theoretical capacity.
- In the longer term, another important goal is to design batteries that are fully recyclable and produced with low carbon emissions.

As a result, lithium-ion batteries will continue to exist in the near future; however, solid-state, sodium-ion, and next-generation chemistries are developing rapidly. The real transformation is not only about finding a new battery, but about turning the battery into a low-carbon, safe, and sustainable system from production to recycling.



“Electric vehicles are ‘zero tailpipe emission’ vehicles because they do not produce emissions from the exhaust; however, it is not scientifically accurate to call them completely ‘zero carbon.’ This is because a vehicle’s carbon footprint is generated not only during driving, but throughout its entire life cycle, from production to the energy source.”



“Lityum-iyon piller yakın gelecekte varlığını sürdürecektir; ancak katı hal, sodyum-iyon ve yeni nesil kimyalar hızla gelişiyor. Asıl dönüşüm, yalnızca yeni bir pil bulmak değil; bataryayı üretimden geri dönüşüme kadar düşük karbonlu, güvenli ve sürdürülebilir bir sistem haline getirmek.”

What systemic transformations are needed—beyond technological ones—for electric mobility to be sustainable?

Electric mobility is often perceived simply as “replacing the car’s engine.” However, true sustainability comes not from a single technology, but from a transformation of the entire system. Electric vehicles are an important starting point, but several fundamental structural changes are required for them to create a meaningful climate impact.

First, the decarbonization of the electricity grid. The climate advantage of electric vehicles is directly linked to the source of the electricity that charges them. If the grid relies on fossil fuels, emissions are merely shifted from the exhaust to power plants. Therefore, renewable energy investments and clean grid infrastructure are essential for electric mobility.

Second, charging infrastructure must be expanded in a smart and accessible way. Electric mobility should reach not only large cities but all income groups and regions. This requires fast-charging networks, residential charging solutions, and harmonized standards.

Third, the battery supply chain must become sustainable. The extraction, processing, and production of critical minerals carry environmental and ethical risks. Therefore, battery recycling, second-life use, and the transition to more sustainable materials must be integral parts of the system within a circular economy approach.

Fourth, transportation must be rethought not only as vehicle-based but as a mobility ecosystem. Strengthening public transport, designing cities around pedestrians and bicycles, and integrating shared systems and logistics optimization are essential. Simply electrifying vehicles will not be sufficient on its own.

Fifth, digitalization and artificial intelligence are critical components of this transformation. If smart management systems are established between electric vehicles, batteries, and the grid, energy efficiency can be increased. However, digital infrastructure also consumes energy. Therefore, work on sustainable AI hardware shows that we must also reduce the digital footprint of clean mobility.

Finally, strong climate policies and the right incentive mechanisms are needed. Without carbon pricing, green industry support, battery recycling regulations, and just

transition policies, this transformation cannot take place quickly or inclusively enough.

In summary, electric mobility is a powerful tool for a sustainable future; however, real success is only possible when it progresses together with clean energy, a circular battery economy, infrastructure investments, urban transformation, and science-based climate policies.

Can hybrid systems (battery + supercapacitor) be the systemic future of energy storage?

Absolutely yes — hybrid energy storage systems can play a very important role in the future of electric mobility and renewable energy infrastructure. Because it is often not possible to meet all needs with a single energy storage technology.

Batteries are ideal for long range and long-duration storage thanks to their high energy density. However, when very fast power output is required—such as sudden acceleration or high current pulses like regenerative braking—batteries can be strained. Supercapacitors come into play exactly at this point: they can charge and discharge very quickly, withstand millions of cycles, and provide high power density.

Therefore, battery + supercapacitor hybrid systems offer an intelligent solution that optimizes both “energy” and “power” needs together. This approach provides a strong advantage especially in urban transportation, buses, heavy-duty transport, fast-charging applications, and industrial systems.

Another important point is extending battery life. Supercapacitors handle sudden load changes, reducing stress on the battery. This allows the battery to last longer, creating a significant benefit in terms of both cost and sustainability.

