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Sayın Üyemiz,

Türkiye İhracatçılar Meclisi (TİM)'den alınan bir yazıda, Ticaret Bakanlığından alınan bir yazıya atfen, Dünya Bankası (DB) tarafından yürütülmekte olan "Türkiye Yeşil Büyüme Analitik Danışmanlık Programı"nın Döngüsel Ekonomi başlığında, Türkiye'nin döngüsel ekonomiye geçişinin makroekonomik ve ticari etkileri ile döngüsel ekonomiyi hızlandıracak öncelikli sanayi sektörlerinin değerlendirilmesine ilişkin bir çalışma yürütülmüştür. Bu çalışmanın ticari etkiler başlığında, Avrupa Birliği'nin (AB) döngüsel ekonomi politikalarının tekstil ve konfeksiyon ile otomotiv ve yan sanayi sektörlerinde Türkiye-AB ticaretine etkilerinin ele alındığı aktarılmaktadır.

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Bu itibarla, **"AB'nin Küresel Değer Ekosisteminde Türkiye'nin Döngüsel Ekonomiye Geçişi"** başlıklı rapor ile **"Türkiye'nin Döngüsel Ekonomiye Geçişinin Makroekonomik, Ticari ve Endüstriyel Etkileri"** başlıklı rapor ve raporlara ilişkin özet bilgi notları ekte iletilmektedir.

Bilgilerine sunulur.

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2- Türkiye'nin Döngüsel Ekonomiye Geçişinin Makroekonomik, Ticari ve Endüstriyel Etkileri Raporu (33 Sayfa)
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Türkiye's Circular Economy Transition in the EU's Global Value Chain Ecosystem

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Table of Contents

Acknowledgments 4

Acronyms and Abbreviations 5

Executive Summary 1

Summary of Key Policy Recommendations for Türkiye's Circular Economy Transition 3

1. Introduction: The Rationale for Türkiye's Transition to a Circular Economy 4

2. The How: A Dual-Scenario Framework for the Economics of the Circular Economy Transition 5
- 2.1 Circular Economy 'Light': Adaptive and Progressive Steps 5
- 2.2 Full Circular Economy: Beyond Incremental Steps 7
- 2.3 Factors Enabling Circular Economy Readiness 8

3. Türkiye's Circular Economy Today: Achievements and Challenges 10
- 3.1 Türkiye's Preparedness to a 'Light Transition' Scenario: Technological Upgrades and Their Drivers 10
  - 3.1.1 Adoption of Resource-Efficient Production Technologies 10
  - 3.1.2 Traceability and Monitoring: Digital and Reporting Infrastructure 13
  - 3.1.3 Other Machinery Upgrades and Process Innovations 15
  - 3.1.4 Licensing Agreements for Foreign Technology 16
  - 3.1.5 Access to and Use of Recycled Inputs 17
  - 3.1.6 Skills 19
- 3.2 Türkiye's Preparedness to a 'Full Transition' Scenario: Contributing to Advancing the Circular Economy Global Innovation Frontier 21
  - 3.2.1 Innovative Activities and R&D Expenditures 21
  - 3.2.2 Anecdotal Evidence on Entrepreneurial Potential in Türkiye 22
- 3.3 Financing the Transition 22
- 3.4 Regulatory Alignment within Türkiye and with the EU 25
  - 3.4.1 Türkiye's Action Plans and Incentive Programs 25
  - 3.4.2 Challenges of Coordination with the EU and across Actors within Türkiye 29

4. Policies to Fast-Track the Light Transition and Catalyze the Full Transition 30
- 4.1 Recycling Ecosystem 31
- 4.2 Digital Infrastructure for Monitoring and Traceability 33
- 4.3 Establishing Shared Infrastructure Resources to Lower the Costs of CE Transition 36
- 4.4 Increase Funding for the CE Transition through New and Established Financial Mechanisms 37
- 4.5 Managing the Relationship with the EU 39
- 4.6 Institutional and Coordination Enhancements within Türkiye's Government 40
- 4.7 Fostering Greater Collaboration between Public Stakeholders and the Private Sector 42
- 4.8 Longer-term Strategies for Catalyzing a Full Transition 44
  - 4.8.1 Human Capital Development and Awareness Building 44
  - 4.8.2 Fostering an Innovative Ecosystem 44
  - 4.8.3 Fostering a National Vision for a Sustainable, Inclusive, and Circular Economy 44

5. Conclusions 46

References 47

Annex A. Sector Selection 50

Annex B. EU CE Regulatory Landscape in the Auto and Textiles and Apparel Industry 53
- B.1 Textiles and Apparel 53
- B.2 Automotive industry 57

Annex C. The Textiles and Apparel and Automotive Machinery and Equipment Industries in Türkiye 61
- C.1 Industry Overview 61
- C.2 Initiatives, Challenges, and Opportunities in the Two-Focus Sectors: Evidence from Field Interviews and Desk Research 63
  - C.2.1 Textiles and Apparel 63
  - C.2.2 Automotive Machinery and Equipment 68
- C.3 Expected Impact of Policy Recommendations on Enhancing Türkiye's Position in the Automotive

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and Textiles and Apparel GVCs 73
Annex D. Global Best Practices 74
Annex E. Achieving the EU's CE goals through Cooperation with Türkiye 76
E.1. The Central Role of Türkiye in the EU Circular and Green Value Chains 76
E.2 The Importance of Cooperation and Collaboration 78
E.3 Potential Consequences of Lack of Cooperation 78
Annex F. Data Sources 80
F.1 Stakeholders Interviews (May–September 2023) 80
F.2 Enterprise Survey Data 80
F.3 Other Data Sources 81

Figures:

Figure 1. Two transition scenarios 5
Figure 2: Adoption of CE practices 11
Figure 3: Energy efficiency enhancing measures 11
Figure 4: Resource productivity 12
Figure 5: Environmental footprint monitoring 14
Figure 6: Certification 15
Figure 7: Machinery upgrades and process innovation 16
Figure 8: Technology licensing 17
Figure 9: Purchasing of trademarks, copyrights, patents, or other intangible assets 17
Figure 10: Recycling rate 19
Figure 11: Workforce skills 20
Figure 12: IT skills and usage 20
Figure 13: Manager responsibilities for climate and environmental issues 21
Figure 14: Innovative activity and R&D spending 22
Figure 15: Major obstacle as identified by firms 23
Figure 16: Main impediment for non-adoption of energy efficiency enhancing measures 24
Figure 17: Energy efficiency measures: Main impediment for non-adopters 24
Figure A.1 Türkiye's exports to the EU-27 as a share of total exports, 2021 50
Figure A.2 Domestic content in Türkiye's gross exports, 2011–2020 51
Figure B.13 Key characteristics of the EU Green Deal approach to sustainability 53
Figure E.1: Network representation of the country-level buyer-seller relations, global perspective 77
Figure E.2: Network representation of the buyer-seller relations, Türkiye perspective 77

Tables:

Table 1: Descriptive statistics 12
Table 2: Principal Turkish Sustainability Strategies and Action Plans 26
Table 3: Relevant Turkish Incentives Focused on Enhancing Green and Circular Production 27
Table A.1 Contribution of key export industries to the Turkish economy (2021) 51
Table B.1: Key circular economy-related EU legislation affecting the textiles and apparel GVC 55
Table B.2: Key circular economy-related EU legislation affecting the automotive GVC 58

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Acronyms and Abbreviations

CBAM	Carbon Border Adjustment Mechanism
CE	Circular Economy
CEAP	Circular Economy Action Plan
CIRPASS	Collaborative Initiative for Standards-based Digital Product Passport
CLEPA	Association of European Automotive Components and Parts Industry
CRM	Customer Relationship Management
CTCN	Clean Technology Centers and Networks
DA	Delegated Act
DPP	Digital Product Passport
EEA	European Environment Agency
ELV	End-of-Life Vehicle
EPR	Extended Producer Responsibility
EPZ	Export Processing Zone
ERP	Enterprise Resource Planning
ESPR	Eco-design for Sustainable Products Regulation
ETS	Emission Trading System
EU	European Union
EV	Electric Vehicle
GDAP	Turkish Green Deal Action Plan
GDPR	General Data Protection Regulation
GVC	Global Value Chain
ICE	Internal Combustion Engine
IHKIB	Istanbul Apparel Exporters Association (Türkiye)
IPA	Instrument Pre-Accession
IT	Information Technology
ITHIB	Istanbul Textile Raw Materials Exporters Union (Türkiye)
ITKIB	Istanbul Textile and Apparel Exporters Associations (Türkiye)
IoT	Internet of Things
LCA	Life Cycle Analysis
MRF	Material Recovery Facility
OECD	Organisation for Economic Co-operation and Development
OEM	Original Equipment Manufacturer
OIB	Automotive Industry Exporters Association (Türkiye)
OSD	Automotive Manufacturers Association (Türkiye)
PEF	Product Environmental Footprint
PET	Polyethylene Terephthalate
PPP	Public-Private Partnership
R&D	Research and Development

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REACH	Registration, Evaluation, Authorization, and Restriction of Chemicals
RMDZ	Recycling Market Development Zone
SBTI	Science Based Targets Initiative
SMEs	Small and Medium Enterprises
SPI	Sustainable Products Initiative
TALSAD	Turkish Aluminum Manufacturers Association (Türkiye)
TAYSAD	Automotive Suppliers Association of Türkiye (Türkiye)
TÜBITAK	Scientific and Technological Research Council of Türkiye
TÜIK	Türkiye Istatistik Kurumu (Türkiye), Turkish Statistical Institute
UNDP	United Nations Development Programme
UNFCC	United Nations Framework Convention on Climate Change
VAT	Value Added Tax
WBES	World Bank Enterprise Survey
WFD	Waste Framework Directive
WRAP	Waste and Resources Action Programme

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Executive Summary

This report examines the transition of Turkish firms to align with circular economy (CE) principles, highlighting both immediate needs and the longer-term opportunities from engaging in a transition agenda. The report stresses that the changing landscape toward the CE in the European Union (EU) offers a significant strategic opportunity for Türkiye to strengthen its position in global markets and build resilience against economic shocks.

The shift to a CE can be achieved through varying approaches, each with distinct implications for Turkish firms. We categorize such different approaches as 'light' and 'ambitious' transition scenarios. The light transition scenario aims at more efficient use of materials with an increase in reuse and recycling through measures that are already in progress or that can be implemented in the immediate future. The ambitious transition scenario envisions enhanced environmental standards and a comprehensive redesign of products, business models, and financing. The light approach is a conservative strategy, while the ambitious transition, in many respects, represents a higher-risk, higher-returns strategy that can help Turkish firms shift toward producing and exporting higher value-added goods and services. The approach is ambitious as it involves transitioning from a primarily one-way flow of goods to a dynamic two-way exchange. However, although the shift introduces uncertainty, it offers opportunities for significant advancement without necessarily incurring high costs.

A key insight from the desk analysis and fieldwork is that a one-size-fits-all reform is not going to be helpful. The relationship between costs and transformation efforts is not straightforward, primarily due to the diverse nature of industries and sectors within the Turkish economy. This diversity means that while some sectors and firms can rapidly advance, supported by the necessary reforms, others may only undergo incremental changes due to external decision-making factors. This requires a focus on adaptive transformation in such sectors and firms. Meanwhile, other sectors and firms should have higher aspirations, since they can catalyze transformation, achieve leadership roles in the relevant CE global value chains (GVCs), and enhance competitiveness through innovation-led growth.

In the very short term, and with the light approach in mind, three improvements are paramount.

First, accelerating the adoption of mature technology and of critical tools is essential for resource-efficient production. For example, there is an urgent necessity for firms to access recycled inputs and to monitor production through digital tracing infrastructure.

Second, the problem of insufficient scale and high fixed costs to invest in the transition, particularly for smaller firms and lower-tier suppliers in GVCs, needs to be addressed. This includes a need for targeted financing options to address the initial investment hurdles faced by businesses; shared infrastructure, such as wastewater treatment facilities and environmental monitoring systems, to support sustainable practices, and other shared resources, such as green transformation centers and one-stop shops for information and implementation of new regulation.

Third, institutional and coordination enhancements are needed to help address the coordination shortfalls and promote innovation, observed in the preparation of this report. This entails two dimensions: one pertaining to relations with the EU and another concerning domestic platforms for intergovernmental and public-private coordination and partnership. Specifically, Türkiye should strengthen ties with EU entities and ensure regulatory alignment while also advocating for regulations that consider the unique needs of Turkish companies. In particular, Türkiye's government should balance between maintaining an open dialogue with the EU counterparts to meet evolving regulatory requirements while also carefully timing the transition to EU standards, to optimize the tradeoff between costs and market opportunities. In addition, it should foster collaboration among public stakeholders in Türkiye (Ministries of Trade, Environment, Urbanization and Climate Change, and Industry and Technology) and with private sector entities, to unify the national approach toward sustainability and CE transitions.

In the envisioned 'ambitious scenario', this report aims to position Turkish firms at the forefront of new and emerging industries, creating a fertile ground for sustained growth, innovation, and the advancement of the CE. The focus is on bolstering research and development (R&D) activities, pioneering innovative business models and processes, and nurturing green skills. Our findings reveal a direct link between a firm's scale, its reliance on import and export activities, and its R&D investment. Yet, in comparison to their peers in Europe and Central Asia, Turkish companies tend to lag in R&D spending. The shift toward a CE emerges as a possible avenue for bridging this gap. The Turkish private sector exhibits remarkable resilience and adaptability, and it is poised to capitalize on its integration into

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European initiatives, connections with global GVCs, and exposure to the most innovative practices. This positions Türkiye favorably to fully embrace the CE, provided there is sufficient and long-lasting governmental backing. Our field research highlights the dynamic strides local entrepreneurs are making in adopting existing sustainable innovation solutions, such as polyester recycling and the implementation of waterless dyeing techniques for synthetic fibers. These efforts have been further propelled by Türkiye's involvement in EU initiatives, such as Horizon Europe projects focusing on textile and plastic recycling. These successes illustrate the potential of Turkish businesses to lead in ecofriendly business practices and technological breakthroughs, even in ambitious transitions to a CE. For instance, global innovation in cotton recycling and waterless dyeing of nonsynthetic textiles could benefit from Turkish ingenuity, contingent upon a supportive long-term policy strategy.

Beyond the immediate priorities outlined earlier, a fully successful and robust transition into global CE industries requires three longer-term actions. These are of critical importance but easily actionable. *First*, Türkiye's government should invest in green skills and in raising awareness about CE among firms, the workforce, educational institutions, and the general public. *Second*, it should foster an innovative ecosystem that supports R&D, new business models, and environmental sustainability through tailored finance, subsidies, incentives, and cross-border collaborations. *Finally*, to catalyze sufficient private investment, the government must signal to the private sector its long-term commitment and policy coherence in promoting this agenda and communicate the convinced alignment to broader global initiatives promoting green markets and sustainable investment vehicles. This can be achieved through fostering a national vision for sustainable and inclusive development and a mindset shift: rather than an imperative, the CE transformation should be viewed as an opportunity to upgrade Turkish firm's position in GVCs, enhance export competitiveness, and build resilience against economic shocks through the adoption of sustainable practices.

In conclusion, this report highlights the importance of a deliberate, strategic, and articulated approach toward transitioning Turkish firms to a CE, blending immediate actionable steps with a forward-looking long-term strategy. By moving forward with flexibility and vision, Türkiye can use its distinct advantages to not only respond to the changing global economy but also to lead in sustainable innovation and resilience, establishing a model for others in the worldwide move toward a more circular and thriving future.

The report is structured as follows. Section 1 introduces the report. Section 2 illustrates the two scenarios for the transition, both attainable by Türkiye but differing in ambition level. Section 3 assesses the current competitiveness of Türkiye, also focusing on the key challenges, as they emerged from desk analysis, fieldwork, and stakeholder interviews. Section 4 offers policy solutions and suggests intervention in line with the dual approach proposed above, and Section 5 concludes.

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Summary of Key Policy Recommendations for Türkiye's Circular Economy Transition

Strategic Approach

- **Diversified strategy:** Adopt a diversified approach to facilitate rapid progression in sectors and companies capable of transformative leaps while guiding others through gradual adaptations.
- **Flexibility and vision:** Utilize Türkiye's distinct advantages to respond to the global shift toward a circular economy (CE), maintaining international competitiveness in sustainable innovation.

Immediate Priorities (Light Approach)

- **Advanced technology adoption:** Prioritize the establishment of a robust recycling ecosystem and a reliable digital infrastructure for efficient resource use.
- **Foundation for transition:** Address challenges related to scale and investment, especially for smaller firms and lower-tier suppliers in global value chains (GVCs).
- **Institutional governance:** Enhance coordination within Türkiye and with the European Union (EU), balancing the need for dialogue and strategic timing of transitioning to EU standards.

Ambitious Scenario for Full Transition

- **Skill investment:** Focus on developing skills related to the green economy and raising awareness about the CE across various stakeholders.
- **Innovative ecosystem:** Support research and development (R&D), innovative business models, and environmental sustainability through tailored finance, subsidies, and incentives.
- **Private investment:** Encourage significant private sector investment through clear government signaling of long-term commitment to the CE.

Detailed Strategies

- **Recycling ecosystem:** Enhance infrastructure, financial accessibility, and industry practices to support recycled inputs and secondary materials markets.
- **Digital infrastructure:** Improve digital capabilities for better traceability and monitoring, crucial for regulatory compliance and sustainability practices.
- **Shared resources:** Establish shared environmental infrastructure to reduce individual business burdens and promote collective adherence to environmental standards.
- **Financing the transition:** Enhance financing mechanisms, leveraging innovative models and international financing to support the transition to sustainable practices.
- **EU relations:** Manage the relationship with the EU through strategic dialogue and phased adoption of EU standards, leveraging financial instruments to ease the transition.
- **Institutional coordination:** Strengthen interinstitutional coordination to ensure unified implementation of sustainability and CE initiatives.
- **Public-private collaboration:** Foster greater collaboration between public stakeholders and the private sector to align national strategies with sustainability goals.

Long-Term Vision

- Embrace the opportunities presented by the CE to strengthen Türkiye's global market position and economic resilience.
- Address challenges such as skill gaps and green infrastructure development, carefully timing the transition to meet EU regulations without incurring unsustainable costs.
- Brand the country as a sustainable and circular production base.

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1. Introduction: The Rationale for Türkiye's Transition to a Circular Economy

The concept of a circular economy (CE) is a paradigm shift from traditional linear economic models, focusing on the efficient use and reuse of resources to create sustainable, self-sufficient, closed-loop systems. For Türkiye, this transition is both a matter of environmental stewardship and a strategic alignment with the EU's emphasis on sustainable practices within its green value chain ecosystem. As the EU advances toward more sustainable practices (World Bank 2022), Türkiye, with its deep economic and trade ties to the region, finds itself at a crucial juncture. Embracing CE principles can position Türkiye as a key player in this evolving green landscape, enabling greater economic growth alongside sustainability. The general motivation for Türkiye's transition to a CE is therefore twofold: it addresses the evolving regulatory environment of its principal trade partner, the EU, and it aligns with Türkiye's own environmental and sustainability objectives, exemplified by its ambitious Zero Waste Initiative.[1]

The EU's progression toward stricter environmental standards presents Türkiye with both challenges and opportunities. Adapting offers a chance not just for compliance but for innovation and a more significant role in sustainable global markets. Like all emerging countries, Türkiye faces the choice between continuing to pursue the linear development strategy initiated in past decades or seizing new growth opportunities through the CE transformation. The former, characterized by high resource consumption and waste, poses significant challenges in terms of energy and resource efficiency. Transitioning to a CE offers a pathway to address these challenges. It promises enhanced job resilience and a transformative economic impact by fostering growth in green sectors. This shift allows Türkiye to leverage its strengths while mitigating environmental issues.

The EU's regulatory evolution toward sustainability and circularity, given Türkiye's economic integration with the EU, acts as a powerful catalyst for Türkiye's transformation. Noncompliance with these regulations poses significant risks, including reduced market access and competitiveness, while adaptation could boost Türkiye's economic robustness and secure its EU market position. Proactively engaging with these regulatory changes is crucial for Türkiye's economic prosperity and continued development progress.

[1] http://zerowaste.gov.tr/.

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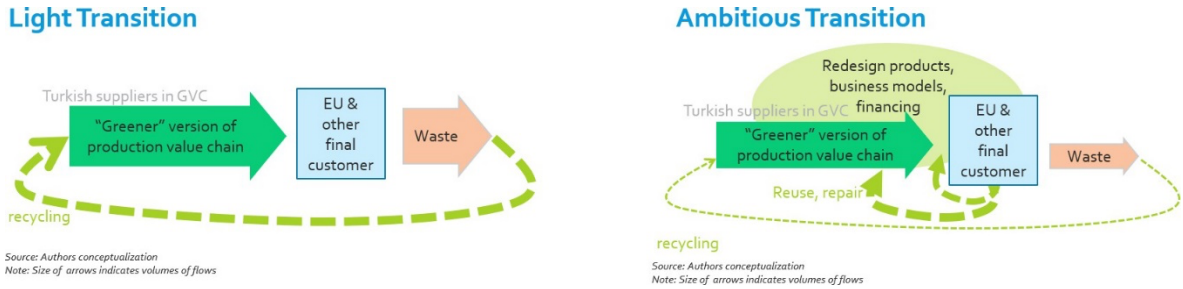
2. The How: A Dual-Scenario Framework for the Economics of the Circular Economy Transition

The transition to a CE, characterized by its emphasis on sustainability and resource efficiency, marks a significant shift from traditional linear economic models. This transition encompasses a spectrum of activities, ranging from low-tech recycling initiatives to high-tech innovations. Central to this paradigm shift is the strategic interplay of different combinations of such activities. In other words, varying emphasis on redesigning products and business models; reducing the reliance on virgin materials; enhancing the durability of products; and elevating practices like reuse, repair, and recycling can lead to different patterns for affected industries and different competitiveness outcomes for the concerned countries.

In this context, we explore the implications of this transition for Turkish firms within GVCs, particularly under two distinct scenarios. The first, a light version of the CE, predominantly focuses on reduction and recycling strategies (see Figure 1, lefthand side panel). This approach aligns closely with imminent EU regulations that prioritize traceability and the provision of detailed information on circularity and sustainability metrics, as well as minimum recycled content requirements. Such a strategy can be considered 'reactive' to the EU's 'first-mover' stance. Its transformation potential relative to the linear make-use-waste is smaller relative to the second, more robust scenario. This latter envisions a comprehensive shift to a full CE (see Figure 1, righthand side panel). This scenario entails a deeper structural change, driven by extensive redesign of products and business models, coupled with a significant uptick in reuse and repair activities.

Current regulatory proposals in the EU, including mandates for improved product repairability, are nudging economies toward this more comprehensive model. However, the path of reform, its timeline, and the likely effects on the EU industry are still fraught with considerable uncertainty. EU trade partners, such as Türkiye, could consider an 'anticipatory strategy' of leapfrogging into the CE. Reform plans do not necessarily entail prohibitive costs but can help Türkiye's firms to increase value addition, strengthen their competitive position on the global markets, and build resilience against economic shocks, especially when considering the potential for technological leapfrogging.