In my research area as well, it is critical to think about energy storage systems not only at the material level but also at the system level. The storage solutions of the future will be hybrid architectures where different technologies work together and are optimized with AI-supported management systems. Especially in electric vehicles and grid storage, task-oriented, modular, and intelligent system designs are emerging instead of a “one-size-fits-all” battery approach.

Of course, there are also engineering and economic challenges for the widespread adoption of hybrid systems, such as integration complexity, cost, control algorithms, and standardization. However, in a world where the energy transition is accelerating, such multi-component solutions are becoming increasingly necessary.

In conclusion, hybrid energy storage systems are not just an alternative; they are one of the most powerful system-level approaches for making electric mobility and clean energy infrastructure more efficient, resilient, and sustainable.

What kind of roadmap should be followed in clean energy technologies for developing countries?

For developing countries, the transition to clean energy is not only an environmental goal; it is also a strategic opportunity in terms of energy security, economic development, and social welfare. However, for this transformation to succeed, a systemic roadmap designed according to local conditions is needed rather than relying on a “single technology.”

First step: Reading the local energy reality correctly.

Each country has different energy resources, infrastructure, industrial structures, and climate risks. Therefore, the roadmap should be shaped not according to a “one-size-fits-all” model, but according to parameters such as the country’s electricity grid capacity, dependence on energy imports, transportation needs, and industrial intensity.

Second step: Starting with solutions that provide quick gains.

Renewable energy systems such as solar and wind have become the lowest-cost source of new electricity generation in many countries. However, because of the intermittent nature of renewables, simultaneous investments in energy storage and grid flexibility are also required. Here, batteries, microgrids, and demand management solutions are critical.

*****Third step: Scaling decentralized solutions.*****

Especially in rural areas where access to the grid is limited, microgrids and local systems based on solar plus storage offer a fast and effective solution. This approach creates a direct development impact for education, healthcare, and small businesses.

Fourth step: Viewing technology transfer not as “product import” but as capacity building.

A common mistake is to import clean energy technologies and assume this will be sustainable. However, for lasting success, local manufacturing, maintenance and repair ecosystems, a skilled workforce, and R&D capacity must be developed. Universities play a critical bridging role at this point. As I have observed in my work in both research and innovation programs, strengthening mechanisms such as patents, technology transfer, and entrepreneurship at an early stage creates significant long-term impact.

Fifth step: Financing and policy framework.

One of the biggest barriers in developing countries is the high cost of capital. Therefore, international climate finance, development banks, and risk-sharing mechanisms need to be activated. In addition, transparent and predictable regulations—such as grid connection rules, incentives, recycling standards, and efficiency criteria—are essential for investor confidence.

Sixth step: Just transition and social acceptance.

While the clean energy transition creates new areas of employment, it also transforms certain sectors. Therefore, social policies, education programs, and a “just transition” approach must be an integral part of the roadmap.

In conclusion, the most appropriate roadmap for developing countries is a strategy based on renewable energy + storage + grid modernization, which strengthens local capacity, makes financing accessible, and places just transition at its core. If designed correctly, the clean energy transition can accelerate economic development alongside climate goals.

How do you evaluate Turkey’s potential in clean energy, energy storage, and battery technologies?

I think Turkey has very strong potential in clean energy, energy storage, and battery technologies. There are several main reasons for this: Turkey is geographically advantageous in terms of renewable energy resources, has a strong industrial infrastructure, and possesses a young and dynamic engineering workforce.

First of all, Turkey is one of the countries with significant growth potential in solar and wind energy. However, for renewable energy investments to be truly sustainable, they need to be supported by energy storage systems. This is because one of the most critical components of the clean energy transition is maintaining grid balance in systems where production is intermittent. This makes battery technologies strategic.

In the field of batteries, Turkey has an important opportunity: its automotive and manufacturing ecosystem is already strong. The transition to electric vehicles can create a major technological and industrial transformation not only in vehicle production, but also in areas such as battery cells, packaging, recycling, and supply chains. This represents both an economic and strategic leap opportunity for Turkey. Moreover, energy storage is not limited to vehicles. Grid-scale batteries, industrial storage, and microgrids can also play a critical role in Turkey’s energy security. In particular, storage technologies are an important lever for reducing dependence on energy imports.

Another advantage of Turkey is the scientific capacity and research infrastructure within its universities. There are strong research groups in materials science, electrochemistry, and engineering. However, the critical issue here is enabling academic research to translate more rapidly into technology transfer and industrial applications. The patent ecosystem, entrepreneurship support, and university-industry collaborations will be decisive in this regard.

In conclusion, with the right strategic investments and strong coordination between R&D, industry, and policy, Turkey is in a position to become a regional leader and a global player in energy storage and battery technologies. This field represents one of the greatest opportunities for Turkey in terms of both climate goals and economic development.



A symbol of translating years of laboratory work into real-world impact

What does it mean to you to be the first female academic in the history of the University of California to receive the “Inventor Award”?

This award is both a great honor and an important responsibility for me. Being the first female academic to receive the “Inventor Award” in the history of the University of California, within such a strong research ecosystem, is not only a personal achievement; it is also an indication that science and innovation are moving toward a more inclusive future.

For me, this award is a symbol of fundamental research conducted in the laboratory creating real-world impact. While working in areas such as energy storage, sustainable batteries, and climate technologies, my goal has always been to generate societal benefit alongside scientific excellence.

Being selected as an Invention Ambassador by the National Academy of Inventors is also an important part of this journey. This role carries the responsibility of promoting a culture of innovation, supporting young inventors, and strengthening university–industry collaborations.

One of the most meaningful aspects of this award is that it serves as an inspiration for young female researchers. It is very valuable to me that they overcome invisible barriers in science and feel empowered to say, “I can do it too.” I share this achievement with my team members and students, and I aim to contribute to transforming more ideas into patents, ventures, and societal solutions in the future. This award is not only a recognition of the past, but also a call to advance science in order to solve humanity’s greatest challenges.

FROM THEORY TO THE FIELD: CASE STUDIES ACCELERATING TRANSFORMATION IN CLIMATE TECHNOLOGIES - 2026



The TTGV Climate Technologies Case Studies that we have put into practice in order to accelerate the development of climate technologies and strengthen the transformation capacity of industry offer an approach that nourishes learning with real-world experiences while establishing a strong bridge between theoretical knowledge and applications in the field.

TRIPY – Mobility

In the decarbonization process of the mobility sector, micromobility solutions play a critical role. The rapidly growing e-bicycle market on a global scale and Turkey's increasing production and technology capacity show that this field is an area of transformation that is economic and strategic as well as environmental. Especially in short-distance urban transportation, electric bicycles are becoming one of the fundamental elements of sustainable mobility through their low carbon emissions, energy efficiency, and accessibility advantages.

Within this scope, as the TTGV Climate Lab Community, we came together with Tripy Mobility under our moderation and under the mentorship of Semih Dilsiz, Deputy General Manager of Yapay Zekâ Fabrikası and our Mobility Climate Pioneer. The case study reveals, within a broad framework extending from the effects of shared systems to battery technologies and field experiences, that micromobility offers a concrete and scalable solution in urban transportation.

Designed with a business model based on the sharing economy, Tripy increases resource efficiency by placing sharing rather than ownership at the center, and demonstrates its environmental and social impact strongly in the field through its implementations in different cities.



Bosch Home Comfort Group - Built Environment

The built environment, which is responsible for a large part of energy consumption and carbon emissions, stands out as one of the most critical areas that must transform in order to achieve climate targets. In this transformation, heat pumps are among the solutions that are becoming increasingly prominent thanks to their flexible usage areas and high efficiency. The growing interest on a global scale and the expanding areas of application in Turkey show that this technology is positioned at the center of transformation in the built environment.