Figure 1. Two transition scenarios



Source: Original elaboration.

Crucially, the evolution from a linear to a circular economic framework holds wide-ranging consequences for all firms in the value chain. We observe that impending subsidies and regulatory changes are poised to alter the incentive structures around R&D significantly. These shifts could influence the relative costs of older and newer production technologies and affect the pricing dynamics of recycled versus nonrecycled inputs. Türkiye's position in this evolving landscape will be determined by its ability to rapidly adopt new technologies and business models. This adaptability will be a critical determinant in its successful integration and competitiveness within the CE's GVC.

In summary, as Türkiye navigates this transition, understanding the economic underpinnings of these two alternative scenarios becomes crucial. The country's strategic response to these developments will shape its economic trajectory in an increasingly resource-conscious global market.

2.1 Circular Economy 'Light': Adaptive and Progressive Steps

The concept of a 'light' transition in the context of a CE focuses on minimizing environmental effects and integrating mature and sustainable technologies. This approach prioritizes recycling, monitoring carbon and material footprints, and making incremental improvements to the existing linear

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production models. For Turkish firms, this transition necessitates changes in product design to favor recycled materials and enhance resource efficiency. Such a shift is crucial for firms engaged in GVCs, particularly those facing demands from EU customers for less resource-intensive production processes. In this scenario, the structure of value chains and production remains largely product-centric and linear but incorporates greater resource efficiency and transparency. Adjustments in production technology and material usage aim to reduce water consumption and improve product durability, without overhauling the fundamental business model. These changes, while maintaining the core linear paradigm, are steps toward a more sustainable production methodology.

The adoption of this 'light' CE model requires Turkish firms to invest in digital infrastructure to meet stringent information requirements, such as those proposed by the EU Digital Product Passport.[2] This necessitates the development of new workforce and skills focused on sustainability monitoring and enhancement of products and processes. Firms may need to train existing employees, hire new specialists, or consult external experts to adapt to these new demands. These technological and procedural adaptations will inevitably alter cost structures, affecting competitiveness based on the ability to adapt. The effect of these changes will vary across industries, with some facing more significant challenges and costs. For instance, the textile industry might encounter ambitious sustainability targets that current technologies cannot meet, and smaller firms may have limited influence in EU regulatory discussions.

Despite these challenges, the 'light' transition offers opportunities for Turkish suppliers to integrate more closely into the EU market, for example, through new upstream connections for sourcing recycled materials. These gradual changes align with the EU's short to medium-term regulatory goals and contribute to the broader objectives of its sustainability agenda and Circular Economy Action Plan. This transition, though less intensive than the alternative full-fledged transition, is a strategic alignment with global sustainability trends, positioning Turkish firms on solid ground for future growth and resilience. In summary, there are several strategic, operational, economic, and supply chain considerations to the light transition scenario toward a CE relevant to Turkish firms in GVCs that this report will discuss and that can be briefly summarized as follows:

1. **Strategic Approach**
    - **Incremental change over radical overhaul:** The light transition represents a gradual shift from the traditional linear model to a CE, focusing on enhancing resource efficiency and minimizing environmental impact within the existing production framework rather than a complete structural transformation.
    - **Emphasis on reduction and recycling:** Central to this scenario is the reduction of environmental impact at each production stage, including minimizing wear and tear, and improved recycling practices to close the material loop.
2. **Operational Adjustments**
    - **Monitoring and reporting requirements:** Heightened focus on monitoring carbon and material footprints, necessitating the implementation of digital systems for effective tracking and reporting of the relevant metrics.
    - **Adaptation in production processes:** Turkish GVC firms may need to alter product designs and shift from virgin materials to recycled inputs for less resource-intensive production.
    - **Technological and skill upgrades:** Investments in new machinery and digital infrastructure, along with the development of new workforce skills for sustainability monitoring and product/process improvements.
3. **Economic and Competitive Implications**
    - **Shift in cost structures and competitiveness:** Changes in fixed and variable cost structures affect the overall competitiveness, highlighting the importance of firms' ability to adapt to new requirements for maintaining or improving their market position.

[2] The Digital Product Passport (DPP) digitally stores data on a product's characteristics making it electronically accessible for all stakeholders. The information requirement can vary depending on the specific product and can include details on a product's technical performance, environmental footprint, materials and their origin, recycling capabilities and repair activities.

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- **Industry-specific challenges and cost distribution:** Variations across industries in the extent of required upgrades and the distribution of costs, with some sectors facing more stringent targets and unique challenges due to technological and policymaking limitations (see Annex C).

4. **Supply Chain and Market Dynamics**

   - **End-of-role in production process:** The current end-of-role for Turkish suppliers coincides with product shipment to the EU market. The transition might facilitate the potential emergence of new sourcing connections for recycled inputs, indicating shifts in supply chain relationships to the advantage of Turkish producers.
   - **Alignment with EU regulatory changes:** Incremental changes need to align with the EU's near to medium-term regulatory changes and developments in the EU Circular Economy Action Plan (see Annex B), which will likely shape the market and operational landscape for Turkish businesses.

2.2 Full Circular Economy: Beyond Incremental Steps

A full transition to a CE is a transformative shift, requiring businesses to fundamentally rethink their models and practices. At the heart of this shift is the move toward reuse, repair, and product-as-service models, which not only aims to minimize environmental impacts but also opens new avenues for innovation and competitiveness. Unlike the modest adaptations of the light model, this comprehensive approach extends far beyond mere recycling, which is re-envisioned as a last resort, to keep products in the usage cycle for as long as possible. The essence of this paradigm shift lies in a profound redesign of products and business models, steering the economy toward service-oriented solutions. This is not a mere tweak of existing processes but involves significant innovation across products, processes, and potentially the entire value chain. The transition encompasses a strategic overhaul, from product conception to end-of-life management, embedding circular principles at every stage.

For Turkish suppliers, particularly those integrated into the EU markets, this transition poses both challenges and opportunities. Traditionally characterized by a one-directional flow of goods, value chains might evolve into dynamic ecosystems where suppliers engage in postconsumer repair and maintenance, fostering closer consumer interactions. This redefines traditional supply chain roles, urging suppliers to adapt to new business models that are more interactive and service oriented. This fundamental shift toward a CE is laden with uncertainties, from the direction of future regulatory actions to the readiness of markets to embrace new models. Yet, these uncertainties are balanced by the potential for pioneers of new circular business models to deliver promising risk-return profiles, even as the current landscape remains dominated by linear production models.

In conclusion, the journey toward a fully realized CE is a comprehensive venture that redefines product design, usage, and maintenance, transcending the traditional environmental or efficiency imperatives. It heralds a new era of economic opportunities and innovation for Turkish GVC firms and beyond, demanding strategic, systemic changes alongside business model innovation to navigate the evolving regulatory landscape:

1. **Strategic Vision and Innovation**

   - **Beyond environmental impact minimization:** While incorporating the environmental strategies of the light scenario, the full transition expands the goal from merely reducing environmental impact to actively promoting a system where products are kept in use longer, with recycling as a last resort rather than a primary activity.
   - **Value chain innovation:** Encourages innovation across products, processes, and the entire value chain, fostering a systemic shift toward circular principles.
   - **Long-term structural change:** Acknowledges the transition to a full CE as a profound, long-term structural shift, requiring sustained commitment and strategic planning.

2. **Business Model Transformation**

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- **Redesign of products, business models, and financing:** This calls for a radical rethinking and redesigning not just of products but also of the underlying business models and financing mechanisms, to align with CE principles.
- **Focus on reuse and repair:** The emphasis shifts to service-oriented solutions and product-as-service models, promoting reuse and repair over mere recycling. It reduces the need for new materials and extends product lifecycles.
- **Transformation of supplier business models:** For Turkish suppliers in the EU market, this transition means evolving from traditional supply chains, characterized by a one-directional flow of goods, to engaging in a more interactive, two-way flow, which also encompasses a growing role for postconsumer activities in the production process and revenue streams.

3. **Adaptive Regulatory Alignment and Forward-Thinking Policy and Market Engagement**
   - **Uncertainty and regulatory considerations:** Recognizes the challenges and uncertainties, particularly in regulatory landscapes, that come with ambitious transitions, emphasizing the need for adaptive strategies and forward-thinking policy engagement.
   - **Potential for new economic opportunities:** Highlights the economic potential inherent in circular business models, suggesting that despite uncertainties, there are significant opportunities for innovation and value creation, as well as attractive risk-return profiles, within circular frameworks that possibly extend to the whole economy, even to linear value chains that will support the new circular business models from the periphery of the industrial ecosystem.

2.3 Factors Enabling Circular Economy Readiness

In the global move toward CEs, strategic positioning and competitiveness hinge on several key factors, each playing a pivotal role in enabling a successful transition. At the core of the CE is the need for effective traceability and robust digital monitoring systems. These systems are crucial for ensuring carbon and material efficiency in key sectors, tracking resource flows, identifying inefficiencies, and minimizing waste. Access to and use of recycled inputs is another fundamental aspect of a successful transition. The demand for recycled inputs under a weak CE scenario tends to increase, presenting countries in transition with two strategic options: securing foreign recycled materials or developing a domestic recycling industry. Hence, fostering growth in domestic recycling rates and securing adequate access to imported recycled materials are important and complementary enablers. As economies progress from light to full circularity, the focus expands from merely ensuring access to recycled inputs to maintaining products in the usage cycle for longer periods, thereby reducing reliance on both new materials and recycled ones.

Ultimately, the transition requires innovation. Technological upgrades, advancing the innovation frontier, and upskilling the workforce are therefore fundamental ingredients too. Seamlessly transitioning to the CE necessitates significant technological advancements across all sectors of the economy. As circular technologies and practices become more prevalent in the domestic economy, the cost of adoption per unit of output decreases more rapidly. Technological upgrades include at least three key strategies: swiftly deploying technologies that conserve resources, upgrading machinery, and investing heavily in workforce upskilling to reduce the material footprint of production. Agility in adopting and adapting to new technologies is therefore crucial for implementing CE practices, whether in light scenarios or more comprehensive ones.

However, transitioning effectively goes beyond mere technological upgrades; it requires a strong push toward innovation and R&D. It is about rethinking business models, products, and processes to fully integrate circular principles. Innovation in the value chain is key, demanding a proactive stance in crafting new, sustainable business strategies. The goal is to create new products from prototypes or new patents and to make commercially viable technical solutions that may be still at the experimentation stage. Those firms and countries who lead in such frontier efforts can secure a first-mover advantage once the innovation becomes economically viable.

Clearly supporting such transformations requires new skills and competencies across the entire society. It also requires carefully designed and adaptable financing frameworks. These frameworks must cater to the diverse needs of various firms and industries, facilitating their shift toward more asset-

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light, circular business models. Such financial support structures should be inclusive, accommodating the evolving challenges of different market players during this structural transition. A comprehensive financing strategy that leverages the different sources of financing is suggested. Financing can originate from many different sources: own capital, intra-GVC financing, private financial investors, such as institutional investors and private equity, and public subsidies and finances. These differ from one another in time horizon, investment size class, criteria for financing, and domestic versus international considerations.

Finally, demand and supply dynamics also matter. The broader context of consumer preferences and market demands significantly steers the pace and direction of the transition. Aligning national sustainability trends with global movements and responding to the changing demands within key partner markets can accelerate the adoption of CE practices. Domestically, fostering a shift in material consumption patterns can act as a powerful catalyst, bolstering the local private sector's capacity for circular initiatives.

In acknowledging these enablers, it becomes evident that a multifaceted approach, encompassing technological, strategic, and financial dimensions, is essential for economies aiming to thrive in a circular future. Section 3 will delve into Türkiye's preparedness to embrace these enablers, setting the stage for a detailed exploration of its strategic readiness for a circular transformation.

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3. Türkiye's Circular Economy Today: Achievements and Challenges

Building upon the foundational principles of CE readiness discussed in Section 2, this section delves into the current outlook of the CE in Türkiye, with a spotlight on the textile-apparel and automotive machinery-equipment sectors whenever industry-specific evidence is available.[3] These sectors not only stand at the forefront of Türkiye's export economy, particularly to the EU, but also, due to their unique market structures and GVC engagements, encounter distinct yet complementary industry-specific challenges and opportunities amid the EU's evolving sustainability regulations. This diversity offers valuable insights for shaping a more holistic national strategy.[4]

As we further explore Türkiye's readiness for a CE transition, the analysis will compare the current state of CE in Türkiye to peers in Europe and Central Asia; it will detail the differences and similarities across industries, international engagement, production tier, and size of firms; and discuss the main achievements and challenges as they emerge from statistical evidence and stakeholder consultations during fieldwork.

3.1 Türkiye's Preparedness to a 'Light Transition' Scenario: Technological Upgrades and Their Drivers

The first step in transitioning toward a circular economy requires the adoption of globally established technologies. The adoption spectrum encompasses both general-purpose and green technologies that are critical for expanding recycling possibilities, extending product lifecycles, enhancing efficiency, and fostering sustainable practices. Advanced recycling solutions technologies employ sophisticated machinery and software solutions designed to optimize the recovery of valuable materials from electronic waste, mitigating data security concerns while promoting material circularity. Lifecycle extension software allows for updates and features to be delivered via software to prolong the usability of products, reducing the necessity for frequent physical replacements. Finally, integration with the Internet of Things (IoT) helps improve product traceability, facilitate efficient tracking, and streamline repair processes, thereby enhancing overall product longevity and resource utilization. The adoption of these and related technologies among Turkish firms can be evaluated by examining outcomes in several interconnected areas, which are discussed in the remainder of this section of the report. Delving into each of these areas will allow to assess Türkiye's performance against comparable countries and to investigate any variations in size, operational tier, and sectoral engagement.

3.1.1 Adoption of Resource-Efficient Production Technologies

Several Turkish firms have made significant strides in adopting resource-efficient production technologies, yet there are gaps compared to firms in other European and Central Asian economies in some sectors, as evidenced by the most recent World Bank Enterprise Survey (2019).[5] On average, 19 percent of Turkish firms adopted waste minimization, recycling or waste management practices. Notably, firms in the garments and textiles sectors have been much more successful in introducing waste and recycling management than their counterparts in the fabricated metal products and machinery sectors (see Figure 2). While more than 40 percent of firms in the Turkish garments and textiles sectors adopted circularity practices, a proportion substantially higher than the one posted by Europe and Central Asia peers, in the fabricated metal products and the machinery and equipment sector, Turkish firms still lag substantially behind those in Hungary, Poland, and Romania. In line with

[3] The focus on Türkiye's textile-apparel and automotive machinery-equipment sectors in the transition to a CE is driven by their significant export contributions, particularly to the EU. These sectors are vital to Türkiye's economy, highly influenced by EU CE policies, and essential for strategic planning in response to EU sustainability regulations. For more on sector selection, see Annex A.

[4] The textile-apparel and machinery-equipment sectors highlight Türkiye's need for varied approaches to CE integration. The textile sector navigates sustainability and fast fashion pressures, aiming for market differentiation through eco-friendly practices. In contrast, the automotive machinery sector adapts to electrification and EU environmental norms, focusing on technological advancements. Türkiye's R&D and production capabilities support the transition in both industries, yet their differences call for tailored policy support. A detailed sector comparison is in the reports in Annex C.

[5] Subsection F.2 describes the survey data and details how indicators are computed and peer groups are formed.

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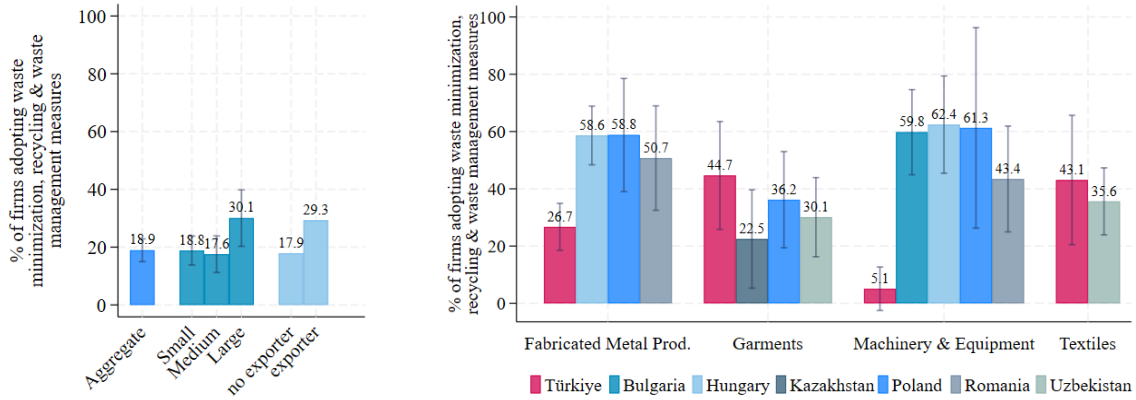
international evidence, in Türkiye, a greater number of larger firms as well as firms selling on the international markets (that is, direct exporters) adopted resource-efficient solutions.

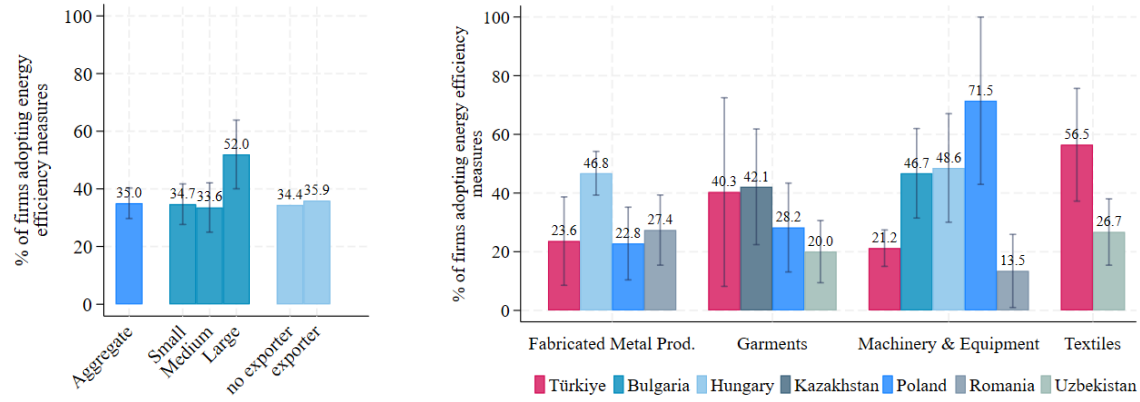
Figure 2: Adoption of CE practices



Source: Original analysis
Note: This figure shows the percentage of firms that adopted CE practices such as waste minimization, recycling, or waste management in the three years preceding the latest World Bank Enterprise Survey (WBES). The left panel depicts adoption rates in the aggregate Turkish economy, broken down by establishment size and export status. The right panel illustrates adoption rates in the four CE priority sectors with representative coverage and adds sectoral averages of surveyed Europe and Central Asia economies with the same industry stratum (for details, see subsection F.2). Whenever inference is possible, 95% confidence intervals are included.

Only 35 percent of the surveyed firms have taken steps to improve their energy efficiency, with such initiatives being more common in larger companies, whereas export activity does not seem to influence this trend (see Figure 3). A significant portion of these firms have developed their energy efficiency measures inhouse, as detailed in Table 1. The adoption of energy efficiency practices differs markedly between the apparel-textiles sector and the automotive machinery and equipment industry: the textiles sector shows significant energy efficiency activities, outpacing some regional competitors. Meanwhile, Turkish firms in the machinery and equipment sector are below their peers in Bulgaria, Hungary, and Poland. Among nonadopters, there is a noted lack of financial resources and prioritization for these initiatives, especially among smaller and domestic-oriented firms (see Figure 16, Figure 17).

Figure 3: Energy efficiency enhancing measures



Source: Original analysis
Note: This figure shows the percentage of firms that adopted measures to enhance their energy efficiency in the three years preceding the latest WBES. The left panel depicts adoption rates in the aggregate Turkish economy, broken down by establishment size and export status. The right panel illustrates adoption rates in the four CE priority sectors with representative coverage and adds sectoral averages of surveyed Europe and Central Asia economies with the same industry stratum (for details, see subsection F.2). Whenever inference is possible, 95% confidence intervals are included.

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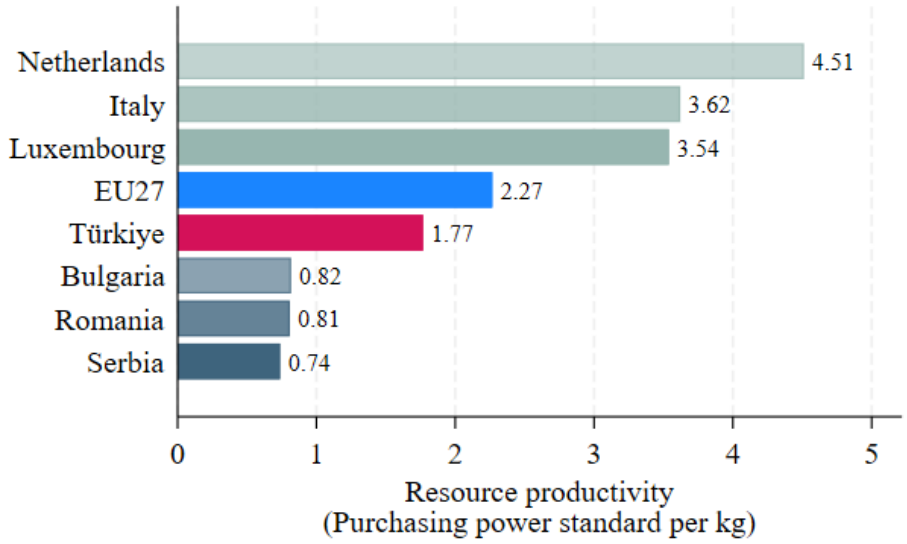
Table 1: Descriptive statistics

	Percent of firms	N
Any energy efficiency measures self-developed	54.01	337
Innovation new to market	56.37	129
Establishment emits CO_2	5.51	1,604
Establishment monitors its CO_2 emissions	26.67	74
Completed external audit on energy efficiency	2.72	812

Source: Original analysis.
Note: This table shows additional descriptive statistics for the aggregate Turkish economy from the 2019 WBES.

A third relevant metric covers resource productivity and carbon footprint. In these areas there is significant scope for improvement. While these measures are only available for the national aggregate, and against different peers from those presented above, the data confirm the picture of below-par energy efficiency. Türkiye's overall resource productivity ranges in the bottom half in Europe, with approximately 1.8 units of purchasing power adjusted GDP generated out of every kilogram of domestic material consumption, where domestic material consumption is computed as domestic material inputs, that is, the sum of domestic extraction plus physical imports, minus physical exports. This compares to an EU average of 2.3 purchasing power standards per kilogram (see Figure 4). Similarly, the Turkish manufacturing sector is more carbon intensive than the EU average (World Bank Group 2022).

Figure 4: Resource productivity



Source: Eurostat 2021.
Note: This figure depicts resource productivity in 2021 for Türkiye, on average across the EU27, and for the top and bottom 3 countries out of 34 European states with Eurostat data records.[6] The 34 countries include the EU27 plus Iceland, Norway, Bosnia and Herzegovina, North Macedonia, Albania, and Serbia in addition to Türkiye.