Within this framework, in order to address the transformation in the built environment in a multidimensional way and examine in depth the role of heat pumps in this process, we carried out the case study titled **“Climate-Compatible Systems in the Built Environment.”** Within the scope of this study, conducted under the moderation of the TTGV Climate Lab Community and with the mentorship of Tuğba Uçar Demir, Senior Innovation Manager at Eczacıbaşı Holding and our Built Environment Climate Pioneer, we analyzed the transformation dynamics in the sector through the experience of Bosch Home Comfort Group.

During the study process, a broad framework was addressed through a holistic approach, extending from the areas of use of heat-pump technologies to implementation experiences, from system integration to user behavior, and from digitalization to value-chain transformation. The findings that emerged clearly reveal that the transformation in the built environment is not limited only to technical solutions, but must be evaluated as a multilayered, systemic process of change.



SÜTAŞ - Agriculture/Food

The dairy sector, while forming the foundation of food security, is passing through a critical transformation process in line with increasing environmental pressures and 2050 Net Zero targets. In order to understand this transformation and make good examples visible, we implemented the case study **“Climate Resilience and Technological Transformation in the Milk and Dairy Products Sector.”** The study took shape under the mentorship of Semi Hakim, Founding Partner of Kök Proje & Kök Ventures and our Food Climate Pioneer, and the moderation of the Climate Lab Community.

This study, carried out through the example of SÜTAŞ, addresses with a holistic approach topics such as the integrated business model, animal welfare, drought-resistant feed, water and carbon management, biogas and solar-energy applications, digitalization, and regenerative agriculture. At the same time, it sheds light on the transformation of the value chain through technology and on the critical learnings obtained from sustainability practices.

As a field at the intersection of agriculture, animal husbandry, and food, the dairy sector plays a more critical role than ever in terms of comprehensive solutions that increase climate resilience.



CLIMATE PIONEERS

#İklimÖncüsü



**ASSOC. PROF. DR.
TUNÇ DURMAZ**

TTGV Climate Pioneer
Faculty Member, Yıldız Technical University



THE CIRCULAR ECONOMY WILL BECOME AS NATURAL AS THE AIR WE BREATHE

We have entered a forced transformation due to the climate crisis. While everyone is adapting this to their lives, as TTGV, we selected you as a “Climate Pioneer” based on your field of work and the value you contribute to it. What was your motivation for becoming a climate pioneer?

The fight against climate change is not something that can be confined to a single track, achieved by a single person, or solved with a single technology. In short, it is not a struggle that can be accomplished through “singularities.” If technology is in question, there is a need for a portfolio; when people are in question, there is a need for togetherness; when science is in question, there is a need for plurality of voices. Since the problem is a public good—that is, CO₂ is a global pollutant, its effects and costs transcend geographical boundaries, and it can affect everyone in the world—this plurality is very important. Otherwise, as current events reflect, even a single pollutant can affect very large populations through the global climate crisis. We should always keep this in mind: if you remain alone, you cannot fully understand or explain, and a one-sided solution prevails; even if we achieve successful outcomes individually, we struggle to create impact because combating climate change requires plurality. Therefore, the fact that communities are guided by pioneering individuals, that members learn from one another due to their dynamics, and that knowledge spreads rapidly and demands can be voiced more strongly in this way was the main factor that led me to take part in the TTGV Climate Lab Community program. The idea of creating a mosaic from these pieces and ensuring that this work creates long-term impact became my greatest source of motivation.

In Turkey and around the world, the climate crisis, climate technologies, and sustainability are no longer just agenda items; they are a strategic necessity. So, which areas should we prioritize in this field?

As an economist, I attach great importance to placing economic rationality at the center of climate change studies. By this, I do not mean maximizing profits and revenues as much as possible; rather, I mean conducting studies and making decisions based on integrated models in which (i) the distinction between short and long term is made, (ii) opportunity costs (the values forgone when making a choice), (iii) shadow prices—environmental costs without price tags in the market—and (iv) externalities are clearly calculated at every stage of the process. The more accurately we position the economy and economic rationality at the center, the more we can provide a sustainable ecosystem for the business world, consumers, and our planet. Therefore, just as it is important for economists to understand other disciplines and collaborate with them, it is equally important for other disciplines to understand economists and trust their guidance. Because the greatest incentive on the path to climate change and green transformation is pricing. Why do carbon markets exist? To put a price on carbon. How is the carbon price formed? Through the establishment of a market that is normally missing, via regulatory intervention. Wherever the price mechanism operates, the need for economic reasoning is undeniable. However, the functionality of this role depends—just like in industrial symbiosis—on a symbiotic working culture

in which different disciplines feed each other, technical knowledge provides input to economic models, and the outputs of these models in turn feed other disciplines. As a result, it is not enough to develop technology; we must also build this common language and methodology that blends these technologies with economic reality.

What breakthroughs and innovations are expected in climate technologies in the near future? What will be their impact on sectors?

Since the thematic area I represent includes cross-cutting applications and technologies, we are talking about a subject that has a place in every sector. Therefore, we need to consider breakthroughs and innovations in terms of their areas of impact. First of all, the circular economy will become as natural as the air we breathe. At a time when resource constraints are increasingly felt, correctly pricing the value created by circularity is of vital importance. Since circularity is a multidisciplinary issue, the importance of collaborative technologies such as artificial intelligence that optimize processes, blockchain that ensures traceability, and digital twins that provide simulation capabilities will continue to grow.

In addition, limited access to financing makes it difficult to reach the required scale, while the passage of time increases the costs of transformation. I foresee that the biggest breakpoint in our thematic area will occur when we reach the effective emission reduction frontier. We attach great importance to the renewable transition, but we are approaching the end of the low-hanging fruits. As an example, we can point to the fact that the land required for energy transformation is starting to compete with agricultural and residential areas, and the high costs of storage and grid investments required due to intermittent

production.

Moreover, considering the ever-increasing energy demand and the renewable energy supply that can barely keep up with it, we are in a period where emissions continue to rise and the climate crisis deepens. In such a situation, there is a risk of creating very large opportunity costs by not utilizing the rich technology portfolio we have. The opportunity cost of choosing a high-cost transformation at the emission frontier means foregoing the resource savings and economic welfare that could be achieved through more efficient technologies.

The point we should focus on is determining which technology will have a lower emission reduction cost per unit from a long-term perspective. In light of financing costs and carbon price projections, if carbon capture and utilization (CCU), carbon capture and storage (CCS), or carbon dioxide removal (CDR) technologies present a lower total cost picture (including environmental costs), economic rationality requires investment in and deployment of these technologies. Therefore, a sustainable future will be possible not through ideological preferences, but through a symbiotic working culture in which different disciplines support each other and by directing efforts toward the right technology portfolio indicated by economic cost analyses that also consider social welfare.



“I attach great importance to placing economic rationality at the center of climate change studies.”



GÜVEN FİDAN

Founder & CEO – Alkazar

A CLIMATE CHANGED BY FLAMES: A DATA-DRIVEN LINE OF DEFENSE IN FIRE FIGHTING

In the Mediterranean geography, the summer season is now remembered not only for tourism, but also for the increasing threat of forest fires. Since the Manavgat fire in 2021, the picture we have seen is clear: fires are becoming more frequent, faster, and more destructive. On “red alert” days, when the temperature exceeds 40°C and humidity falls below 20%, even a small human-caused spark can in a very short time turn into uncontrollable mega-fires.

In the face of this “new normal,” proceeding with entirely reactive methods that only go into operation after the smoke is seen is no longer sufficient. The real need is climate-oriented decision-support systems that foresee risk before the fire starts and manage the intervention. In other words, the problem is not only “putting out the fire,” but measuring fire risk, seeing it early, and directing the right resource to the right place at the right time.

“İklim değişikliği yangın sezonunu uzatıp şiddetini artırırken, savunma hattımızı teknolojiyle güçlendirmek zorundayız.”