Firm interviews confirmed the important sectoral and firm-size differences discussed above. The apparel and textiles sector posts many examples of innovation and sustainable production methods. In contrast, the automotive machinery and equipment industry's initiatives emerged as more focused on compliance and adaptation to external pressures. Smaller and lower-tier firms across both sectors appeared to face instead significant challenges and greater fixed costs in keeping pace with these sustainability transitions.

[6] Eurostat (Statistical Office of the European Communities), Resource productivity [env ac rp], https://ec.europa.eu/eurostat/databrowser/ product/page/env ac rp$defaultview, accessed December 15, 2023.

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3.1.2 Traceability and Monitoring: Digital and Reporting Infrastructure

Building on the previous discussion, the deployment of digital tracking and oversight systems holds significant promise for elevating Türkiye's resource efficiency metrics. Furthermore, enhancing the infrastructure for comprehensive digital data collection and processing is useful along two additional dimensions. First, it would enable companies in Türkiye to disseminate crucial information to their customers while also complying with the EU DPP's information requirements (see Annex B). Second, it would allow businesses to evaluate their material footprint, signaling potential areas for improvement.

Unfortunately, and in alignment with findings from Section 3.1.1, the evidence from the WBES confirms that Türkiye's efforts in tracking crucial environmental metrics beyond energy usage are modest and limited in scope. According to the 2019 survey, while a majority (56 percent) of Turkish firms monitor their energy consumption (Figure 5, panel a), only about one-third keep tabs on water use (Figure 5, panel b), and a mere fraction (less than 5 percent) tracks CO_2 emissions within their supply chains (Figure 5, panel c).[7] Direct exporters do slightly better (9 percent). Notably, the textile sector stands out, with around 20 percent of firms assessing their suppliers' emissions, showcasing its advanced approach compared to other Europe and Central Asian countries. Evidence on comparable peers (for example, eastern members of the European Union [EU]) is not available, but in countries like Uzbekistan less than 5 percent of textile producers monitor such emissions.

Sustainability reporting represents another important dimension of sustainability-related traceability and monitoring efforts. Familiarity with internationally recognized quality certifications and external audits could potentially ease the transition to new reporting standards. In Türkiye, although there is widespread adoption of general quality certifications, the uptake of certifications related to sustainability is still low. Specifically, 29.5 percent of firms hold general quality certifications (see Figure 6), a number that exceeds the average across surveyed Europe and Central Asian economies by approximately 7 percentage points. Among exporters and larger enterprises, the rate climbs to above 60 percent. Meanwhile, the certification of environmental standards remains very low. For example, under 3 percent of surveyed firms across the Turkish economy had completed external energy consumption audits as of 2019 (see Table 1).

Finally, company-level practices that could speed up the adoption of this and other critical infrastructure and tools are not very common. For example, assigning responsibilities for environmental issues at the management level, as well as the ability to draw from within company IT expertise, could speed up the firms' transition toward a comprehensive digital reporting infrastructure focused on environmental footprint monitoring, but there is little evidence of either of these practices in Türkiye (see Section 3.1.6). The preexistence of digital tools and communication channels between the firm and its customers could lessen the regulatory compliance burden. In 2023, around 38.9 percent of Turkish firms utilized digital resources such as Enterprise Resource Planning (ERP) software, Customer Relationship Management (CRM) software, or Business Intelligence software or shared supply chain information electronically with their suppliers or customers. Although this rate increases to 81.9 percent among larger enterprises, it still lags more than 10 percentage points behind the EU average across all firm sizes (Figure 12 right panel).

Findings from field research in September 2023 were consistent with the above statistical evidence. Interviews revealed that despite a surge in monitoring activities among larger firms, driven by EU customer requirements, there is widespread lack of effective digital infrastructure for environmental footprint monitoring. While all interviewees recognized that effective monitoring and tracing systems are crucial to success, most of them declared limiting themselves to monitoring basic measures only, such as energy and water consumption. More detailed monitoring, including CO_2 emissions tracking, is uncommon. Few companies declared having experience with quality certification and external audits relative to environmental standards. When this was found, the driver was brand-led environmental certification requirements. Finally, interviewees confirmed that rarely companies in Türkiye integrate environmental issues at the management level and/or employ IT specialists dedicated to sustainability goals (see subsection C.2 for additional discussion of firms' views).

[7] Notably, nearly all surveyed firms reported that they do not emit CO_2. Among the few that do declare that they emit CO_2, only about one-fourth monitor their emission levels. However, due to the limited number of respondents acknowledging CO_2 emissions, this finding is not statistically significant at the 95% confidence level (see Table 1).

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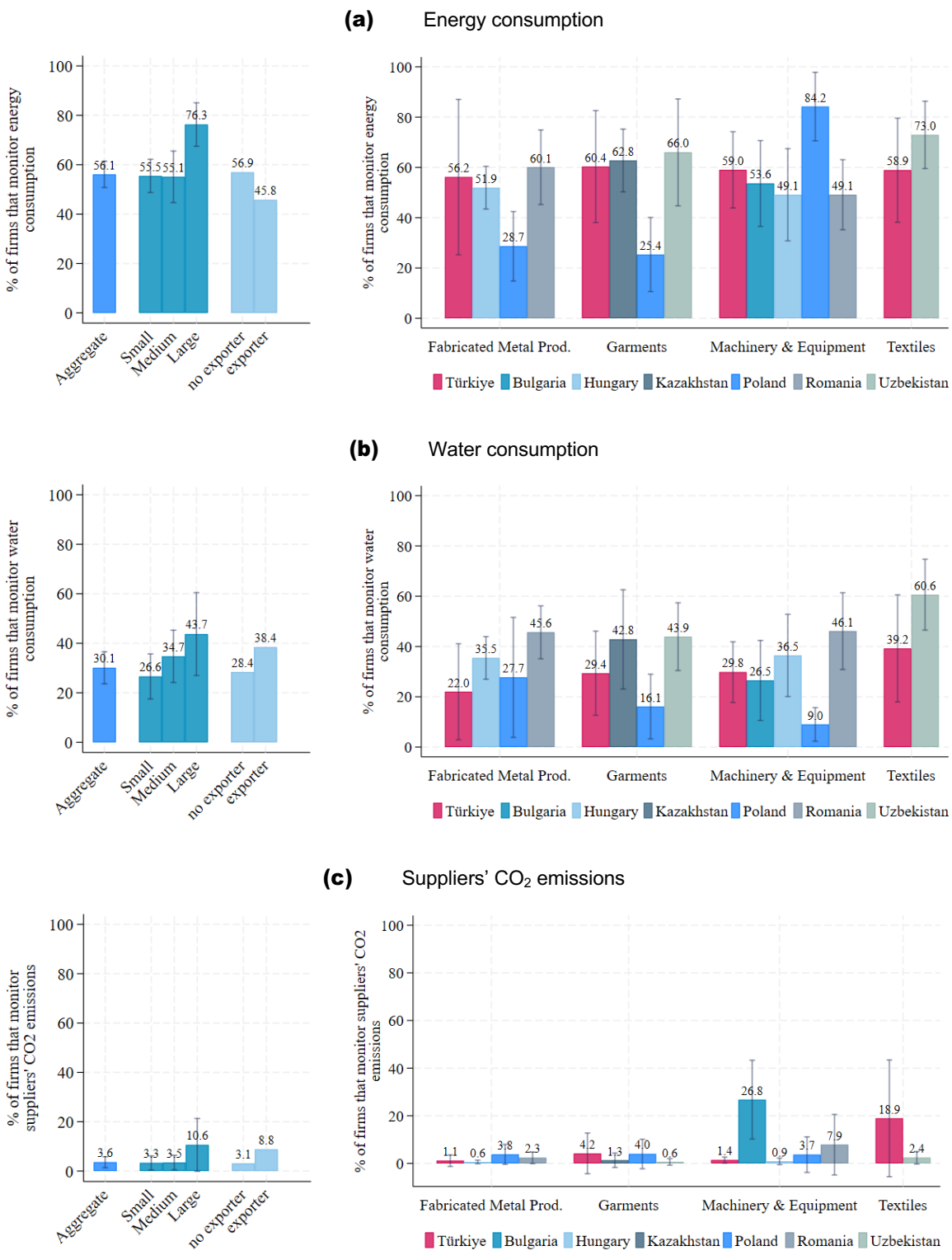
Figure 5: Environmental footprint monitoring



Source: Original analysis.
Note: This figure shows the percentage of firms that monitored their energy consumption (panel a)), their water consumption (panel b), and their suppliers' CO_2 emissions (panel c)) in the three years preceding the latest WBES. The left panel depicts adoption rates in the aggregate Turkish economy, broken down by establishment size and export status. The right panel illustrates adoption rates in the four CE priority sectors with representative coverage and adds sectoral averages of surveyed Europe and Central Asian economies with the same industry stratum (for details, see subsection F.2). Whenever inference is possible, 95% confidence intervals are included.

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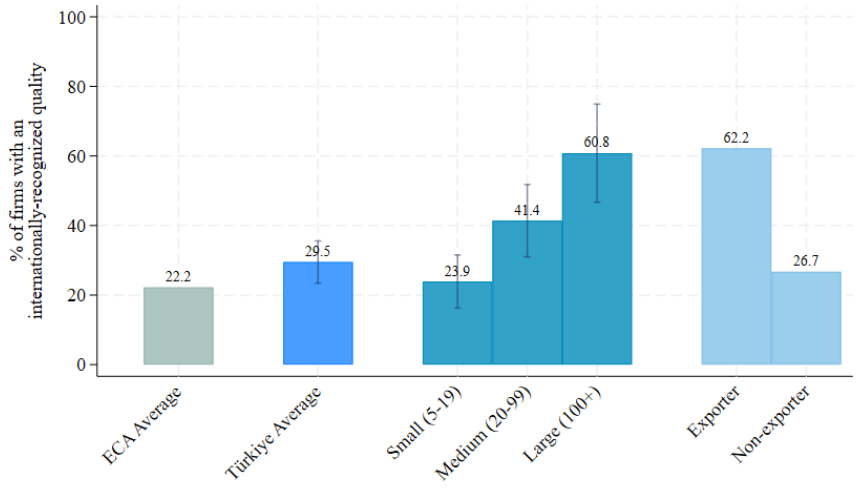
Figure 6: Certification



Source: Original analysis.
Note: This figure shows the percentage of firms that have an internationally recognized quality certification, on average across surveyed Europe and Central Asia economies, on average in Türkiye, and within firm size groups and export exposure in Türkiye. Whenever inference is possible, 95% confidence intervals are included.

3.1.3 Other Machinery Upgrades and Process Innovations

Metrics documenting other machinery upgrades and process innovation offers a comparable perspective to the above. Despite notable individual initiatives of adoption of solar energy, pre-consumer recycling, industry 4.0, waste-water treatment facilities, and replacement of old machinery, there is no systemic approach: improvements are applied oddly, with lower tiers of GVCs, domestic-oriented, and smaller firms lagging significantly behind. According to the WBES,[8] approximately 25 percent of Turkish firms declared to engage in the use of recently upgraded machinery, yet fewer than 3 percent have adopted new or substantially improved processes. This indicates a significant lag in process innovation adoption compared to the average across the Europe and Central Asia region, where 21.5 percent of firms report introducing new processes. The disparity is particularly pronounced in sectors such as fabricated metal products and machinery. Direct exporters and larger firms are more inclined to undertake machinery upgrades, reinforcing the notion that company size and international exposure are pivotal factors in embracing technological advancements, as illustrated in the upper panels of Figure 7.

Notably, and despite the overall low rate of process improvement in Türkiye relative to the Europe and Central Asia average, the gap in process innovation between Turkish exporters and their EU counterparts is significantly narrower, as depicted in the lower panel of Figure 7. Meanwhile large firms are only slightly more prone than smaller ones to process innovation. The dominant disparity in adoption for firms with different degrees of exposure to international markets underscores the crucial role of cross-border and firm-to-firm links in driving process innovation and its relevance for the transition to a circular economy. These observations align with the findings of Bastos et al. (2024), who offer an in-depth analysis of the influence of multinational firms and GVCs on technology diffusion in their recent study. By examining 29 disruptive technologies across 17 countries and 46,000 firms from 2014 to 2022, their research challenges the traditional belief that proximity to technology invention centers automatically facilitates faster technology diffusion. Instead, their data suggest that diffusion patterns are more complex and are significantly influenced by supply chain connections and firm-to-firm relationships, underscoring the intricate dynamics at play in the spread of technological innovations.

[8] World Bank Enterprise Surveys, https://www.enterprisesurveys.org/en/enterprisesurveys, accessed: December 5, 2023.

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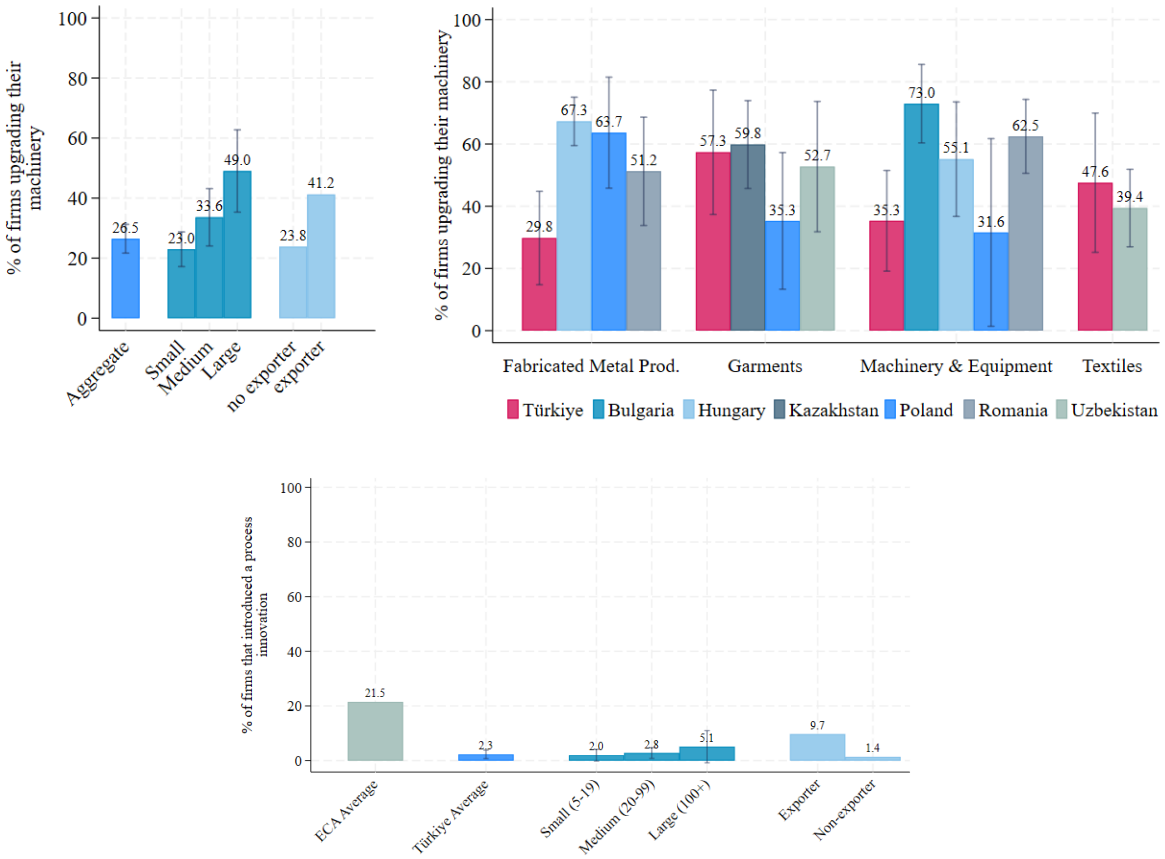
Figure 7: Machinery upgrades and process innovation



Source: Original analysis.
Note: The upper panels show the percentage of firms that upgraded their machinery and equipment in the three years preceding the latest WBES. The left panel depicts upgrading in the aggregate Turkish economy, broken down by establishment size and export status. The right panel illustrates upgrade rates in the four CE priority sectors with representative coverage and adds sectoral averages of surveyed Europe and Central Asia economies with the same industry stratum (for details, see subsection F.2). Whenever inference is possible, 95% confidence intervals are included. The bottom panel shows the share of firms that introduced any new or significantly improved process, on average across surveyed Europe and Central Asia economies.

3.1.4 Licensing Agreements for Foreign Technology

Licensing agreements are also important, since they facilitate the spread of technology by creating a structured and mutually beneficial framework for sharing innovations, reducing market entry barriers, and fostering collaborative advancements across industries and borders. In Türkiye, however, the adoption of foreign technology through licensing remains modest, with only 14 percent of manufacturing establishments operating under such agreements. This figure, while limited, is not significantly different from the average across Europe and Central Asia, as depicted in Figure 8. Notably, Turkish exporters are more than three times likely to utilize licensed technology compared to firms focused solely on the domestic market.

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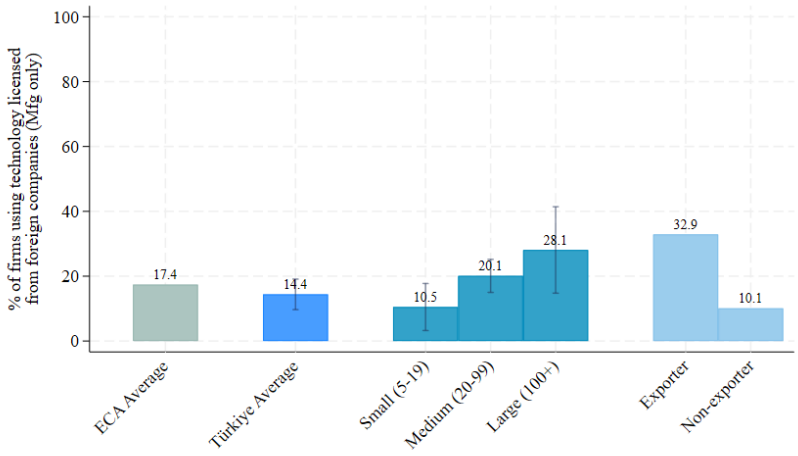
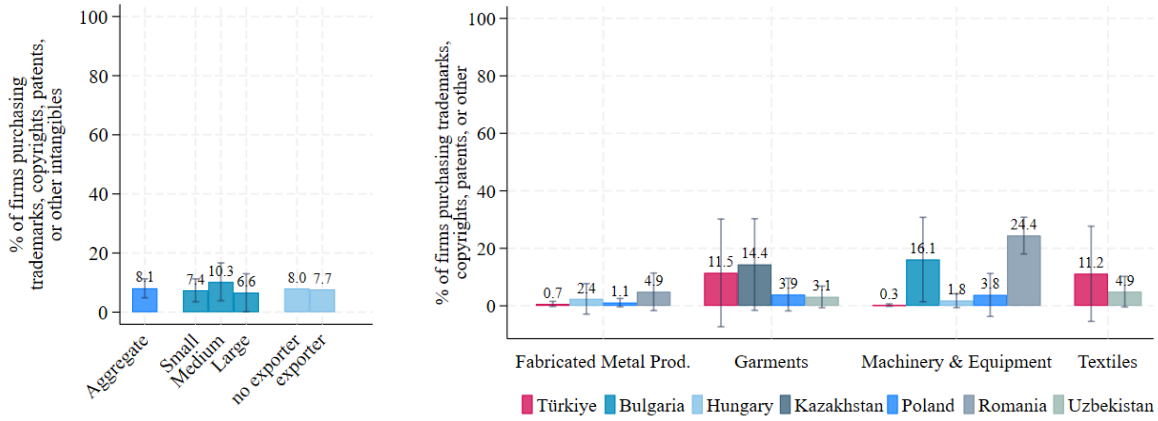
Figure 8: Technology licensing



Source: Original analysis.
Note: This figure shows the percentage of manufacturing firms using technology licensed from foreign companies, on average across surveyed Europe and Central Asia economies, on average in Türkiye, and within firm size groups and export exposure in Türkiye. Whenever inference is possible, 95% confidence intervals are included.

The landscape of technology adoption within the same sectors varies significantly across countries. For instance, in the machinery and equipment sector, Romanian firms are significantly more inclined than their Turkish counterparts to engage in production under licensing agreements, as evidenced by their higher acquisition rates of copyrights, patents, and other intangible assets (see Figure 9). The uneven diffusion of technology, particularly to smaller firms and those in lower tiers, observed in the data (Figure 8) represents a main obstacle to broader technology adoption.

Figure 9: Purchasing of trademarks, copyrights, patents, or other intangible assets



Source: Original analysis.
Note: This figure shows the percentage of firms that purchased or acquired trademarks, copyrights, patents, licenses, service contracts, franchise agreements, or other intangible assets in the year leading up to the latest WBES. The left panel depicts shares in the aggregate Turkish economy, broken down by establishment size and export status. The right panel illustrates shares in the four CE priority sectors with representative coverage and adds sectoral averages of surveyed Europe and Central Asia economies with the same industry stratum (for details, see subsection F.2). Whenever inference is possible, 95% confidence intervals are included. Around 8% establishments acquired trademarks or similar intangibles.

3.1.5 Access to and Use of Recycled Inputs

Section 2.3 discussed the importance of access to and use of recycled inputs as a fundamental enabler of a successful transition, particularly in the 'light transition' CE model. It emerges that, access to and use of recycled inputs requires significant and urgent upgrading in the two surveyed industries. They both need innovation and face significant hurdles impeding large-scale adoption.

Broadly speaking, meeting current minimal recycling standards is feasible through pre-consumer recycling, an avenue sometimes more cost-effective than using virgin materials, owing to either lower

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prices or substantial premiums. However, in a scenario where recycling requisites become more prevalent, including a need for postconsumer recycling, Türkiye faces a strategic bottleneck. Field mission findings and hard evidence suggest that Türkiye's CE transition could substantially benefit from an improved waste management and recycling ecosystem. For example, in 2020, Türkiye's recycling rates for municipal waste stood at a mere 12.3 percent, a stark contrast to the EU average of 48.7 percent (Figure 10). More recent data from Turkish national sources indicates a substantial catching-up in the recycling rate to 35 percent in 2023, leaving some room for further improvement.[9]

In the textiles industry, where the use of recycled inputs often deals with concerns over diminished quality and durability of downstream products, the availability of inputs for recycled content is severely constrained by the interaction of diverse factors. Except for a few and recent initiatives, multiple hurdles to the creation of an effective recycling ecosystem are a significant handicap in this industry.[10] For example, interviewed stakeholders indicated that less than 10 percent of postconsumer textiles are collected domestically for recycling (Field Research, 2023). At the same time, there is a shortage of inputs from waste management for recycling and there are import restrictions for used clothes that significantly limit the availability of used garments as recycling inputs. Additionally, few firms have engaged in clothes recycling due to limited market readiness and high costs. The result is a recycling ecosystem that is still in its infancy and reliant on imports from countries such as Malaysia, Thailand, and China to meet its demand.

Access to and use of recycled inputs in the automotive sector in Türkiye is also problematic. Türkiye's end-of-life vehicle (ELV) recycling ecosystem could benefit from upgrading. Türkiye only scraps a fraction of the number of cars compared to European and Japanese countries, resulting in a low supply of inputs available for the recycling sector. There is also a lack of demand from the automotive sector for secondary materials, which provides little incentive for recyclers to invest. Additionally, there is insufficient steel and plastic produced locally with the technical requirements of the industry, leading to heavy reliance on imports. This presents challenges for the automotive industry in terms of accessing recycled raw materials and controlling emissions throughout the supply chain.

Going forward, the growing demand for recycled inputs under a light CE scenario presents Türkiye with two strategic options: securing foreign recycled materials or further developing its domestic recycling industry. If Türkiye opts for increasing reliance on imports of foreign recycled materials (that is, bolstering imports), there are several challenging aspects to consider. First, increasing reliance on imported recycled materials introduces Türkiye to the complexities of waste shipment regulations. This encompasses ramifications of the EU waste shipment directive (see Annex B) which might reduce, for instance, the supply of ferrous metal scrap, an important input for Türkiye's steel industry. Additionally, there are implications regarding Turkish import regulations, recycling firms' efforts of circumventing bans on imports like used cars and clothes, the extent of material retention within the country, and so on. This landscape suggests that while opportunities exist to increase Türkiye's access to recycled inputs through imports, they are accompanied by a complex regulatory and operational framework that the country must navigate. The second option, involving enhancement of its domestic recycling capabilities, needs significant investments in the current waste collection and recycling ecosystem, and leapfrogging in postconsumer recycling. This includes nontrivial challenges in developing postconsumer recycling, contingent on the pioneer stage of many technological solutions which both globally and in Türkiye are still nascent.[11] While it is important to note that Turkish stakeholders are keen on staying abreast of the global advancements in this field, on the whole, these considerations suggest that relying exclusively on postconsumer recycling is a longer-term solution.[12] For now, a blend of securing better access to post-consumer materials to be recycled in Türkiye, strengthening the capacity of domestic collection of used garments, increasing domestic recycling capabilities, and fostering Türkiye's participation to global R&D efforts in advancing postconsumer recycling seems the best approach.

[10] A new technology has recently been developed by a large Turkish producer, to transform postconsumer cotton, polyester, and most importantly polycotton textile waste into high-quality, sustainable, and ready-to-spin recycled raw materials (see Annex C.2.1).
[11] Some recent examples of innovative activity of Turkish firms in advancing (post-consumer) recycling technologies are discussed in Annex C.2.1.
[12] Turkish stakeholders organized, for instance, field trips to Finnish and Dutch recycling facilities, which represent the highest standard globally. This is an area in which innovation is growing at a rapid pace and large-scale adoption gives a competitive hedge to those countries facilitating such activities. How Türkiye could potentially lead innovation in this, and other frontier sustainability technologies, is discussed in Section 4.2.

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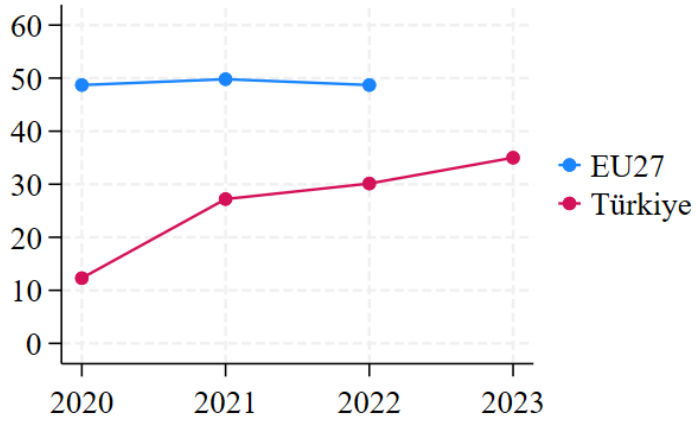
Figure 10: Recycling rate



Source: Original analysis.
Note: This figure shows recycling rates across the EU27 and in Türkiye. Data for the EU27 and the estimate for Türkiye for 2020, is obtained from Eurostat.[13] More recent data from Turkish national sources indicate a recycling rate of 27.2 percent for 2021, of 30.13 percent for 2022 and of 35 percent in 2023.[14]

3.1.6 Skills

The challenge of facing limited technology diffusion across all the above fronts is compounded by the fact that investments in upgrading workforce skills in Türkiye lag the Europe and Central Asia average. Skill inadequacy was a recurrent theme in the field interviews, with firms lamenting the shortage of skilled personnel in areas relevant to green transitions, such as sustainability experts, digital professionals, and recycling technicians. This skill gap was unanimously viewed a significant challenge for Turkish firms attempting to comply with the EU's green requirements. While overall labor force productivity substantially increased during the past two decades and there has been a significant move from low-productivity agriculture to industry and services, skill adequacy remains a major concern for employers (World Bank Group 2024). In particular, job seekers are both underqualified and overqualified, underscoring that the mismatch is not only rooted in general educational attainment (World Bank Group 2024). Since many of the technologies needed for the green transition are still in their infancy globally, further constraints are in order in this context.

Statistical evidence confirms local stakeholders' sentiment. Formal training is offered by 31 percent of establishments, which is 6 percentage points below the average across surveyed Europe and Central Asia economies (Figure 11). This discrepancy may be related to the relatively low number of firms that view an inadequately educated workforce as a major impediment: every fifth firm identifies insufficient workforce skills as a major constraint, relative to a Europe and Central Asia average of 25 percent (right-hand side panel of Figure 11). Furthermore, formal training programs are more prevalent in larger firms, which are also more likely to cite concerns about workforce education levels, underscoring a potential skills gap that could hinder the effective adoption and implementation of licensed technologies.

This interdependence between technology diffusion and workforce skills is reflected in the data. Firms that moved forward with the green transition (for example, by adopting climate-friendly energy generation on site, machinery and equipment upgrades) are more frequently identifying retraining needs as well as a need to improve skills compared to non-adopters (World Bank Group 2024). More than 20 percent of firms identified skills as the main obstacle for not investing in the development of innovative green products or processes, and over 80 percent called for government support to build the relevant

[13] Eurostat, Recycling Rate of Municipal Waste [ceiwm011], https://ec.europa.eu/eurostat/databrowser/product/page/cei_wm011, accessed October 28, 2024. The latest available data reported for Türkiye by Eurostat is 2020.
[14] Ministry of Environment, Urbanization and Climate Change, https://cygm.csb.gov.tr/sifir-atik-ile-geri-kazanim-orani-35e-ulasti.-haber-286897.

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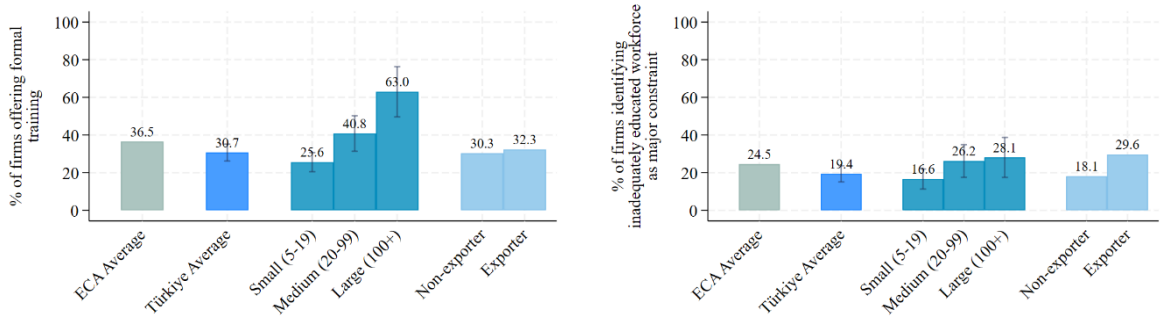
knowledge in the firm (World Bank Group 2024).[15] Finally, Turkish firms also fall behind the EU average in employing IT specialists (18 percent versus 21 percent, Figure 12 left panel) and providing information and communication technology (ICT) skill training (16 percent versus the EU's 22 percent, Figure 12 middle panel).

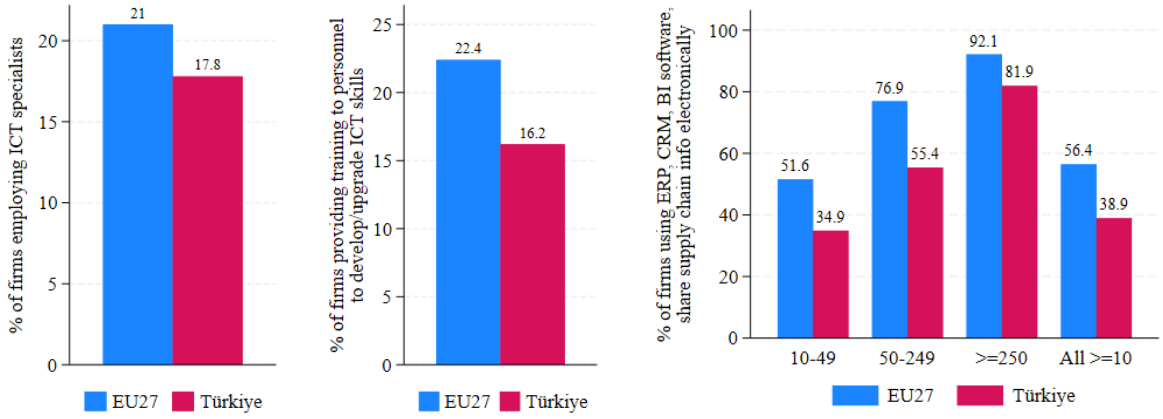
Assigning responsibilities for environmental issues at the management level is often not appreciated enough. High managerial sensitivity to the sustainability agenda can considerably speed up the CE transition. Yet, as of 2019, a mere fraction of establishments (under 5 percent) had a designated manager for environmental and climate change issues, though this figure rose to 12 percent for direct exporters and about 15 percent for larger firms (see Figure 13). In the European context, sectors such as fabricated metal products and machinery and equipment see a higher integration of environmental concerns at the management level, particularly in Hungary, Poland, Romania, and Bulgaria.

Figure 11: Workforce skills



Source: Original analysis.
Note: The left panel shows the share of firms that offer formal training for their employees, on average across surveyed Europe and Central Asia economies, on average in Türkiye, and within firm size groups and export exposure in Türkiye. Whenever inference is possible, 95% confidence intervals are included. The right panel depicts the share of firms that consider an inadequately educated labor force as a major constraint.

Figure 12: IT skills and usage



Source: Eurostat 2022a, 2022b, 2023b.[16]
Note: This figure shows the percentage of enterprises across the EU27 and in Türkiye that employ ICT specialists (left panel) and that provided training to develop/upgrade ICT skills of their personnel (middle panel) in 2022. The right panel shows the share of enterprises using ERP software, CRM software, or Business Intelligence or share supply chain management information

[15] The increasing demand for green skills is also reflected in high-skill job ads on LinkedIn, a leading platform for matching demand and supply of labor. In Türkiye, about 1 in 10 openings state green skills among required candidate characteristics, similar to comparator countries in Latin America and Europe (World Bank Group 2024).
[16] Eurostat, Enterprises that employ ICT specialists by size class of enterprise [isoc ske itspe], https://ec.europa.eu/eurostat/databrowser/product/page/isoc ske itspe$defaultview, accessed December 13, 2023; Enterprises that provided training to develop/upgrade ICT skills of their personnel by size class of enterprise [isoc ske itts], https://ec.europa.eu/eurostat/databrowser/product/page/isoc ske itts$defaultview, accessed December 13, 2023; Integration of internal processes by size class of enterprise [isoc eb iip], https://ec.europa.eu/eurostat/databrowser/product/page/isoc eb iip, accessed December 13, 2023.

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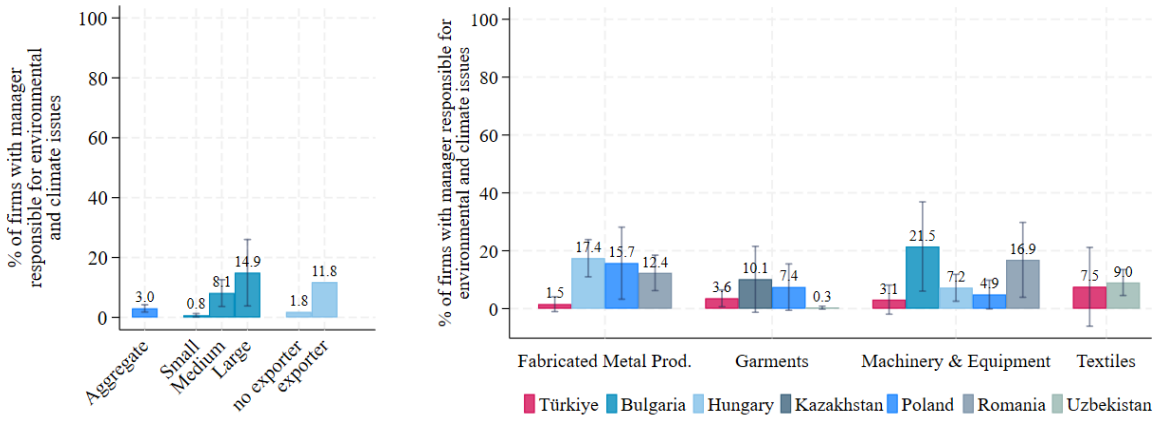
electronically with suppliers or customers in 2023 by company size. Enterprises from the nonfinancial sector with 10 employees or more are included.

Figure 13: Manager responsibilities for climate and environmental issues



Source: Original analysis.
Note: This figure shows the percentage of firms that had a manager responsible for environmental and climate change issues in the fiscal year preceding the latest WBES. The left panel depicts shares in the aggregate Turkish economy, broken down by establishment size and export status. The right panel illustrates shares in the four CE priority sectors with representative coverage and adds sectoral averages of surveyed Europe and Central Asia economies with the same industry stratum (for details, see subsection F.2). Whenever inference is possible, 95% confidence intervals are included.

3.2 Türkiye's Preparedness to a 'Full Transition' Scenario: Contributing to Advancing the Circular Economy Global Innovation Frontier

Challenges impeding the broader adoption of mature technology and R&D in emerging fields include paradoxically also the country not being at the technological frontier or pushing it. Being behind the technological curve can limit access to the latest advancements and best practices, making it harder to implement existing mature technologies effectively or innovate within new fields. Additionally, without pushing the technological frontier, the country may struggle to cultivate a culture of innovation and attract the necessary investments in R&D, further impeding progress and adoption in both established and emerging technological domains. This creates a cycle where the lack of advancement reinforces the barriers to adopting and developing new technologies.

In the realm of technology, particularly product innovation in nascent areas, the overarching goal is to achieve reduced unit costs and enhance global availability. This involves cutting-edge fields like nanotechnology, which enables products to dematerialize and self-repair but also more mundane innovation in, for example, technical and specialty textiles or packaging solutions. Being a pioneer in such innovation often grants a significant competitive edge. This raises the question: how actively is Türkiye participating in these innovative ventures? To answer this question, in this section we will explore the objective of achieving lower unit costs and greater availability at a global scale through innovation at the global technological frontier. Additionally, we will assess Türkiye's involvement in these efforts and compare it to other European and Central Asian countries. We will also discuss the challenges faced by Türkiye in increasing the diffusion of mature technology and engaging in R&D activities in nascent technologies.

3.2.1 Innovative Activities and R&D Expenditures

Turkish firms display a varied landscape of innovative activities, with an overall performance that trails behind their European and Central Asian counterparts. Data from the latest WBES reveal a striking contrast: only 7 percent of Turkish firms have introduced a novel or significantly improved product or service in the past three years, markedly lower than the 37 percent average in the surveyed economies of the Europe and Central Asia region (see Figure 14, left panel). Notably, a significant portion of these innovations (56 percent) were new to their main markets (see Table 1). The prevalence of innovation is higher among firms that are direct exporters (22 percent) compared to those focused on the domestic market or indirect exporters. Size also plays a role, with medium to large firms exhibiting more innovative activities (see Figure 14, left panel).

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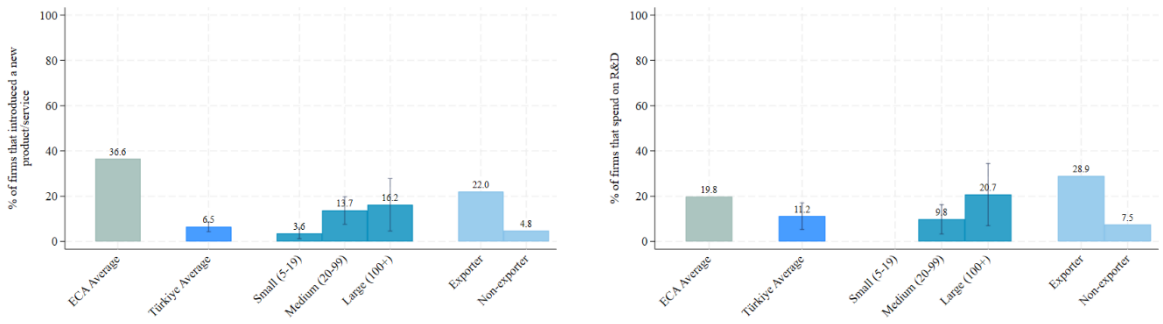
Figure 14: Innovative activity and R&D spending



Source: Original analysis.
Note: The left panel shows the share of firms that introduced new or significantly improved products or services over the three years preceding the latest WBES, on average across surveyed Europe and Central Asia economies, on average in Türkiye, and within firm size groups and export exposure in Türkiye. The right panel depicts the share of firms that spent on formal R&D activities during the last fiscal year. Whenever inference is possible, 95% confidence intervals are included.

The proportion of Turkish firms investing in R&D also varies with firm size and export orientation, lagging the Europe and Central Asia average by 9 percentage points (see Figure 14, right panel). On average, 11 percent of Turkish firms allocate funds to R&D activities. Direct exporters and larger firms are more inclined to invest in R&D. A survey of Turkiye's Top 500 industrial enterprises finds that 265 of them have engaged in R&D in 2023, reaching a plateau after a steady increase prior to 2018.[17] However, there are notable sectoral differences. Türkiye's investment in R&D in some sectors, including fabricated metal, garments, machinery and equipment, and textiles, does not significantly diverge from most of its Europe and Central Asia competitors.

3.2.2 Anecdotal Evidence on Entrepreneurial Potential in Türkiye

Field missions reveal that Türkiye's shift toward a circular economy predominantly follows a 'light transition' model, yet some initiatives, especially in the textiles and apparel sector, are proving to be transformative (refer to Annex C.2). This sector is making notable investments in sustainable innovations, such as water-efficient dyeing methods, and advanced technologies, such as fully integrated robotic dispensing systems. It is also exploring closed-loop recycling for specialized markets and enhancing sustainability in raw material procurement, notably through the Politeks initiative, which utilizes recycled polyester from PET bottles powered by renewable energy without using freshwater.

In comparison, the textiles and apparel industry, characterized by its typical industrial dynamics and GVC power relations in the global market, shows a higher propensity for innovation than sectors like automotive machinery and equipment. The latter's initiatives tend to focus on compliance, targeting of carbon emission reduction, and waste management to meet EU standards and consumer expectations. However, there are significant efforts within this sector to modernize facilities and embrace Industry 4.0 technologies. While innovation among smaller and lower-tier firms is scarce, there is a keen interest in contributing to national sustainability efforts, provided challenges such as resource limitations, exclusion from certification programs, and the financial strains of sustainable transitions are addressed.

In summary, Türkiye's entrepreneurs are making significant strides in sustainable innovation, demonstrating the country's potential to lead in eco-friendly practices and technological advancements within a CE framework. With the right long-term policy support, Turkish ingenuity could significantly contribute to global innovations in areas like cotton recycling and waterless dyeing techniques.

3.3 Financing the Transition

While flexible access to finance is critical to both the 'light transition' approach and the 'full transition' scenario, firms of all sizes in Türkiye face significant challenges in accessing

[17] https://www.iso500.org.tr/sunum-ve-konusma-metni-iso-500-eng.

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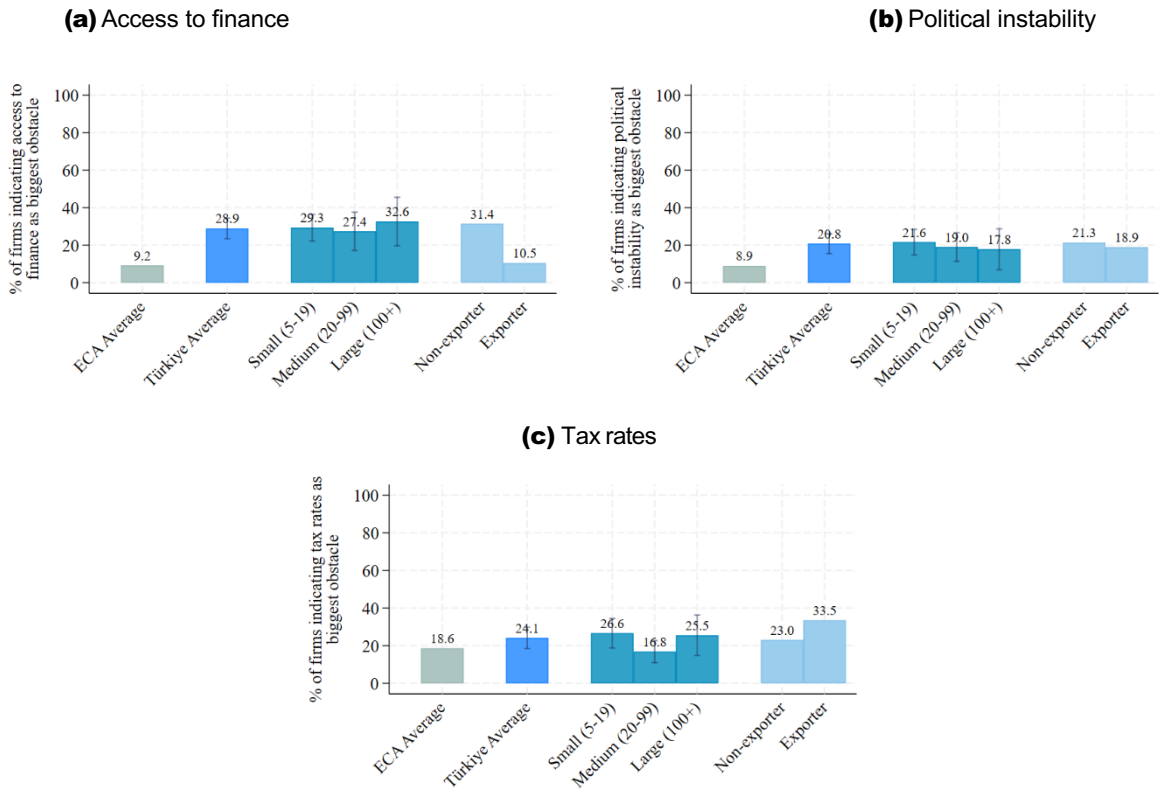
finance.[18] Approximately 29 percent of Turkish companies cite financing difficulties as a major barrier, a figure that is substantially higher than the 9 percent average in the Europe and Central Asia region. This issue affects companies uniformly across different sizes but is more pronounced among those focused on the domestic market compared to those engaged in direct exporting. Additionally, between 20 percent and 25 percent of businesses highlight political instability or high tax rates as their primary concerns, surpassing the Europe and Central Asia averages by over 10 and 5 percentage points, respectively. These concerns regarding political instability are similarly widespread across firms of all sizes and are independent of their export activities.[19]

Figure 15: Major obstacle as identified by firms



Source: Original analysis.
Note: This figure shows the percentage of firms that identify access or the cost of finance (panel a), political instability (panel b), or tax rates (panel c) as a 'major' or 'very severe' obstacle. The panels display average shares across surveyed Europe and Central Asia economies, in Türkiye, and within firm size groups and export exposure in Türkiye. Whenever inference is possible, 95% confidence intervals are included.