From static maps to dynamic foresight

In fire technologies, the rules of the game are changing. Traditional, static risk maps are giving way to dynamic decision-support mechanisms that bring together meteorological forecasts, geographic information systems (GIS), and historical fire data. These next-generation systems produce data that directly enable decision making for a wide group of stakeholders, from insurance to public institutions, and from infrastructure operators to the private sector.

1. Preventive intelligence

The system can, days in advance, identify the regions where risk reaches a critical level by evaluating together data such as weather, wind, temperature, humidity, and vegetation cover. When “risk pins” appear on the map, public authorities can position their teams and equipment in a more intelligent way before the fire starts.

2. Operational foresight

Once the fire has started, the same system can estimate, by processing variables such as wind direction and speed, topography, and fuel load, in which direction and at what speed the flames may spread within hours. This foresight makes it possible to optimize evacuation decisions, intervention plans, and resource distribution more accurately within minutes, even seconds.

IoT, satellite, and SaaS

Karar destek sistemlerinin gerçek gücü, sahadan gelen verinin çeşitliliği ve sürekliliğinde yatıyor. Sahadaki IoT sensörlerinden gelen anlık sıcaklık ve nem ölçümleri; uzaydan gelen güncel uydu görüntüleriyle birleştirildiğinde, yangın risk analizi yalnızca “teorik bir harita” olmaktan çıkıp sahaya dönük, uygulanabilir bir faydaya dönüşüyor.

Bu sistemlerin SaaS (Hizmet Olarak Yazılım) yaklaşımıyla sunulması ise erişimi kolaylaştırıyor; farklı kurum ve şirketler aynı altyapıyı kendi karar süreçlerine entegre edebiliyor.

Sigorta Sektörü

Dinamik risk haritaları sayesinde konut, sanayi ve kritik altyapı bölgeleri için daha gerçeğe dayalı risk primlendirmesi ve portföy yönetimi yapılabilir.

Yatırımcı ve Özel Sektör

Enerji santralleri, turizm tesisleri ve üretim tesisleri; varlıklarının anlık risk durumunu izleyerek iş sürekliliği ve koruma önlemlerini daha erken devreye alabiliyor.

Kamu Kurumları

Kaynaklar veriye dayalı yönetildiğinde, müdahale maliyeti düşerken operasyonel etkinlik artıyor. En kritik kazanım ise müdahalenin doğru yerde ve doğru zamanda yoğunlaşması oluyor.

Conclusion

As climate change lengthens the fire season and increases its severity, we must strengthen our line of defense with technology. Decision-support systems that operate the data network extending from the field to space through climate-oriented predictive models are one of the most strategic steps that carry fire fighting from “extinguishing” to “managing.” This approach is the most concrete way of being prepared not only for today’s risk, but also for tomorrow’s much harsher climate conditions.

MANAGING TRANSFORMATION—NOT JUST TECHNOLOGY—IN THE AGE OF ARTIFICIAL INTELLIGENCE



SUAT BAYSAN

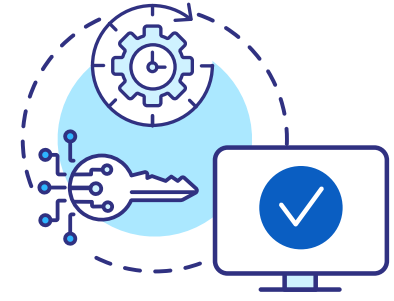
Member of the Board of Founders, TTGV
Founding Partner, ACMENA Technology
Management and Investment Services

We are going through a period in which artificial intelligence and natural intelligence are beginning to reach near parity in terms of capability. Technologies developed with enthusiasm and curiosity gradually begin to exceed their originally intended functions. What was initially designed for data collection and information compilation has long been surpassed. The volume of synthetic data is now exceeding that of human-generated data. As a result, insights derived from this composite data mix are gradually losing their diversity.