A survey of Turkish companies that have not pursued energy efficiency enhancements confirms that financing is among the primary reasons. Approximately half of these nonadopters report prioritizing other investments over energy efficiency measures. Around 20 percent of them attribute their inaction to concerns about profitability or insufficient financial resources. Interestingly, the findings also indicate that uncertainties regarding future regulations and pricing, along with operational or technical risks, are not considered significant deterrents by the majority of these companies (Figure 16, Figure 17).

[18] Experimentation with business models and process innovation is necessary to achieve technological transformation, but this is hindered by lack of tailored financing, along with regulatory ones. Innovation in business models, particularly around concepts like repair, reuse, and product-as-a-service, could offer Turkish firms opportunities to become integral parts of a service-oriented circular economy, particularly in their proximity to the EU market. Financing the transition in any of the above dimensions can be done by using own funds or by tapping into the resources of GVC firms, private investors, and public subsidies. But each of these face challenges too, due to macroeconomic uncertainties and the cost of finance locally and internationally. The previously mentioned skill gap, evidenced by Türkiye's lower proportion of green jobs and a higher need for upskilling further, also complicates the availability of finance.
[19] Similar concerns are raised in the most recent Country Economic Memorandum for Türkiye, based on the country performance in terms of macroeconomic uncertainty as measured by standard indicators: economic uncertainty index, exchange rate volatility, and credit spread (risk premium).

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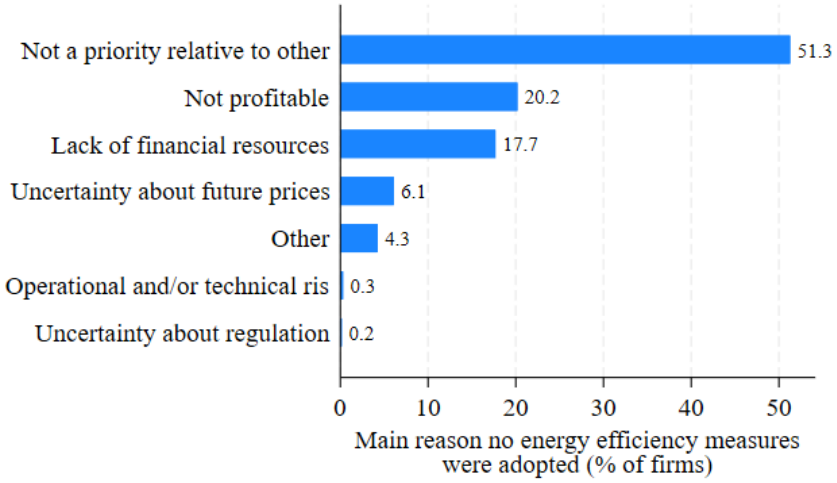
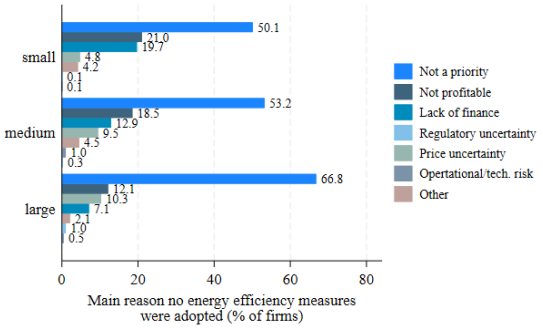
Figure 16: Main impediment for non-adoption of energy efficiency enhancing measures



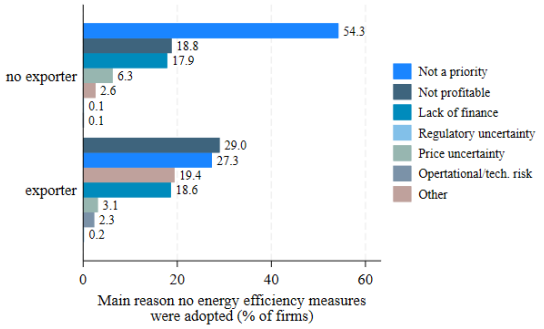
Source: Original analysis.
Note: This figure shows the main impediment for the subset of firms not implementing any energy efficiency improvements in the three years preceding the latest WBES.

Figure 17: Energy efficiency measures: Main impediment for non-adopters

(a) By size



(b) By exporter status



Source: Original analysis.
Note: This figure shows the main impediment for the subset of firms not implementing any measures to enhance their energy efficiency, broken down by firm size and export status. Relative to larger companies, smaller firms mention more often a lack of financial resources (panel a). Surveyed domestic-oriented firms more often deem energy efficiency enhancing measures a lower priority investment (panel b). Evidence for the aggregate Turkish economy is presented in Figure 16.

Field interviews with operators in the textile-apparel and automotive sectors offer deeper insights into the financing challenges. Key observations include that small and medium enterprises (SMEs) in particular face difficulties due to inadequate scale and substantial fixed costs, which impede their transition efforts. Additionally, even projects that could potentially break even encounter financial access barriers, primarily because firms struggle to cover the initial, up-front company-specific investment expenses. Moreover, macroeconomic instability stands out as an additional significant obstacle to securing financing for change. These issues are examined in greater detail below:

- **Insufficient scale and high fixed costs to invest in the transition:** The interviews highlighted the challenges faced by smaller firms in Türkiye's textiles and apparel industry in adapting to the EU's sustainability requirements. These firms struggle with the high fixed costs and insufficient scale necessary to invest in green technologies and processes. An example of this is the lack of finance for green transition initiatives, particularly at the tier 2 and 3 levels, due to restricted access to financing through the local banking system and limited loan periods. This has resulted in several sustainability projects in the sector being halted. As a result of the situation, many tier 2 and tier 3 suppliers in Türkiye are focused on incremental process upgrading rather than large-scale transitions due to the high up-front investment costs. These suppliers are limited to accessing financing through the local banking system, which is currently severely restricted in Türkiye. More recently, the lack of long-term loans and rising interest rates have significantly raised the costs of financing green transition initiatives.

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- **Inability to fund firm-specific investments up front:** The interviews discussed the difficulties faced by firms in funding up-front investments for firm-specific changes. This is particularly relevant in the context of adapting to new EU regulations that demand specific technological upgrades and process changes and for lower-tier firms. Acquisition of industry 4.0 technologies by tier 2 and tier 3 suppliers to produce parts for the electric vehicle (EV) segment or installing of more energy-efficient machines is a case in point. These initiatives are generally outside the scope of most incentive programs and hence need to be fully funded by firms' own resources, which smaller and lower tier firms do not have, or through the banking system. The complication with access to market-based financing however is that many tier 2 and tier 3 suppliers in Türkiye are limited to accessing financing through the local banking system, which offers only short-term loans with a maximum loan period of 12 months. This limitation hampers their ability to fund firm-specific investments up front, particularly for sustainability measures in their operations.
- **Access to finance for break-even projects:** The interviews identified a lack of access to financing as a major barrier for Turkish firms, particularly in the context of implementing sustainability initiatives. Multiple firms report that they have not been able to proceed with investment-ready projects due to the lack of available finance within the Turkish banking system. Specifically, the current financial system in Türkiye is severely constrained, with availability limited to short-term credits at high and rising interest rates. Firms also noted that Türkiye's ongoing macroeconomic issues further exacerbate this problem. Rising costs resulting from inflation and minimum wage increases have constrained firms' internal financing capacity. This has made it difficult for firms to secure the necessary funds for transition projects that may only break even.
- **Macroeconomic uncertainty affecting firms' ability to finance change:** Türkiye's ongoing macroeconomic concerns have dampened firms' action as they cannot access finance to implement sustainability initiatives. The interviews specifically addressed how macroeconomic instability in Türkiye, including fluctuating exchange rates and inflation, creates uncertainty, thereby affecting firms' ability and willingness to invest in long-term changes required for compliance with the EU's environmental standards. Persistent macroeconomic uncertainty, high inflation, and rising interest rates have significantly raised the costs of financing green transition initiatives. High interest rates and the short maturity of bank loans pose obstacles, especially for SMEs. This is perceived as a major hurdle. Additionally, political instability and tax rates are major concerns for all interviewed firms, affecting foreign direct investment flows and overall economic stability.

3.4 Regulatory Alignment within Türkiye and with the EU

The Turkish government, led by the Ministry of Trade, is aware of the EU's wide-sweeping legislative agenda and has initiated legislative efforts and strategies in response. Numerous action plans and incentive programs have been launched or are under development to support exporters in the transition. However, these have not yet been sufficient to support the transition and need to be both accelerated and reviewed to ensure that all stakeholders, including small and medium-size firms, have access to these instruments. In addition, multiple complementary policies are needed with respect to increased stakeholder coordination, besides those discussed in earlier parts of the report (that is, training and education, technology development, deployment of green infrastructure, better financing, and the establishment of a mature recycling ecosystem).

3.4.1 Türkiye's Action Plans and Incentive Programs

Mirroring the EU's approach, Türkiye's response is focused on two key action plans: the Turkish Green Deal Action Plan (GDAP) and the National Circular Economy Strategy and Action Plan (NCEAP). The country's GDAP was announced in July 2021 and was developed as a multistakeholder plan under the coordination of the Ministry of Trade. The focus of these initiatives is primarily on supporting exporters in the transition to comply with the EU requirements. The GDAP is currently in the process of being updated to reflect recent developments in relevant EU regulations. The Turkish NCEAP is being developed by the Ministry of Environment, Urbanization and Climate Change with financial support of the EU and Türkiye. The Turkish CEAP is oriented toward regulating the domestic economy. Numerous other complementary policies and roadmaps are also under development, including the Green Finance Taxonomy and the Growth Technology Roadmap. These policies are detailed in Table 2. An overview

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of the evolving CE landscape in the EU is presented in Annex B, where sustainability policies, strategies, and action plans affecting the circular economy directly and indirectly are listed.

Table 2: Principal Turkish Sustainability Strategies and Action Plans

Policy	Agency	Description
Turkish GDAP (July 2021, currently undergoing an update)	Ministry of Trade	Establishes key objectives to harmonize response to the European Green Deal. Relevant priorities include Carbon Border Adjustment Mechanism (CBAM), Green and CE regulations, Green Finance, Renewable Energy Supply, Sustainable Agriculture, and Sustainable and Smart Mobility.
National Circular Economy Strategy and Action Plan (under development by the DEEP project)	Ministry of Environment, Urbanization and Climate Change	Sets out the priorities for implementing regulatory changes for a circular economy to ensure alignment with the EU's CEAP. Will establish processes and requirements for life cycle analysis (LCA), focused on six priority sectors (textile, plastics, food, batteries and vehicles, packaging, electronics and information and communications technology).
Medium-Term Program 2023–2025 (September 2023)	Ministry of Treasury and Finance	Reiterates priorities with respect to the European Union Action Plan (EUGDAP) and the NCEAP. Relevant points include completion of Green Organized Industrial Zones and Green Industrial Zone certification systems and accreditation, increase in rate of recycled raw materials from industrial waste, development of incentives and guidance, increase in use of renewable energy, mainstreaming of response to eco-design for sustainable products legislation, establishment of calculation and monitoring methodologies for LCA and carbon footprint, and so on. Analyze labor market impacts and foster skills development for the transition.
Mobility Vehicles and Technologies Roadmap (June 2022)	Ministry of Industry and Technology	Developing the EV supply chain, including localization of the supply base (75%) and becoming a regional battery manufacturing center
Green Finance Taxonomy (Under development)	Ministry of Environment, Urbanization and Climate Change	The taxonomy aligns closely with the criteria established by the EU, with both employing similar checklists for identifying green investments, facilitating private sector investments.
Climate Change Adaption and Mitigation Action Plan (2024-2030)	Ministry of Environment, Urbanization and Climate Change	Establishes sectoral GHG emission reduction strategies in seven main mitigation sectors (energy, industry, buildings, transport, waste, agriculture and land use, land use change and forestry), and two cross-cutting thematic areas (just transition and carbon pricing mechanisms). Designates responsible institutions and organizations and determines monitoring indicators.
Long-Term Low-Emission Development Strategy (Under development)	Ministry of Environment, Urbanization and Climate Change; Presidency of Strategy and Budget	Details long-term low greenhouse gas emission development strategy in line with Paris Agreement, to be submitted to UNFCCC.
12th Development Plan	Presidency of Strategy and Budget	Lays out a holistic roadmap for the years 2024-2028 to advance on the long-term objective of sustainable development, mentioning among other policies and measures support for increased circular economy practices.
Green Growth Technology Roadmap	TÜBITAK (Scientific and Technological Research Council of Türkiye)	Identification of the technologies, R&D efforts, and financial resources needed to increase green production of key industries, including iron and steel, aluminum, plastics, chemicals, cement, and fertilizer.

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Policy	Agency	Description
Low-Carbon Pathway (LCP) Roadmaps	Ministry of Industry and Technology	Identification of roadmap or activities to support the reduction of greenhouse gas emissions in the steel, cement, aluminum, and fertilizer sectors that are within the scope of CBAM.

Sources: Field research 2023, Republic of Türkiye, 2020, Low-Carbon Pathway: https://www.sanayi.gov.tr/merkezbirimi/6f188a931f68/projeler/b81284, Climate Change Adaption and Mitigation Action Plan: https://iklim.gov.tr/db/turkce/icerikler/files/CLIMATE%20CHANGE%20MITIGATION%20STRATEGY%20AND%20ACTION%20PLAN%20_EN(1).pdf, 12th Development Plan: https://www.sbb.gov.tr/wp-content/uploads/2024/06/Twelfth-Development-Plan_2024-2028.pdf.

The Ministry of Industry and Technology has begun to develop programs to support firms in the Green Transition (Table 3). This support is primarily based on tax incentives with only a few programs offering grants or loans. These include large-scale investment incentives oriented to transformational projects with significant technological components. These incentives have a minimal investment threshold and must be approved by Presidential Decree. Other incentives cover wastewater management, renewable energy installations, and green innovation grants. A new Green Transition Incentive program has been announced with more comprehensive coverage and available to all firms regardless of size; however, it is not yet available (Table 3).

Table 3: Relevant Turkish Incentives Focused on Enhancing Green and Circular Production

Incentives	Agency	Description
Priority Investment Incentives (September 2016)	Ministry of Industry and Technology	• Min. fixed investment: US$55,000. • Incentives: value added tax (VAT) and customs duty exemption, corporate tax deduction (up to 40% of capital expenditure), social security support, land allocation, and subsidies on the interest rate (2 to 5 points). • Prioritized areas: energy efficiency investments, electricity generation via waste heat recycling (excluding natural gas production facilities), turbine and generator production for renewable energy generation, investments achieving a minimum 15% of water savings or emissions/water reduction, and so on.
Project-Based Investment Incentives (September 2016)	Ministry of Industry and Technology and Presidential Decree	• Focused on large investments (minimum fixed investment: US$37 million) • Incentives include those of the priority investment scheme plus financial incentives for energy and capital contribution, infrastructure support, qualified personnel employment support, streamlined procedures, and purchasing guarantee.
Green Transformation Incentives (KOSGEB)	Ministry of Industry & Technology	• Focused on SMEs • Financial assistance for energy-efficient equipment, grants for energy efficiency and renewable energy, consulting services for green business practices • Financial assistance for digital product and services development, digitalization, and ecommerce • Reimbursable grants to adopt green transformation plans • Funded by a World Bank Loan: US$250 million
Wastewater Management Incentives (May 2023)	Ministry of the Environment, Urbanization and Climate Change	• Facilities that reuse wastewater and enhance sustainable use of water; resources may be eligible for up to 100% of operation costs.

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Incentives	Agency	Description
Renewable Energy Incentives (January 2021)	Ministry of Energy and Natural Resources	• Renewable energy support mechanism (YEKDEM): In addition to feed-in tariffs, the Renewable Energy Law provides incremental price incentives for licensed generators that use domestically manufactured mechanical and electromechanical components. • Other incentives: 85% reduction on permit costs, rent, and other costs of gaining rights to access and use state-owned land; for a period of 8 years, generation facilities based on renewable energy and local resources are exempted from annual license fees.
Green Innovation Grants	TÜBITAK	• Reimbursable grants to implement green R&D activities; upgrade new or existing machines; license new technologies; hire R&D personnel; obtain technical assistance, prototypes, and patent application; develop/approve green standards; and so on. • Financed by a World Bank Loan: US$175 million.
Green Transformation Support Program	Ministry of Industry and Technology	• Focused on SMEs and large companies that implement green production processes. • Incentives: VAT and custom duty exemptions, tax discount, social security support, interest rate, or profit share support. Conditional on meeting at least 75% of the project targets.
Digital Transition Support Program	Ministry of Industry and Technology	• Focused on SMEs and large companies in the manufacturing sector that have been operating for at least 5 years to support the digitization of their business processes, improved monitoring of production processes, and productivity enhancements through the integration of technological products and solutions. • Incentives: VAT and custom duty exemptions, tax discount, social security support, interest rate support (Priority investment incentives under Decision No. 2012/3305 on "State Aids in Investments," regardless of whether investment in 5th region)
Instrument Pre-Accession (IPA) IPAII (2014–2020), IPAIII (2021–2027)	EU Ministry of Industry and Technology	• The Competitiveness Sectors Program allows Türkiye, as an EU candidate country, to access IPA funds from the EU to support their development. • Projects include (a) digital transformation, including the establishment of a center for digitalization and consultancy services for digital transformation for SMEs (in implementation); (b) Green Transition, including preparedness for the DPP (in implementation); and (c) circular economy and design (future).
Producing Cities Program	Ministry of Industry and Technology	• The Producing Cities Program has been designed for the 'growth pole' cities which have high capacity in manufacturing and exportation with a growth potential similar to metropoles. The overall objective of the program is to improve the business environment, innovation ecosystem, and investment climate of these cities and in this way increase their competitiveness and create a more balanced economic and demographic habitation system across the country. One of the priority areas of the program is supporting clean production in prominent sectors of selected cities. Financial support can be provided for selected projects like consultations on clean production and energy efficiency centers.

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Incentives	Agency	Description
Energy Efficiency Law No. 5627	Ministry of Energy and Natural Resources	• Two programs within the scope of the Energy Efficiency Law No. 5627 aim at incentivizing increased energy efficiency and reduced energy intensity: • *The Efficiency Enhancing Project (VAP) Support Program* provides grants covering 30% of project costs (maximum project size = TRL 5 million) for investments into energy efficiency. Supported measures include improvements to equipment and system use, insulation, recovery of waste energy, cogeneration systems or electricity production from waste heat, among others. • *The Voluntary Agreement Support Program (VA)* provides payments to industrial enterprises that achieve agreed emission intensity reduction targets amounting to 30% of a company's energy expenses (capped at TRL 1 million). The program was expanded to include carbon intensity and energy consumption targets.
Government Support Program for Projects of Alignment to the European Green Deal	Ministry of Trade	• Covers 50% of consultancy expenses (for 5 years up to 10 million TL) for companies aiming to undergo green transition. • Open to all exporting companies irrespective of sector and size • Consultation expenses will be governed in 3 phases: (i) analysis of current state of play and road map for green transition (ii) project development in priority areas (iii) monitoring of progress

Sources: Ministry of Industry and Technology 2023; Norton Rose Fulbright 2023; Republic of Türkiye 2020; Field Research (2023).
Note: The Priority Investment Incentive is one of the four schemes within the Investment Incentive Program, alongside the Regional Investment Incentive Scheme (which aims to eliminate interregional imbalances), the Strategic Investment Incentive Scheme (which aims to increase the production of intermediate and final products with high import dependence), and the General Investment Incentive Scheme.

3.4.2 Challenges of Coordination with the EU and across Actors within Türkiye

Effective coordination with the EU is a challenge. Türkiye is in a unique position among GVC actors serving the European market due to the EU Türkiye Customs Union and Türkiye's longstanding EU candidacy. These agreements mean that not only do Turkish exporters have to comply with the EU's import requirements but that the country must also harmonize various national policies in the areas influenced by the EU's sustainability agenda. Thus, Türkiye's response must achieve the necessary balance between aligning domestic legislation in a timely manner while remaining competitive with other GVC competitors that have no such obligation. Prematurely implementing regulatory requirements before these are widely adopted in Europe would increase the financial burden to the country's exporters and undermine their competitiveness. Effective policy efforts on Türkiye's part are thus constrained as much of the EU's legislation and timing of implementation remains under debate and has not yet been finalized.

A perceived fragmentation of initiatives within Türkiye makes the above task even more complex. During stakeholder consultations, a recurring concern emerged regarding the regulatory landscape, with stakeholders highlighting the issue of fragmented initiatives and a perceived absence of unified action in adapting to the EU's regulatory shifts (see Annex C). This fragmentation is believed to have an impact on all parts of the value chain, hindering a cohesive transition strategy. The textiles and apparel industry, in particular, emphasized that this fragmentation has led to lack of synchronization among various supply chain participants and suggested that it impedes a unified, effective adaptation to new standards. A critical issue identified was a notable absence of collaboration between industry associations and recycling entities at the supply chain's end. Similarly, in the automotive industry, stakeholders pointed out a significant shortfall in coordination, especially concerning raw material supplies and the handling of ELVs. This disjointed approach has left stakeholders with an incomplete understanding of the regulatory changes in progress, leading to misaligned priorities and inconsistent requirements for suppliers in both sectors.

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4. Policies to Fast-Track the Light Transition and Catalyze the Full Transition

The primary takeaway from the discussion in Section 3 and the additional evidence in Annex C **is that Türkiye's engagement with the global shift toward a circular economy has shown noteworthy advancements** and substantial growth opportunities in specific sectors and companies, alongside significant obstacles and delays in others. Furthermore, the cost-benefit dynamics of transformation efforts are complex, reflecting the Turkish economy's sectoral and industrial diversity. Implementing a universal reform approach would therefore be ineffective.

Consequently, the recommended strategy suggests a diversified approach, facilitating rapid progression in certain sectors and companies via transformative leaps, supported by targeted reforms, while guiding others through more gradual, incremental adaptations. For those on a less ambitious path, the emphasis should be on flexible adaptation to change. In contrast, for those sectors and companies that can aim higher, the ambition should be to help them achieve transformative change. By moving forward with flexibility and vision, Türkiye can use its distinct advantages to respond to the changing global economy, be internationally competitive in sustainable innovation and resilience, and establish a model for others in the worldwide move toward a more circular and thriving future. The prioritization of initiatives advocated by this report is shaped by the above strategic vision and informed by both empirical data and consultations with firms, agencies, and public sector entities that have a stake in the CE agenda.

With the light approach in mind, three improvements are suggested as critical in the immediate future:

- Accelerating the adoption of mature technology and of tools for resource-efficient production. To expedite the use of such advanced technology and tools, Türkiye should prioritize establishing a robust recycling ecosystem and a reliable digital infrastructure for monitoring and tracing.
- Laying the foundation to address the challenges of insufficient scale and high fixed costs to invest in the transition, particularly for smaller firms and lower-tier suppliers in GVCs.
- Enhancing the institutional governance and coordination within Türkiye and with the EU. Managing the relationship with the EU involves balancing between maintaining an open dialogue with the EU counterparts to meet evolving regulatory requirements while also carefully timing the transition to EU standards, to optimize the tradeoff between costs and market opportunities. Domestic institutional and coordination enhancements can instead be achieved by fostering greater collaboration among public stakeholders and private sector entities to unify the approach toward sustainability and CE transitions.

In the envisioned 'ambitious scenario', this report suggests bolstering further the efforts outlined above. In addition, Türkiye should aim to position Turkish firms at the forefront of new and emerging industries and create a fertile ground for sustained growth, innovation, and the advancement of the CE, by steering its economy toward R&D activities, facilitating experimentation with pioneering innovative business models and processes, and nurturing relevant skill. Hence, beyond the immediate priorities outlined earlier, a fully successful and robust transition into global CE industries can be achieved by adding to the short-term agenda three longer-term actions. These are of critical importance but easily actionable.

- Investing in the whole range of skills related to the green economy and raising awareness about the CE among firms, workforce, educational institutions, and the general public
- Fostering an innovative ecosystem that supports R&D, new business models, and environmental sustainability through tailored finance, subsidies, incentives, and cross-border collaborations
- Catalyzing sufficient private investment through a signaling effort by the government to the private sector, to clearly communicate long-term commitment and policy coherence in promoting this agenda, and convinced alignment to broader global initiatives promoting green markets and sustainable investment vehicles.

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In accordance with this vision, a structured and comprehensive set of policy recommendations is proposed, for each of the above agenda items. Starting with the first agenda item, that is, accelerating the adoption of technology and tools for resource-efficient production, the analysis of Section 3 and Annex C identifies two immediate priorities: creating a robust recycling ecosystem and upgrading the digital tracing and monitoring infrastructure. These are discussed below, before turning to solutions for better financing the transition, and institutional and coordination enhancements. Engaging effectively on each of these priorities requires a comprehensive approach that cuts across the other important areas. Most of the suggested policy solutions therefore require multistakeholder, multisector engagement across areas as diverse as infrastructure enhancement, financing of innovation, legislation and coordination improvements, new industry practices, skill upgrading, and capacity and awareness building.

4.1 Recycling Ecosystem

Achieving a robust recycling ecosystem requires enhancing the infrastructure, financial accessibility, legislative environment, and industry practices needed to support the use of recycled inputs and the development of secondary materials markets. Only by implementing all these strategies, can firms be encouraged to increase their use of recycled materials, contributing to a more sustainable and circular economy.

1. **Legislative framework and policy support. Objective:** To build on the existing legislative agenda discussed in Table 2 to create a more supportive legal and policy environment that mandates recycling practices and encourages waste reduction at the source.

   Actions:

   - **Updating legislation and incentives:** Updating legislation to improve incentives for recycling and use of recycled materials can help develop secondary materials markets at the required pace. This includes removing the tax incentives for destroying materials and instead providing benefits for recycling and using recycled inputs, thus making recycled materials more competitive and attractive for firms. Consider removing minimal investment thresholds and approval by Presidential Decree (see Table 3), to facilitate the creation of a robust market for secondary materials.
   - **Promoting the use of recycled inputs in the automotive sector:** Incentivizing the recycling of old cars (as done in 2018–19) and modifying legislation to facilitate access to EU ELVs for recycling can provide recycled inputs such as metals, plastics, and other raw materials for the industry. In particular, consider modifying/adapting the legislation that bans the imports of scrapped cars and parts to facilitate access to EU ELV cars for recycling and update the legislative requirements for battery recycling, especially for EVs and others to comply with the Battery Regulation Directive.
   - **Establishing clear targets, standards, and responsibilities:** Develop and implement laws that set clear recycling targets, standards, and responsibilities for businesses, municipalities, and consumers.
   - **Incentivizing waste segregation: Strengthen the implementation of existing regulation and** introduce policies with strong implementation tools that encourage or mandate the separation of recyclable materials at the source, including households and industrial facilities.
   - **Example:** Model legislation on the EU's Waste Framework Directive, which sets recycling goals, defines waste management principles, provides finance mechanism for waste management ecosystem through the collection of Extended Producer Responsibility (EPR) fees, and encourages the reduction of waste generation. Model incentives for ELVs' recycling on the French example (see Annex D).

2. **Development of recycling infrastructure. Objective:** To build the necessary infrastructure for the collection, sorting, and processing of recyclable materials, ensuring efficiency and effectiveness in the recycling process as well as sufficient volumes of secondary materials.

   Actions:

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- **Establishment of advanced material recovery facilities (MRFs):** Invest in state-of-the-art MRFs that can efficiently sort and process a wide range of recyclable materials.
- **Expansion of collection networks:** Develop comprehensive collection systems that ensure the widespread and convenient collection of recyclables from residential, commercial, and industrial sources. Establishing recycling collection centers at the municipal level can help convert local waste into a supply chain input, ensuring that materials such as synthetic textiles, cotton, plastics, steel, and aluminum are recycled and reenter the supply chain, thus supporting the secondary materials market.
- **Development of Green Transformation Center of Excellence and Recycling Export Processing Zones (EPZs) to position Türkiye as a recycling hub in Europe.** The EPZs should host all recycling activities, for example, in the automotive industry: collection, hazardous material removal, dismantling, sorting, shredding, certification of materials for recycling, distribution, and waste management of nonrecyclables. These EPZs should also include the recycling of EV batteries. Treating both domestically collected waste and imported raw materials for recycling in specialized industrial zones could facilitate reaching the necessary economies of scale**.**
- **Investment in shared resources:** Establishing shared infrastructure, such as environmental footprint monitoring systems and wastewater facilities, on a pragmatic pay-per-use basis can encourage SMEs to use recycled inputs by making compliance with environmental standards more affordable and feasible.
- **Establishment of a Green Transformation Center of Excellence and Recycling EPZs:** These centers can act as hubs for innovation and best practices in recycling and the use of secondary materials. They can provide firms with the necessary resources, knowledge, and technology to efficiently use recycled inputs, thereby facilitating the creation of a robust secondary materials market.
- **Examples:** The Republic of Korea's waste management system includes extensive collection infrastructure and advanced MRFs, contributing to high recycling rates. France's system for ELV recycling is noted for its efficiency, with a strong national focus on extended producer responsibility (EPR) schemes and a regulatory framework that requires automakers to establish a network of approved ELV centers.

3. **Public awareness and education programs. Objective:** To raise public awareness about the importance of recycling, proper waste segregation, and the environmental impact of waste, thereby encouraging active participation in recycling efforts.

   Actions:

   - **Incentivize deposit return schemes for apparel and home textiles:** Encouraging the implementation of schemes where consumers, retailers, and the government contribute to a deposit tax, with refunds issued upon item return can promote recycling and reuse. This increases the availability of recycled inputs for firms and supports the development of secondary materials markets.
   - **Conduct national recycling awareness campaigns:** Launch campaigns that educate the public on how to recycle correctly, the benefits of recycling, and the role individuals play in the waste management ecosystem.
   - **Conduct educational programs in schools:** Integrate recycling and waste management education into school curricula to instill sustainable habits from a young age.
   - **Example:** Model initiatives on Keep America Beautiful's recycling education programs, which include a variety of resources and activities designed to increase recycling participation and awareness.

4. **Stakeholder engagement and partnership development. Objective:** To foster collaboration among all stakeholders in the recycling value chain, including government agencies, private sector companies, nonprofits, and the public, to enhance the recycling ecosystem's effectiveness.

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Actions:

- **Establish recycling partnerships:** Create multistakeholder platforms that bring together key players in the recycling sector to share knowledge, coordinate efforts, and drive innovation. (See Section 4.7 for further elaboration on this point.)
- **Support recycling enterprises:** Provide technical assistance, business development services, and networking opportunities for emerging recycling businesses and entrepreneurs.
- **Example:** Draw inspiration from the Ellen MacArthur Foundation's Circular Economy Network, which promotes collaboration across sectors and disciplines to accelerate the transition to a circular economy, including in recycling.

5. **Financial incentives and support mechanisms. Objective:** To provide financial assistance and incentives that encourage investment in recycling infrastructure and technologies, and reward sustainable waste management practices. Tailoring financing mechanisms to overcome high initial investment barriers can make it easier for firms, especially SMEs, to invest in technologies and processes that utilize recycled inputs. This may include access to grants, subsidies, or loans specifically designed for green investments.

   - **Subsidies, loans, and grants for recycling facilities:** Offer financial support to establish and upgrade recycling plants, especially for materials with less developed recycling markets, complementing the current tax incentive schemes with offerings of subsidies, loans, and grants.
   - **Link tax incentives to clear targets of sustainable practices:** Provide tax breaks or rebates for companies that achieve high levels of waste diversion from landfills, complementing current schemes targeting primarily investment in recycling technologies and use EPR fees to disincentivize waste generation and fund waste management activities.
   - **Example:** Implement a scheme similar to California's Recycling Market Development Zone (RMDZ) Program, which offers loans, technical assistance, and product marketing to businesses that use recycled materials (see Section 4.4 for additional suggestions on financing).

4.2 Digital Infrastructure for Monitoring and Traceability

Enhancing the digital infrastructure and capabilities of firms in Türkiye enables them to improve traceability and monitoring of their products and processes. There are several specific measures for enhancing digital infrastructure to support traceability and monitoring, which are crucial for firms, especially in the context of meeting evolving regulatory requirements and enhancing sustainability practices. These measures include technological deployment, regulatory support, stakeholder engagement, and capacity building. Here is a detailed strategy for setting up an effective digital monitoring and traceability system along these dimensions:

1. **Development of a National Digital Infrastructure Framework (enhanced DPP). Objective:** To create a unified framework that outlines the standards, protocols, and technologies for digital monitoring and traceability across various sectors, aligning with the standards currently under development for the EU's DPP. This platform will serve multiple purposes: centralize environmental indicators, facilitate LCA compliance, support DPP compliance, and allow for easy integration of suppliers with multiple buyers' platforms. This should function as a single platform for all indicators requested by third-party certification, buyers, the EU, and Türkiye's requirements used to assess the product environmental footprint (PEF). Built as an enhancement of the DPP, it should in its core facilitate a seamless integration into the EU's DPP while incorporating additional information metrics. A single nationwide system would provide a competitive advantage for Türkiye, providing economies of scale and allowing for the incorporation of SMEs at a lower cost. The data should be hosted with the strictest security system by a government department.

   Actions:

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- **Technical standards:** Develop and standardize technical specifications for digital tracking systems to ensure compatibility and interoperability across different industries and platforms, aligning with the EU's DPP standards.
- **Framework development:** Collaborate with industry experts, technology providers, and regulatory bodies to create a comprehensive national framework for digital traceability and monitoring.
- **Example:** The EU's Digital Single Market strategy aims to open up digital opportunities for people and businesses and enhance Europe's position as a world leader in the digital economy.

2. **Legislative and regulatory support. Objective:** To provide a comprehensive legal and regulatory foundation that mandates the use of digital monitoring and traceability systems for resource efficiency and supports the protection of data privacy.

   Actions:

   - **Enact mandatory requirement through legislation:** Introduce laws that require the implementation of digital tracking systems in key sectors and in some cases across the whole economy, particularly those with significant potential to lower the unit cost of adoption of technology and use of shared infrastructure in critical industries.
   - **Data privacy and security regulations:** Ensure that the digital monitoring infrastructure complies with strict data protection and privacy standards to build trust among stakeholders.
   - **Example:** Model regulations on the General Data Protection Regulation (GDPR) of the EU, ensuring that data handling in the traceability system respects privacy laws and builds user trust.

3. **Implementation of digital tracking technologies. Objective:** To deploy advanced digital technologies that enable the tracking, monitoring, and analysis of resource flows, waste generation, and recycling rates.

   Actions:

   - **Development of a National Digital Platform (enhanced DPP):** Establishing a national digital platform that supports the information exchange required for DPPs and other compliance requirements is a key measure. Paragraph 4.2.1 details policy objectives and recommended actions.
   - **Bundle investment in hard and soft infrastructure:** In incentivizing the development of green industrial parks, which can leverage economies of scale to reduce the financial burden of compliance in resource efficiency, emphasize the soft infrastructure (digital) component and the need for a secure and comprehensive digital support infrastructure. Ensure that the data of such important national infrastructure is hosted with the strictest security systems by a government department.
   - **Foster adoption of IoT and blockchain technologies:** Foster the utilization of IoT devices for real-time data collection and blockchain for secure and transparent data management.
   - **Pilot projects:** Initiate pilot projects in selected industries to demonstrate the benefits of digital traceability systems and refine the technology deployment strategies.
   - **Examples:** Explore the use of blockchain in the supply chain, similar to the way IBM's Food Trust network enhances traceability and transparency in the food industry.

4. **Capacity building and training. Objective:** To equip stakeholders with the necessary skills and knowledge to effectively use and manage digital monitoring and traceability systems.

   Actions:

   - **Training programs for businesses:** Offer workshops and training sessions for businesses, focusing on how to implement and leverage digital tracking systems for resource efficiency.

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- **Technical assistance for SMEs:** Provide SMEs technical support and guidance to adopt digital traceability solutions.
- **Example:** Implement training initiatives similar to the Digital Skills and Jobs Coalition by the European Commission, which aims to enhance digital skills across various sectors.

5. **Public-private partnerships for infrastructure development. Objective:** To leverage the expertise, resources, and innovation of both the public and private sectors in developing and deploying digital monitoring and traceability infrastructure.

   Actions:

   - **Collaborative infrastructure projects:** Foster partnerships between government bodies, technology companies, and industry players to develop shared digital infrastructure.
   - **Incentives for private sector participation:** Offer incentives, such as tax breaks or co-funding opportunities, to encourage private investment in digital traceability technologies.
   - **Example:** Replicate successful Smart Cities initiatives, where public-private partnerships (PPPs) play a crucial role in developing digital infrastructure to enhance urban sustainability and efficiency.

6. **Stakeholder engagement and collaboration. Objective:** To ensure the active involvement of all relevant stakeholders in the development, implementation, and continuous improvement of the digital monitoring and traceability system.

   Actions:

   - **Multistakeholder platforms:** Establish forums and platforms where government, industry, academia, and civil society can collaborate on digital traceability initiatives (see Section 4.7 for additional discussion).
   - **Feedback and continuous improvement mechanism:** Create channels for ongoing feedback from users of the digital tracking system to facilitate continuous improvement and adaptation to emerging needs.
   - **Example:** Adopt a collaborative approach similar to the Global Partnership for Sustainable Development Data, which brings together different stakeholders to harness the data revolution for sustainable development.

7. **Financial support. Objective:** Reduce the costs of adoption, particularly for SMEs and lower-tier suppliers.

   - **Financial support for SMEs:** Provide financial support to SMEs to obtain sustainable certifications and access to consultants that can help them in the adoption of digital monitoring technology. This could include support for certification costs, consultant fees, software, and training, all of which are essential for enhancing traceability and monitoring capabilities.

8. **Single window website:** Creating a ‘single window’ website that contains all current information regarding new EU regulations and available incentives and programs in Türkiye to facilitate the transition to compliance with these regulations is discussed in Section 4.3. This centralized information hub should include tools that can help firms, especially SMEs, stay informed and take necessary actions to enhance their traceability and monitoring systems in line with regulatory changes.

These measures not only aid in regulatory compliance but also support the broader goals of sustainability and CE by ensuring that products and materials can be traced throughout their lifecycle, thereby facilitating recycling, reuse, and responsible consumption.

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4.3 Establishing Shared Infrastructure Resources to Lower the Costs of CE Transition

To establish shared infrastructure and resources that support sustainable practices and address the initial investment hurdles faced by businesses, a detailed plan encompassing targeted financing options, development of shared facilities, and creation of support centers is essential. A cohesive approach to achieve such objectives might include the following actions:

1. **Establishment of shared environmental infrastructure. Objective:** To develop shared facilities that reduce the financial and operational burden on individual businesses, promoting collective adherence to environmental standards.

   Actions:

   - **Wastewater treatment facilities:** Develop communal wastewater treatment plants in industrial zones, allowing businesses to share the costs and benefits of advanced treatment technologies.
   - **Environmental monitoring systems:** Implement shared environmental monitoring systems to track emissions, waste, and resource use, providing data for businesses to improve their environmental performance.
   - **Transform key sectors** such as automotive into hubs for ecofriendly vehicle production, emphasizing innovation and sustainability.
   - **Adopt a pay-per-use model for SMEs,** enabling them to achieve operational efficiencies and comply with environmental standards without bearing the full cost.
   - **Example:** The success of the Eco-Industrial Park concept demonstrates how businesses near each other share infrastructure and resources to enhance their environmental, economic, and social outcomes.

2. **Creation of green transformation centers and green industrial parks. Objective:** To provide technical support, resources, and training for businesses undergoing sustainability and CE transformations.

   Actions:

   - **Incentivize the development of green transformation centers** and green industrial parks in which economies of scale can be leveraged to reduce the financial burden of compliance in renewable energy, water treatment, recycling infrastructure, and so on. Establish a certification system to ensure these parks meet the necessary minimum standards.
   - **Provide tax incentives for companies** to use green transformation centers and to relocate to green industrial parks and for firms that invest in green infrastructure development.
   - **Offer technical assistance and consulting:** Offer services in green technology adoption, process optimization, and sustainability certification through the centers.
   - **Provide training and capacity building:** Provide workshops, seminars, and courses on sustainable practices, regulatory compliance, and green innovation.
   - **Example:** Similar to the Clean Technology Centers and Networks (CTCN) under the United Nations Framework Convention on Climate Change (UNFCCC), these centers could act as hubs for knowledge exchange, technical assistance, and capacity building in green technologies and sustainable practices.

3. **Launch of one-stop shops for regulation compliance. Objective:** To simplify the process for businesses to access information on environmental regulations, compliance strategies, and available support mechanisms.

   Actions:

   - **Regulatory information portal:** Develop an online platform that aggregates all relevant regulatory information, guidelines, and updates, making it easily accessible for businesses.

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- **Compliance assistance services:** Offer advisory services through the one-stop shops to help businesses understand their regulatory obligations and how to meet them.
- **Examples:** A 'no wrong door' approach and 'one-stop shop' access approach, exemplified by Austrade in Australia, involves trade promotion agencies developing networked organizations that provide a seamless end-to-end service for firms in GVCs, reducing duplication and enhancing service quality. The EU's Single Digital Gateway provides a model for offering easy access to information and administrative services across various sectors, which could be adapted to focus on environmental regulation and sustainability compliance.

4. **Facilitate collaboration and knowledge sharing. Objective:** To encourage the exchange of best practices, innovations, and experiences among businesses to foster a collaborative approach to sustainability.

   Actions:

   - **Industry roundtables and forums:** Regularly organize events that bring together businesses, experts, and policy makers to discuss sustainability challenges, opportunities, and collaborative projects.
   - **Online collaboration platforms:** Create digital forums and databases where businesses can share case studies, technologies, and lessons learned in sustainability practices.
   - **Example:** The Ellen MacArthur Foundation's Circular Economy Network offers a precedent for how collaborative platforms can facilitate the exchange of knowledge and foster sustainability partnerships.

4.4 Increase Funding for the CE Transition through New and Established Financial Mechanisms

To enhance the financing necessary for Türkiye's transition to sustainable practices and the establishment of a robust circular economy, a comprehensive approach encompassing innovative financing models, targeted financial solutions, and supportive infrastructure development is essential. This approach should focus on ensuring that SMEs have access to the necessary resources, fostering collaboration with large corporations, and leveraging international financing for green infrastructure development, going beyond the current support through tax incentives (see Table 3) and targeting forms of finance resilient to macroeconomic shocks and fiscal constraints.

1. **Innovative financing models. Objective:** To integrate development objectives with the business interests of large real sector companies, leveraging their financial strength and operational frameworks to support SMEs in adopting sustainable practices.

   Concept and Operational Mechanism:

   - **Concept:** The proposed financing model aims to integrate CE objectives with the business interests of large real sector companies, utilizing their balance sheets, standards, and investments to drive sustainable practices and innovations down the supply chain. This model, which could be developed in partnership with a development bank, to kickstart investments, can reduce the cost of financing for SMEs when adopting CE technologies. It can facilitate the widespread adoption of sustainable practices among SMEs and also contribute to the overall resilience and sustainability of the business ecosystem.
   - **Operational Mechanism:**
     - **Value chain integration:** Conduct comprehensive appraisals of large real sector companies to ensure their alignment with CE transition objectives, focusing on areas like resource efficiency, waste elimination, and broader sustainability goals.
     - **Direct engagement through large corporates:** Utilize large companies as conduits to reach and support SMEs within their value chains, eliminating the need for individual project appraisals and making the financing process more efficient.

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- **Financial product innovation:** Design new financial products such as supplier finance and purchase order finance that rely on operational data and long-term payment histories for risk assessment, leveraging big data analytics.
- **Adjustment in risk assessment:** Shift from traditional financial statement-based assessments to an operational data-driven model, requiring a holistic appraisal of large companies and their supply chain.
- **Legal and relationship frameworks:** Develop novel financial products with extensive legal work to ensure enforceable contracts and effective risk management, while building trust-based relationships with large companies.

- **Benefits:** Increased access to finance for SMEs, risk mitigation, scalability across various industries, and alignment of financing with sustainable practices to achieve CE transition objectives.

2. **Targeted financing solutions. Objective:** To provide SMEs with accessible and affordable financing options for sustainability upgrades and the development of shared infrastructure using existing financing instruments from public and private sources.

   Solutions:

   - **Green transition incentive scheme:** Accelerate the launch of the Green Transition Incentive Scheme to provide tax incentives to firms that incorporate greener solutions and technologies (for example, water use and treatment, renewable energy, chemical reduction, and so on).
   - **Green Investment Fund:** Establish a fund to offer low-interest loans, grants, and subsidies for businesses investing in CE technologies and shared infrastructure.
   - **Incentives thresholds:** Evaluate and possibly lower thresholds for incentives to ensure all value chain actors, particularly SMEs, have opportunities to access to financial instruments.
   - **Services for SMEs:** Provide financial support to SMEs to obtain sustainable certifications and access to consultants for market access (for example, certification, consultant, software, training).
   - **Financial support for R&D:** Increase investments in R&D and new technologies **to enhance sustainability and circularity. Provide additional financial support for** the creation of R&D centers. Focus on key technologies relevant for the transition of the automotive and textiles and apparel sectors, such as recycling technologies (for example, for postconsumer textiles recycling and ELVs) and enhancement of quality and functionality of secondary materials, water treatment systems, EV supply chain.
   - **Public-private partnership models:** Encourage PPPs to finance the development of shared infrastructure, with incentives like tax breaks or co-financing options for private sector participants.
   - **Example:** Model some of the solutions on the Green Climate Fund, supporting projects in developing countries for a low-emission and climate-resilient transition.