This raises the question of whether we might face a digital-world counterpart of the “mad cow” crisis once experienced in agriculture and livestock sectors. Of course, technology is not allowed to operate entirely unchecked. Ethical and legal dimensions continue to be debated. Unusual or distorted AI applications are not easily accepted by society and fail to secure a lasting place in the market. For this reason, we are constantly reminded that we must learn to understand—and when necessary, manage—software systems that attempt to manipulate our thinking.

It is, in fact, essential to properly examine the conditions behind the remarkable increase in investments in artificial intelligence. In doing so, we must also ask: Why are the resources allocated to natural learning not increasing at the same pace?

Observing where rapidly evolving technology will lead can sometimes feel like watching a suspenseful film. Yet, merely standing still and watching the digital divide widen does not bridge the growing chasms. Escaping an environment where we merely try to surf on the surface requires diving into deeper waters. The warnings are now clearer and stronger. Waves are hitting the shores more frequently and with greater force. Walking along the sand has become riskier than ever.



“It is necessary to quickly move beyond temporary excitements and address transformation in a more conscious way. Otherwise, instead of progressing together, a competitive environment emerges in which we place obstacles in front of one another.”

Is the issue simply understanding technology?

How is this technological progress transforming business life? Are our institutional structures capable of adapting to these innovations? Or is the issue limited to merely understanding technology?

In reality, the issue is about adopting a holistic approach—defining comprehensive projects, developing end-to-end solutions, and implementing them in a structured manner. The challenge often lies in determining where to begin the transformation.

Randomly selected, short-term gains may seem attractive at first. We may even fall into the illusion that progress is rapid and easy. However, such approaches often create isolated “technology islands.” Over time, this leads to serious communication and integration problems. Locked systems and complex processes reduce efficiency.

For this reason, it is necessary to quickly move beyond temporary excitement and approach transformation more consciously. Otherwise, instead of progressing together, we risk creating a competitive environment where we obstruct one another. Understanding how

technology transforms management approaches that elevate businesses to a contemporary level becomes a key component of competitive advantage. Therefore, roadmaps for technology adoption are shaped through benchmarking against companies that successfully implement best practices in the sector.

The process essentially unfolds in two stages:

First, existing capabilities are analyzed; then, new capabilities required to achieve targets are developed.

Remaining continuously connected, cultivating change-responsive employees, and embedding learning into corporate culture are becoming increasingly important. The acceleration of technology makes this inevitable. Ultimately, human resources lie at the core of corporate transformation. Achieving transformation goals is only possible with highly capable employees.

Today, artificial intelligence facilitates the design and planning of corporate architectures. It also helps transform lessons from best practices into concrete projects.



Corporate transformation progresses along four main axes

First axis: With leadership at the headquarters taking a more prominent role, corporate culture, work environment, and sustainability approaches are transformed.

Second axis: Back-office processes are strengthened. R&D, eco-design, production, finance, and human resources are at the center of this transformation.

Third axis: Front-office activities create differentiation in the market. Marketing, sales, brand management, and social responsibility initiatives reinforce the institution's innovative identity.

Fourth axis: Technology serves as the driving force of transformation. The proper and skillful integration of technology supports progress across all other areas.

Where should managing technology begin?

When these four axes progress together, organizations remain competitive.

Overcoming stagnation requires planning in advance the value to be created across these four dimensions. Instead of isolated solutions, interconnected and simultaneous projects should be preferred.

Mutual interaction, consistency, alignment, and continuous monitoring become the keys to success. Projects executed in this manner produce coherent results and ensure that innovations reach the market on time.

In conclusion, attention and diligence play a crucial role in technology management. Making balanced decisions, minimizing errors, and managing transformation effectively depend on this approach. As much as understanding technology, managing it responsibly determines the future of organizations.



“Institutional transformation progresses along four main axes: the headquarters where leadership and corporate culture are strengthened, back-office processes where efficiency is increased, front-office activities that enable differentiation in the market, and technology that advances the entire structure. The simultaneous and mutually supportive development of these areas increases the competitiveness of institutions while ensuring that transformation takes place in a sustainable and effective manner.”



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