3. **Support for shared infrastructure development. Objective:** To invest in shared infrastructure that benefits SMEs by providing them with cost-effective access to essential resources.

   Action: Finance (or co-finance) infrastructure development of shared facilities with pay-per-use models (See Section 4.3).

4. **Collaboration with international financing:** Promote patient capital investment and foreign direct investment in the country, to invest in the areas where there are currently gaps in the financing system for green investments, from green infrastructure to technological advances.

   Action:

   - **Diversify sources of finance**: Explore diverse funding sources, including European and other international private investors seeking environmentally friendly opportunities, with a

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special emphasis on financing for SMEs. For example, attract investment from leading recycling companies in Norway and Finland.

4.5 Managing the Relationship with the EU

To effectively manage the relationship with the EU and navigate the complexities of evolving regulatory requirements, Türkiye needs to implement a strategic plan that balances the need for compliance with EU standards and the optimization of trade-off between costs and market opportunities. The following policy recommendations outline a detailed plan for achieving this balance:

1. **Establish a dedicated EU-Türkiye regulatory dialogue platform. Objective:** To maintain an open and continuous dialogue with EU counterparts, facilitating real-time understanding and response to regulatory changes.[20] This may include the following:
    - **Formalize a Bilateral Committee** comprising representatives from key Turkish ministries (Trade, Environment, Urbanization and Climate Change, Industry and Technology) and their EU counterparts to discuss regulatory updates, challenges, and collaborative solutions.
    - **Regular engagement:** Schedule quarterly meetings, with additional ad hoc sessions as required by the regulatory agenda, to ensure timely updates and discussions.
    - **Example:** Similar to the EU-US Trade and Technology Council, this platform could serve as a formal channel for regulatory dialogue, ensuring that Türkiye remains aligned with EU standards while voicing its concerns and suggestions.
2. **Develop a phased transition plan for EU standards adoption. Objective:** To time the adoption of EU standards in a manner that balances compliance with minimizing the financial burden on Turkish firms. Specific actions could include the following:
    - **Sector-specific impact assessments:** Conduct thorough analyses of the impact of EU regulations on different sectors, identifying those most affected and prioritizing them for early compliance.
    - **Staggered implementation timeline:** Based on the impact assessments, create a staggered timeline for compliance, allowing sectors with higher readiness or strategic importance to lead the transition.
    - **Example:** Prioritize sectors like automotive and textiles for early compliance due to their significant export relationships with the EU, using a phased approach to allow other sectors more time to prepare.
3. **Enhance information dissemination and training. Objective:** To build awareness and understanding among Turkish firms about EU regulations and the benefits of early compliance. Actions could include the following:
    - **Comprehensive information portal:** Create an online platform providing up-to-date information on EU regulatory changes, compliance guidelines, and available support mechanisms.
    - **Training and capacity building programs:** Offer sector-specific training programs to enhance the skills and knowledge necessary for compliance, with a focus on SMEs.
    - **Example:** Launch an EU Standards Academy, offering online and in-person courses tailored to different industries, covering topics such as EU CE regulations, digital standards, and product requirements.
4. **Leverage financial instruments and incentives from the EU public and private investors. Objective:** To ease the financial burden of transitioning to EU standards, particularly for SMEs and lower-tier suppliers. Access to concessional finance, through instruments such as low-interest loans and grants, involvement of private investors, and large real sector corporates, could be complemented by inter-governmental initiatives. For example, opportunities for new

[20] Drawing on the economic literature on trade, GVCs, and innovation, Annex E illustrates the benefits for the EU and EU firms from engaging in a cooperative strategy with Türkiye to achieve circular economy objectives.

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joint funding programs with the EU, dedicated to supporting Turkish firms in sectors critical to EU trade, could be explored. Similarly, existing initiatives could be adapted to meet the specific CE needs. See Section 4.4 for additional suggestions.

5. **Leverage the EU ecosystem for capacity building and technology transfer. Objective:** Strengthen collaboration with stakeholders in the EU's innovation ecosystem.

   Actions:

   - Foster cooperation with EU (and other foreign) universities to facilitate technology transfer and engagement in cutting-edge research projects.
   - Provide scholarships for students to study at European universities leading in sustainability technologies in doctoral programs and post-doctoral fellowships.
   - Invite foreign professors to teach in leading Turkish universities to accelerate capabilities development in the local education system.
   - Establish opportunities and forums for Turkish firms, universities, and research centers to engage with European counterparts on a range of sustainability and circularity R&D projects. Leverage both Turkish and European funding sources to finance these consortia such as TÜBITAK instruments and Horizon Europe.

4.6 Institutional and Coordination Enhancements within Türkiye's Government

To strengthen interinstitutional coordination within Türkiye, particularly in the context of advancing the CE transition, a structured and systematic approach is required. This approach should focus on enhancing collaboration, communication, and alignment among various governmental bodies and agencies to ensure a unified and efficient implementation of policies and initiatives. Coordination is particularly important among the following public stakeholders: Ministry of Trade; Ministry of Environment, Urbanization and Climate Change; Ministry of Industry and Technology; and other public agencies involved in the implementation of the agenda. Enhancing the already existing coordination mechanism under the Green Deal Working Group which prepared and now synchronizes the implementation of the GDAP within its 20 specialized sub-working groups, the following policy recommendations are designed to facilitate an improved interinstitutional coordination on CE issues in particular:

1. **Establish an inter-ministerial focus committee on circular economy. Objective:** To create a formal body that ensures policy coherence, aligns strategies, and facilitates collaboration across different governmental departments and agencies involved in CE initiatives, similar to existing coordination mechanisms under the Green Deal Working Group. This CE-specific platform can ensure streamlined coordination on CE priority issues and help accelerate the CE transformation process in Türkiye. Actions may include the following:

   - **Committee composition:** Include representatives from all relevant ministries, for instance, the Ministry of Trade; Ministry of Environment, Urbanization and Climate Change; and Ministry of Industry and Technology.
   - **Regular strategy sessions:** Conduct regular meetings to discuss policy alignment, share updates on ongoing projects, and resolve interdepartmental issues.
   - **Example:** Model this committee on the German Federal Government's Sustainability Cabinet, which coordinates sustainability efforts across various federal ministries.

2. **Implement a unified national circular economy framework. Objective:** To develop a comprehensive national framework that guides all ministries and agencies, ensuring their activities and initiatives are aligned with overarching CE goals, in close coordination with existing work under the Grean Deal Working Group.

   Possible actions:

   - **Framework development:** Collaboratively develop a national framework that outlines key objectives, targets, and indicators for sustainability and circular economy, endorsed by all relevant ministries. This could include insights from ongoing sectoral work of the Green

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Deal Working Group's subgroups on 'Eco-Design', 'Batteries and Waste Batteries', and 'Construction Materials'.

- **Integration into departmental plans:** Mandate the integration of framework objectives into the strategic plans of all ministries and agencies, ensuring consistency in implementation.
- **Example:** Draw inspiration from Finland's national CE strategy, which provides a clear framework for action across various sectors and governmental levels.

3. **Create cross-sectoral task forces for key initiatives. Objective:** To foster collaboration on specific CE initiatives that require multidisciplinary approaches and expertise, ensuring effective implementation and resource utilization.
   - **Task force formation:** Establish task forces for priority areas such as waste management, recycling and upcycling, and digital monitoring and tracing, involving relevant agencies and departments.
   - **Project-based collaboration:** Task forces should work on defined projects with clear goals, timelines, and shared responsibilities.
   - **Example:** Similar to the UK's Waste and Resources Action Programme (WRAP), which brings together stakeholders from various sectors to work on waste reduction and resource efficiency projects.
4. **Leverage digital platforms for coordination and knowledge sharing. Objective:** enhance communication and collaboration among governmental bodies through the use of digital tools, making coordination more efficient and transparent.

   Actions:

   - **Interagency digital platform:** Develop a secure digital platform for real-time information sharing, project management, and collaborative planning among different ministries and agencies.
   - **Knowledge repository:** Create a centralized digital repository of research, best practices, policy documents, and project outcomes accessible to all government stakeholders.
   - **Example:** Utilize platforms similar to the European Commission's Circular Economy Stakeholder Platform, which facilitates knowledge sharing and collaboration among various stakeholders.
5. **Institutionalize regular interagency reviews and feedback mechanisms. Objective:** To establish structured processes for reviewing the progress of sustainability initiatives, facilitating feedback, and making necessary adjustments to ensure alignment and effectiveness.

   Actions:

   - **Annual coordination meetings:** Host annual interagency meetings to review the progress of sustainability and CE initiatives against the national framework's goals and targets.
   - **Feedback and adjustment process:** Implement a formal mechanism for providing feedback and making adjustments to ongoing projects and policies based on collaborative reviews.
   - **Example:** Adopt a practice similar to the Environmental Performance Reviews of the Organisation for Economic Co-operation and Development (OECD), which assess and provide feedback on countries' progress toward environmental goals, adapted for an interagency context within Türkiye.
6. **Strengthen capacity building and cross-training programs within the public sector. Objective:** To ensure that personnel across different agencies and departments have the necessary understanding and skills to contribute effectively to sustainability and CE initiatives.

   Actions:

   - **Interagency training programs:** Develop and implement training programs focused on sustainability principles, CE practices, and collaborative project management for government officials.

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- **Exchange programs:** Facilitate short-term exchanges or secondments among different agencies to foster better understanding and collaboration.
- **Example:** Look to the United Nations' Capacity-building and Training Strategy on Sustainable Development, adapting its principles for interagency capacity building within Türkiye.

Implementing these policy recommendations will require strong leadership and commitment at the highest levels of government, as well as a willingness among all stakeholders to collaborate and align their efforts toward the common goals of sustainability and circular economy. By improving interinstitutional coordination, Türkiye can ensure that its policies and initiatives are more coherent, effective, and aligned with national and international CE and sustainability objectives.

4.7 Fostering Greater Collaboration between Public Stakeholders and the Private Sector

To foster greater collaboration with the private sector, the following policy recommendations are suggested:

1. **Establish a national council for sustainability and circular economy. Objective:** To create a high-level multistakeholder body that oversees and coordinates national efforts toward sustainability and circular economy.

   Actions:

   - **Formation of the council:** Include representatives from key ministries (Environment, Trade, Industry, and Technology), industry leaders, academia, nongovernmental organizations, and civil society to ensure a broad representation of interests and expertise.
   - **Regular meetings and workshops:** Hold bi-monthly meetings to review progress, set strategic directions, and coordinate initiatives across different sectors and regions.
   - **Example:** Similar to Finland's National Commission on Sustainable Development, this council would act as a platform for aligning national strategies with sustainability goals, facilitating cross-sectoral collaboration and innovation.

2. **Develop integrated policy frameworks. Objective:** To harmonize existing policies, regulations, and initiatives that affect sustainability and CE transitions, ensuring they address the real needs of the private sector and that are mutually reinforcing rather than conflicting.

   Actions:

   - **Policy audit and gap analysis:** Conduct a thorough review of all current policies related to sustainability and the circular economy to identify overlaps, gaps, and contradictions.
   - **Creation of an integrated policy document:** Develop a comprehensive policy framework that aligns all relevant policies toward common goals, with clear targets and timelines.
   - **Example:** Draft a National Sustainability and Circular Economy Blueprint, outlining key priorities, sector-specific targets, and the roles of various private and public sector stakeholders in achieving these goals.

3. **Strengthen PPPs. Objective:** To leverage the strengths and resources of both the public and private sectors in driving the transition toward a more sustainable and circular economy.

   Actions:

   - **PPP platform:** Establish a dedicated platform for fostering PPPs, providing information, guidelines, and matchmaking services for public and private entities looking to collaborate on sustainability projects.
   - **Incentive structures:** Design incentives, such as tax breaks, co-financing options, or regulatory fast-tracking, to encourage private sector participation in sustainability initiatives.
   - **Example:** Launch a series of PPP pilot projects in key areas such as waste management, recycling and upcycling, and tracing and monitoring infrastructure, to demonstrate the effectiveness of collaboration and to build momentum for wider adoption.

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4. **Foster enhanced collaboration within private sector: Objective:** Enhance private sector collaboration to embrace opportunities for sustainability and circularity and ensure representation in decision-making.

   Actions:

   - Promote a culture in which all GVC actors should work together including representation from each stage of the chain in which Türkiye participates from raw material suppliers, parts and component producers, and assemblers/manufacturers, to recyclers.
   - At the level of individual sectors, foster the emergence of industrywide alignment and representation of sustainability interests. Chamber of Commerce could potentially play a coordination role.

5. **Enhance coordination and communication channels. Objective:** To improve the flow of information and coordination among government agencies and between the government and private sector entities, to ensure a unified approach to sustainability.

   Actions:

   - **Interagency task forces:** Create task forces focusing on specific aspects of the sustainability and CE transition, involving relevant government agencies and private sector representatives.
   - **Digital collaboration platforms:** Implement digital tools and platforms to facilitate real-time information sharing, project coordination, and stakeholder engagement.
   - **Example:** Develop an online portal dedicated to sustainability initiatives, serving as a central hub for sharing best practices, regulatory updates, and opportunities for collaboration.

6. **Capacity building and training programs. Objective:** To equip public sector employees and private sector leaders with the knowledge and skills necessary to effectively contribute to sustainability and CE efforts.

   Actions:

   - **Training modules:** Develop and deliver training modules on sustainability principles, CE practices, and relevant technologies for public sector employees across different levels and departments.
   - **Leadership programs:** Offer leadership programs for private sector executives, focusing on sustainable business models, CE innovation, and strategic planning for sustainability.
   - **Examples:** Partner with academic institutions and international organizations to offer certified training programs in sustainable development and circular economy for government officials and business leaders. Replicate the concept of the 'Multistakeholder Sustainable Skills Program in The Netherlands'. This Dutch initiative, led by the nonprofit organization 'Learning for Tomorrow' in collaboration with the Ministry of Infrastructure and Water Management and the Goldschmeding Foundation, focuses on identifying skills gaps in industries transitioning to CE strategies and has led to regional projects and educational reforms.

7. **Promote transparency and stakeholder engagement. Objective:** To ensure that the transition toward sustainability and the circular economy is inclusive, transparent, and responsive to the needs of all stakeholders.

   Actions:

   - **Public consultations:** Regularly engage with stakeholders through public consultations, forums, and hearings to gather input on policy developments, challenges, and opportunities.
   - **Performance reporting:** Implement a system for reporting progress on sustainability goals, including challenges faced and lessons learned, to maintain public trust and accountability.

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- **Example:** Establish an annual National Sustainability Forum, bringing together stakeholders from various sectors to discuss progress, share insights, and collaboratively address emerging challenges.

4.8 Longer-term Strategies for Catalyzing a Full Transition

Looking to the longer term, the changing landscape of the circular economy offers a strategic opportunity for Türkiye to fortify its position in the global market and build economic resilience against shocks. By embracing CE principles, Türkiye can transition to more sustainable production processes, reduce waste, and innovate in product lifecycle management. This not only responds to global environmental concerns but also aligns with consumer trends toward sustainability, opening new market opportunities and offering a competitive edge.

4.8.1 Human Capital Development and Awareness Building

Türkiye must invest more in green skills and raise awareness about CE regulations among its workforce, firms, public sector, educational institutions, and households. Education and training programs tailored to the demands of a greener economy will equip Turkish workers with the competencies necessary to thrive in an increasingly sustainability-oriented global market. This investment in human capital is a cornerstone for ensuring that the workforce can not only meet the current demands but also drive future innovations in green technology and sustainable practices. Concrete suggested actions include:

- Raising awareness and understanding of EU regulations among Turkish firms, with a focus on the implications of inaction, such as exclusion from the EU market;
- Developing specialized sustainability skills through education and skills training, incorporating curricula at different educational levels, and enhancing collaboration between the private sector and educational institutions, following modalities suggested in forthcoming World Bank (2024); and
- Creating awareness campaigns and training programs tailored to the current workforce and educational institutions, emphasizing life cycle analysis, sustainable design, and waste management.

4.8.2 Fostering an Innovative Ecosystem

Furthermore, fostering an innovative ecosystem is indispensable for catalyzing R&D, cultivating new business models, and advancing environmental sustainability. This ecosystem should be supported through subsidies and incentives that encourage firms to undertake R&D activities, innovate their business practices, and implement sustainable solutions. Such an ecosystem will not only drive economic growth but also ensure that this growth is aligned with the principles of sustainability, resource efficiency, and environmental stewardship. To foster an innovative ecosystem, Türkiye should

- Support R&D and innovation in new business models and environmental sustainability through subsidies and incentives and
- Strengthen collaboration with EU innovation ecosystems and engage in technology transfer initiatives, including establishing targeted and innovative financial products to support sustainability-focused innovations.

4.8.3 Fostering a National Vision for a Sustainable, Inclusive, and Circular Economy

Through comprehensive and targeted policies, Türkiye is poised to navigate the complexities of modern economic ecosystems, leveraging global trends toward sustainability and innovation to secure its place as a forward-thinking and resilient economy. The evolving regulatory environment presents a significant chance for Türkiye to enhance its position in the GVCs. By taking a proactive approach to meet the EU's requirements, Türkiye can establish itself as an early adopter and capture market share from its competitors. In the textiles and apparel sector, Türkiye can strategically transform itself into a provider of high-quality, sustainable products, leveraging its extensive experience and adaptable production capabilities to set itself apart from global low-cost competitors and maintain competitiveness in the industry. In the automotive sector, Türkiye has the potential to become a fully integrated production hub for eco-friendly vehicles manufactured using advanced sustainable methods.

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Yet, there are important challenges to achieving these objectives, including addressing skill gaps, developing green infrastructure, establishing a recycling ecosystem, and improving access to finance. Nonetheless, any action plans formulated should account for the competitive dynamics of the global industry. Meeting the EU's upcoming regulations too early could lead to unsustainable cost increases for companies, while acting too late may cause Türkiye to miss out on these opportunities. Hence, the timing of this transition must be meticulously planned.

To foster a national vision for a sustainable, inclusive, and circular economy, Türkiye should consider the following suggestions:

- Leverage the changing CE landscape to strengthen its global market position and build resilience against economic shocks by adopting sustainable practices.
- Utilize policy recommendations and best practices from the textiles and apparel sector, such as implementing deposit return schemes for apparel and home textiles to promote recycling and reuse.
- Address skill gaps, develop green infrastructure, establish a recycling ecosystem, and improve access to finance while carefully timing the transition to meet EU regulations without incurring unsustainable costs.
- Brand the country as a sustainable and circular production base. Suggested strategies include the following:
    - Capitalize on the country's global expertise in automotive and apparel-textile production to position Türkiye as a sustainable production hub for the EU. Türkiye should be marketed as a quality and sustainable producer.
    - Hire an international agency to develop the brand, seeking to establish a clear and consistent internal and external message.
    - Host major events and fairs on sustainable production, for example, Sustainable Fashion Week to showcase Turkish success stories.
    - Participate in all major global events (for example, business and academic events) to promote the brand 'Sustainable Türkiye'.

By integrating these detailed strategies and recommendations into its approach, Türkiye can effectively accelerate the light transition and catalyze a full transition toward a sustainable, inclusive circular economy, leveraging its position in GVCs and embracing the opportunities presented by the changing landscape of the circular economy.

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5. Conclusions

The relationship between costs and transformation efforts is not straightforward, primarily due to the diverse nature of industries and sectors within Türkiye's economy. This diversity means that while some sectors can rapidly advance, supported by necessary reforms in monitoring, postconsumer practices, and financing, others, like the automotive industry, may only undergo incremental changes due to external decision-making factors. This necessitates a focus on adaptive innovation in such sectors. Meanwhile, sectors with high aspirations will require an increased focus on skill development and financing.

Government efforts alongside the private sector's dynamism can catalyze transformation, fostering leadership in the circular economy and enhancing competitiveness through innovation-led growth. Government support in reducing fixed costs, ensuring a level playing field for firms of different sizes and GVC tiers, and fostering domestic demand is essential. The resilience and adaptability observed in the Turkish private sector suggest that the market can do the rest.

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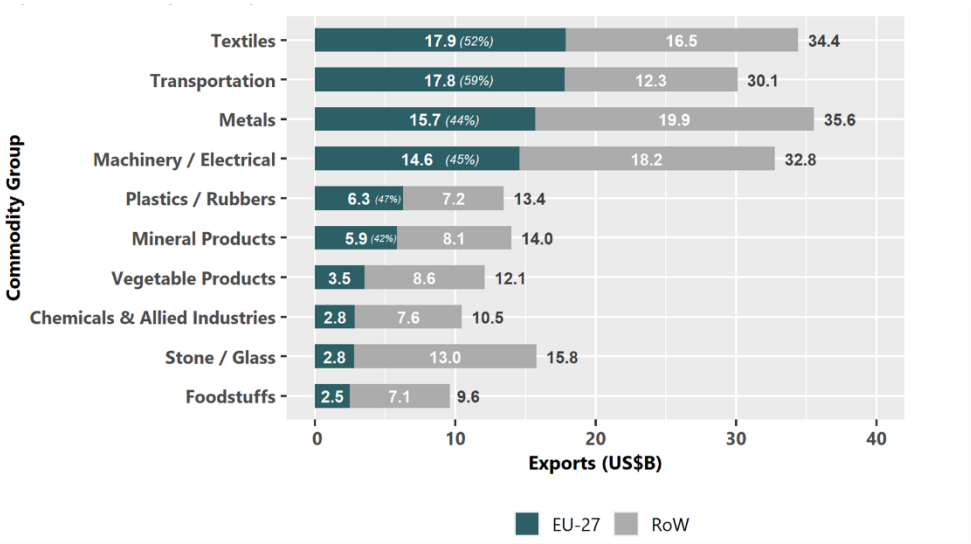
Annex A. Sector Selection

The selection of industries for in-depth analysis is based on three key criteria: relevance of the EU as an export market, the contribution of the sector to the Turkish economy, and the EU's sector prioritization and anticipated depth of EU regulation.[21]

Export relevance: Textiles and apparel and automotive are the most important EU-oriented export sectors with a high dependency on that market. Turkish exports to the EU are dominated by four industries: textiles, transportation, metals, and machinery, which together account for about 70 percent of exports to the EU (compare Figure A.1). Of the four sectors, textiles and transportation are the most dependent on the EU market, which account for 52 percent and 59 percent of exports, respectively. Metals and machinery have a lower dependency on Europe (44 percent and 45 percent, respectively). Disaggregating the two leading industries further, the top two export product categories are vehicles and parts and wearing apparel. These categories have an even higher dependency on the EU market at 65 percent and 61 percent, respectively. Thus, these two sectors not only represent a large share of Türkiye's EU exports but they are also significantly exposed to the EU market.

Figure A.1 Türkiye's exports to the EU-27 as a share of total exports, 2021



Source: UN Comtrade 2023.[22]

In addition, textiles and apparel (textiles and footwear) and automotive (motor vehicles) are Türkiye's manufacturing export sectors with the highest domestic content contribution in value-added terms.[23] This is the result of many input, component, and production activities related to these leading exports being undertaken in the local economy. The high level of domestic content in these two industries occurs for both Türkiye's exports to the world and those to the EU market. Textiles and footwear exports contribute US$22 billion (2019) in domestic content, accounting for 12 percent of domestic value in all Turkish exports to the world (see Figure A.2, panel a). Comparatively, the automotive sector contributes US$14.2 billion (2019), 7.7 percent of total domestic content in exports to the world. In the case of EU-bound exports, these industries again lead in domestic content value, accounting for 12.3 percent and 12.1 percent, respectively (see Figure A.2, panel b). By comparison, the two other leading export sectors—basic metals and electrical equipment contribute, respectively, just 7.4 percent and 3.2 percent of the domestic content in exports to the world and 8.2 percent and 3.5 percent in exports to the EU.

[21] This section draws on the interim report 'Industry Prioritization for Circular Economy Analysis' prepared in March 2023.
[22] UN Comtrade, World Exports and Imports by Reporter and Partner, 2011 - 2021, HS06 (6-digits), http://comtrade.un.org, accessed: January 15, 2023.
[23] Analysis of domestic content in gross exports is based on the OECD Trade in Value Added (TiVA) database (https://www.oecd.org/sti/ind/measuringtradeinvalueadded.htm, accessed March 27, 2023). This dataset aggregates ISIC Rev. 4 classifications of industries and thus there are small differences in the product categories covered.

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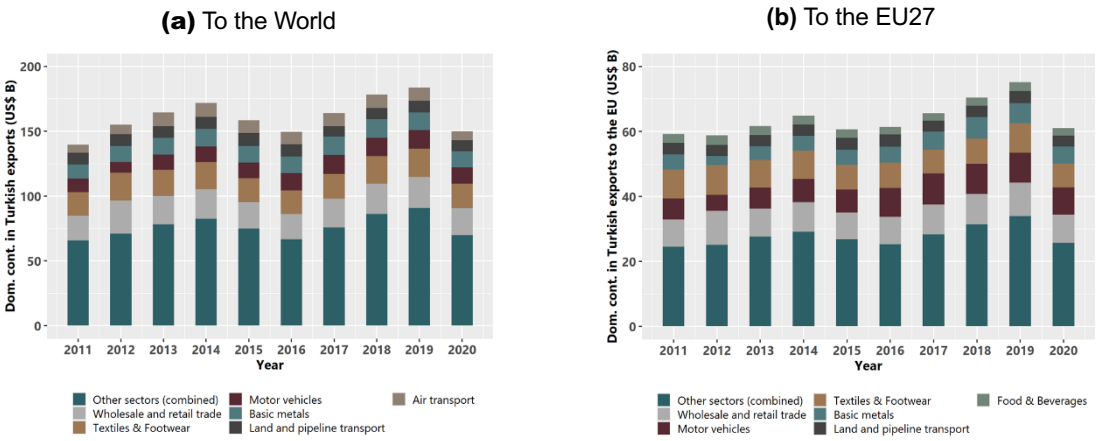
Figure A.2 Domestic content in Türkiye's gross exports, 2011–2020



Sources: OECD 2018. Computation based on Borin and Mancini (2019) and Belotti, Borin and Mancini (2021).

Furthermore, the domestic content as a share of gross exports to the EU is also high; 81 percent of textiles and apparel and 67 percent of automotive export value to the EU can be attributed to domestic content. In other words, over two-thirds of the production value related to these EU-bound exports is occurring within the Turkish economy, rather than relying on imports, and will thus be directly subject to the changing regulations in the EU.

Contribution to the Turkish Economy: Textiles and apparel and automotive are the industries that contribute the most to the GDP and are major employers. Of the four relevant export industries, textiles and apparel is the largest manufacturing employer in Türkiye. In December 2021, it directly employed approximately 1.25 million people (see Table A.1). The textiles and apparel sector is followed by the transportation sector with approximately 550,000 employees. Dominated by the automotive GVC, workers are employed in both parts production and assembly, covering a wide range of skill levels; 35 percent low-skill, 40 percent medium-skill, and 25 percent highly skilled workers with university degrees (ETF 2021). While the number of workers is similar for metals and machinery, employment is distributed among multiple sub-industries, including aluminum, copper, iron and steel, refrigerators, and air conditioners. In terms of their contribution to GDP, the leading sectors are textiles and apparel (6–7 percent), followed by automotive (4 percent), iron and steel (2–3 percent) and machinery (2 percent).

EU prioritization of sectors. Textiles and apparel and automotive are two of the sectors prioritized by the EU with extensive changes anticipated for the near future. The CEAP identified seven sectors that required urgent and comprehensive action to meet the EU's circularity goals: electronics and ICT; batteries and vehicles; packaging; plastics; construction and building; textiles; and food, water, and nutrients. These industries are to be regulated either through the new Eco-design for Sustainable Production Regulation (ESPR) or via independent, industry-specific laws. Two of these industries overlap directly with leading Turkish export sectors to the EU: textiles and footwear, and batteries and vehicles (automotive). Annex B highlights the (planned) regulatory changes in the two sectors. Other end products relevant to Türkiye's export basket to the EU highlighted in the first ESPR work plan include furniture, ceramics, and tires. Exports in these categories, however, are considerably smaller than those in textiles and automotive.

Table A.1 Contribution of key export industries to the Turkish economy (2021)

Export Industries	Direct Employment		Estimated Contribution to GDP (%)
	Number	CAGR (%,11–21)	
Textiles	1,247,153	3.63	6–7
Textiles	514,012	3.33	
Apparel	663,406	4.10	
Transportation	550,000 (c)		4
Automotive Assembly	Estimated 250,000		
Automotive Parts	Estimated 250,000		
Metals	592,046	3.24	

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Export Industries	Direct Employment		Estimated Contribution to GDP (%)
	Number	CAGR (%,11–21)	
Iron and Steel	>100,000		2–3
Machinery/Electrical	543,549	4.54	2

Sources: Taysad (2023); TÜIK (2023).[24]

[24] Taysad, https://www.taysad.org.tr/en/about-us, accessed March 14, 2023; and TÜIK (Turkish Statistical Institute), Paid Employee Statistics (Industry), https://data.tuik.gov.tr/Bulten/DownloadIstatistikselTablo?p=v7tl846ntx1wRD8q1VX2cgZxZw6LvC2s/ wo8XfYZgWrHQrXGQ5KxNwDy1gyR/OxH.

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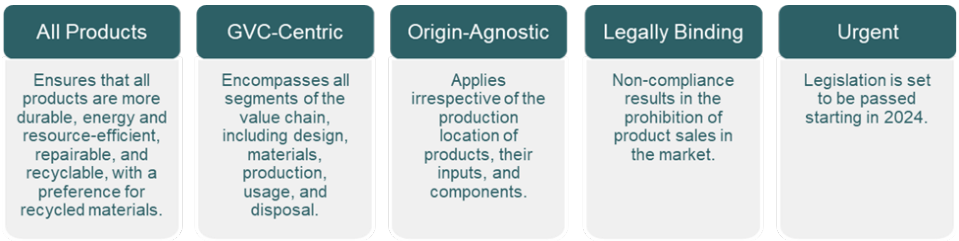
Annex B. EU CE Regulatory Landscape in the Auto and Textiles and Apparel Industry

The EU has increasingly focused on its green and circular economy as a pivotal strategy to reach climate neutrality by 2050. The European Green Deal launched in 2019 aims to extensively legislate the sustainability of all products on the EU market. The EU's focus on the circularity of materials gained significant momentum with the introduction of the European Green Deal. The CE approach is aimed at reducing waste and optimizing material usage. Subsequently, the EU outlined a clear vision, set specific objectives, and started introducing legislation to ensure the widespread adoption of these plans. The new CE policy approach marks a considerable shift from earlier EU efforts; it makes sustainability legally binding, industry focused, inclusive of all stages of GVCs, and global in scope (Figure B.1). At the core of this strategy lies the CEAP, built upon two fundamental principles: comprehensive product coverage and specific regulations (European Commission 2020a). Notably, this marks the world's first attempt to legislate the sustainability of all products within a specific market, with changes required at all stages of the value chain, including product design, choice of materials, production processes, usage, and disposal. The legislation will be rolled out in stages, initially prioritizing product groups with the greatest potential to contribute to the EU's climate objectives.

Textiles and apparel and automotive are priority sectors in the EU CEP. Given the importance of the EU's producers' in the GVCs of these sectors, the impact of the above regulatory changes extends far beyond the EU's borders, affecting especially those economies that like Türkiye import, export, or share important production networks with producers located in the EU countries. Noncompliance entails considerable risks. The EU's highly dispersed production network involves sourcing materials and products globally, necessitating compliance with EU circularity regulations at all stages, affecting global firms and workers. Measures to reduce material use and enhance sustainability will affect countries supplying raw materials and intermediates, necessitating changes in production to meet EU standards. This includes reducing raw material use, energy intensity, and pollution, which may pose significant compliance costs, especially for SMEs, potentially excluding them from the EU market. The EU leverages its central role in GVCs to spread regulatory changes worldwide, encouraging global partners to adopt GVC-centric reforms to align with EU CE goals. The EU's influence is evident in its role in setting global standards, as seen in the adoption of the EUREPGAP standard, leading to the GLOBAL G.A.P standard, which is essential for participation in high-value agricultural GVCs (Fernandez-Stark, Bamber, and Gereffi 2011; 2012). Noncompliance can relegate producers to lower-value markets or force them out of the industry.

Figure B.13 Key characteristics of the EU Green Deal approach to sustainability



Source: Original elaboration.

B.1 Textiles and Apparel

Before the European Green Deal, there were few substantive legal efforts to improve outcomes within the chain, with the system relying on self-governance by brands. Currently, there are just two legal obligations on apparel brands in effect that govern imported apparel. First, the 2011 Textiles Labelling Regulation requires producers to label products with their full-fiber composition, care instructions, and country of origin (European Parliament, Council of the EU 2011). Second, the EU REACH[25] legislation on chemicals requires producers to comply with consumer safety requirements in apparel products and trim, restricting the use of certain hazardous products (European Chemicals Agency 2007). These are complemented by the end-of-life Waste Framework Directive (Rev. 2008),

[25] REACH = Registration, Evaluation, Authorization, and Restriction of Chemicals.

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which requires member states to set up schemes for the separate collection of textiles by 2025. As a directive, its implementation has varied across the region and it has not necessarily helped reduce waste; much of the EU's used textiles have been shipped abroad (European Environment Agency 2023). The remaining initiatives are largely voluntary, such as the EU Ecolabel Regulation voluntary standards (launched 1992) which aims to encourage consumers and producers alike to choose products with a lower environmental footprint. Sustainability controls within the supply chain have been largely left to private sector initiatives governing the consumer-brand relationship.

The CEAP and the Sustainable Products Initiative—together with the European Green Deal—mark an important watershed moment for the EU's approach to sustainability in the textiles and apparel industry (European Commission 2020a). The core principles for sustainability in the sector are outlined in the EU Strategy for Sustainable and Circular Textiles, highlighting that products sold on the EU market must be long-lasting, reparable, reusable, recyclable, and—importantly—made with recycled fibers or those with a lower environmental footprint (European Commission 2022c). Furthermore, it explicitly singles out that products must be free from hazardous substances, avoid microplastic pollution, and be produced without adverse environmental impact. Finally, it places greater emphasis on end-of-life management, introducing new EPRs to make brands not only responsible for their supply chain operations but also financially liable for clothes recycling and banning destruction of unsold goods. This information must be easily available to consumers and regulators alike, through a DPP for each item.

Legislative initiatives are already under way to make these principles legally enforceable requirements. Under the ESPR framework which aims to ensure sustainable products by 2030, textiles and apparel is a prioritized sector and its Delegated Act (DA) is expected as early as 2025. The DA will provide detailed legal requirements for sustainability performance and disclosure and a specific timeline for implementation. In addition, several parallel efforts aim to align existing legislation with the EU strategy on sustainable textiles and ensure requirements are ushered in sooner rather than later. The anticipated changes from these legislative efforts are detailed in Table B.1. Importantly, these encompass all stages of the industry's GVC.

- **Design and production development:** Expected requirements of the DA include altering goods from their inception, establishing criteria for durability, repairability, recyclability, and fiber content at the design stage.
- **Raw Materials and Sourcing:** The DA is expected to shift the demand for textile inputs to more sustainable and recycled options. This will be reinforced by revisions to two existing Regulations—Textiles Labelling Regulation (expected 2024), and EU Ecolabel Revision (expected 2024)—eventually requiring mandatory labelling of circular and sustainable fibers. Certification will be legally required for all products labeled as environmentally friendly (for example, 'green', 'climate friendly', 'sustainable') to eliminate the potential for greenwashing (Fierens, Gillet, and Sterneberg 2022).
- **Production Processes:** The EU Ecolabel Revision, along with a revision of the EU REACH Regulation, will effectively ban the use of hazardous chemicals in textiles (European Commission 2023a). At the same time, the DA is expected to require firms to reduce their environmental footprint in both textiles and apparel production stages (European Parliament 2023a). This includes decarbonization and minimal use of water and chemicals.
- **Usage:** A new legislative proposal on microplastics release while using a product aims to reduce the ongoing impacts of the product after sale.
- **End-of-life/Recycling:** Four key changes are expected to reduce the amount of textiles and apparel products that end up in landfills around the world: (1) a ban on the destruction of unsold clothes introduced by the ESPR; (2) the Waste Framework Directive is expected to extend producer responsibility to apparel producers, and the DA is expected to determine harmonized rules for EPR fee modulation based on the quantity and circularity level of products sold on the EU market; (3) the revision to the Waste Framework Directive will require minimum levels of textile recycling, beginning in 2025, across the EU; and (4) the waste shipment regulation aims to prevent textile waste from being shipped and destroyed abroad.
- **Traceability:** Producers will be required to make information regarding all previously mentioned measures easily available to regulators and consumers alike, through the DPP requirements being proposed in the ESPR. The EU's Collaborative Initiative for Standards-

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based Digital Product Passport (CIRPASS) is working on a DPP for the textiles and apparel industry, in addition to electronics and batteries. Its recommendations for information disclosure were already included in the Battery Regulation that came into force in May 2023. The DPP for batteries thus should be considered indicative of its recommendations for apparel.

Table B.1: Key circular economy-related EU legislation affecting the textiles and apparel GVC

Value Chain Stage	Responsibility	Eco-design for Sustainable Products	Other Legislative Initiatives
Design and Product Development: The EU aims to ensure products are designed and developed to be durable, reliable, reparable, and recyclable and contain high amounts of recycled materials and have lower material requirements.	Brands	New design requirements for textiles, making them longer lasting and easier to repair and recycle	
Raw Materials and Sourcing: The EU aims to encourage consumers to opt for more sustainable apparel materials, by increasing information availability for each type of product.	Brands (power), apparel manufacturer (implementor), textiles manufacturer (implementor)	Mandatory minimums for the inclusion of recycled fibers in textiles; measures will include reducing emissions, water, and energy intensity in textiles production. Apparel must be free of hazardous substances. Encourages use of more sustainable and natural textiles.	Revision of Textiles Labelling Regulation (2024): Mandatory disclosure of circularity and sustainability parameters based on requirements under the proposed Regulation on eco-design for sustainable products Revision of the EU Ecolabel Regulation criteria for textiles (2024) will revise current ecolabel requirements, and the anticipated Green Claims directive will require scientific evidence to substantiate claims of marketing a product as 'sustainable', in an effort to eliminate greenwashing.
Production Processes: The EU aims to reduce the environmental impacts of apparel production.	Brand (power), apparel manufacturer (implementor)	Measures will target manufacturing processes, prewashing at industrial manufacturing plants, labelling, and the promotion of innovative materials. Key goals will be lower carbon footprint (renewable energy), reduced energy and water-intensive production, avoiding of the use and release of harmful substances.	Revision of REACH Regulation and Chemicals Strategy on Sustainability (2024): Restriction of hazardous chemicals in the materials. Ban the most harmful chemicals in consumer products, allowing those chemicals only where their use is essential. **Industrial Emissions Directive** details best available techniques on textiles and sets the framework for products' environmental footprint.
Usage: The EU aims to reduce the overall environmental impact of textiles and apparel products in use as well as decrease overall consumption of these productions.	Brand	Apparel must be longer lasting and easier to repair.	A legislative proposal on reducing the release of microplastics into the environment will also include measures on microplastics in textiles and apparel.

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Value Chain Stage	Responsibility	Eco-design for Sustainable Products	Other Legislative Initiatives
End of Life: The EU aims to reduce total textile/apparel waste that is destroyed or destined to landfills, either within the EU or abroad.	Brands (implementor)	Ban the destruction of unsold products under certain conditions, including unsold or returned textiles. The ban will be effective as of 19 July 2026, yet a derogation has been introduced for small and micro enterprises allowing for a transition period until 19 July 2030. EPR: apparel companies will be responsible to pay a fee for textiles waste produced based on the quantity and circularity level (eco-modulation) of products placed on the market.	Waste Framework Revision (2023): to improve circularity of textile waste: increase the collection, sorting, and recycling of textile wastes by 2025. With this directive, it is aimed to recycle 55% of household waste, including textile products, in 2025, 60% in 2030, and 65% in 2035. Revision of the waste shipment regulation will address shipments of problematic waste outside the EU. The Commission will meanwhile work on developing criteria for distinguishing waste from second-hand textile products, to avoid waste from being falsely declared as used goods for export and ending up in landfill in the destination countries. **Industrial Emission Directive** lays out rules to regulate pollution from industrial installations including textiles and waste management facilities.
Traceability: The EU aims to require brands to increase the transparency of their products, disclosing central circularity parameters of all stages of the value chain, to both regulators and consumers.	Brands, apparel manufacturers	DPP based on mandatory information requirements on circularity and other key environmental aspects. Examples of information requirements that might be included in the DPP are master data such as product, manufacturer, composition, substances of concern, toxicity, sourcing; new data such as use, modification, maintenance, disassembly possibilities; and voluntary product information such as recycled content and product or carbon footprints in complex supply chains.	

Sources: CBI (2021); European Commission (2020b, 2022b, 2022c, 2022e, 2023b, 2023c); European Parliament (2024). https://www.europarl.europa.eu/legislativetrain/themeaeuropeangreendeal/filerevisionoftheindustrialemissionsdirective(refit); McKinsey (2019); OECD (2016); Water Europe (2021), Green Claims Directive: https://environment.ec.europa.eu/topics/circular-economy/green-claims_en.

Note: Anticipated changes under the ESPR are based on the Joint Research Commission's draft report and the EU Sustainable and Circular Textiles Strategy, both of which can be seen as signaling the intended direction of the legislation (European Commission 2022c; Joint Research Center of the European Commission 2023). These details are subject to further debate during the development of the DAs for each product category.

The intention to revise the EU Ecolabel criteria for textiles and apparel in 2024 was stated in the EU Sustainable and Circular Textiles Strategy (European Commission 2022c).

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B.2 Automotive industry

Due to the considerable environmental footprint of the industry and the EU's existing commitments to regulate the industry, it is not surprising that the automotive sector has been one of the key industries to already see significant legislative initiatives. A pioneering legislation was the End-of-Life Vehicle Directive introduced in 2000 along with the Extended Producer Responsibility Directive (European Parliament, Council of the EU 2000). It assigned manufacturers the responsibility to collect, treat, and recover vehicles at the end of their useful life. It was the first legislation to target upstream design by encouraging the use of more recyclable and recycled materials and banned the use of certain hazardous chemicals, including mercury. Since 2015, all member states have been required to recycle 95 percent of the weight of vehicles (Eurostat 2023a). While shortcomings have been recognized, it is considered to have been highly effective in driving change (European Commission 2021); in 2021, 96 percent of ELV weight was recovered across the region.

The CEAP and the Sustainable Products Initiative (along with the European Green Deal) seek to consolidate these gains and target value chain stages not previously regulated, including design and production, as well as eliminate sales of emission producing vehicles by 2035. The anticipated changes from these legislative efforts, detailed in Table B.2, encompass all stages of the GVC.

- **Design:** The anticipated ELV revision is expected to raise not only recycled content requirements (specifically in plastics) but also design for recyclability. Expected changes from the ESPR will also require improved durability and resistance of tire design to reduce microplastic release during usage.
- **Raw Materials and Sourcing:** Sustainable sourcing, in addition to the use of secondary materials, is expected to be required in tires as well as intermediate products (iron and steel, aluminum, and glass goods) under the ESPR. The Battery Regulation already stipulates minimum use of secondary materials by 2031. In addition, for EV batteries, hazardous materials use will be regulated. Furthermore, the ELV revision proposal under debate includes minimal requirements for closed-loop recycling of plastics. Certain iron, steel, and aluminum products used in the automotive industry are also within the scope of the carbon border adjustment mechanism, and will face gradually increasing carbon costs upon import into the EU from 2026 onward. Under the EU Deforestation Regulation, as of December 2024, tires that enter the EU market will need to be accompanied by a due diligence statement confirming that the rubber used in tire production has not been a cause of deforestation in the sourcing country.[26] Overall, the introduction of minimum requirements for secondary materials aims to generate economic incentives for recycling by creating a market for recycled materials.
- **Production Processes:** Regulatory efforts in this stage of the chain aim to reduce environmental impacts during manufacturing. The Battery Regulation requires full disclosure of carbon footprint by February 2025 for EV batteries, with maximum carbon footprint allowances established by 2028. Under the ESPR, the production of tires and intermediates will likely be affected by maximum emissions, energy, and water use requirements.
- **Usage:** Reducing the impact of usage is the primary focus of EU regulatory changes. The Fit for 55 legislation (signed in March 2023) prohibits the sale of emission-emitting vehicles completely by 2035, with the exception of e-fuel vehicles. Euro 7 emissions legislation, as well as the revisions to the roadworthiness package, will require reductions in individual car emissions. Producers should expect it to be increasingly difficult for internal combustion engine (ICE) vehicles to meet the emissions standards. Combined, these initiatives essentially mandate a shift to low and zero-emissions vehicle production over the next decade.
- **End-of-Life:** The Battery Regulation already prohibits the disposal of batteries, requiring their recycling and imposing high (90 percent) recovery rates from 2027 onward. The

[26] While the EUDR will not apply to vehicle imports into the EU market, automotive brands may still ask for EUDR compliant tires as part of their sustainability policies.

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upcoming End-of-Life Directive revision is anticipated to require design for the easier dismantling of cars and reuse of components.

- **Traceability:** Finally, producers will be required to make information regarding sustainable product compliance easily available to regulators and consumers alike, through the DPP requirements. This has already been implemented in the Battery Regulation which requires QR codes to be visible on all batteries for DPP from 2027 onward.

Table B.2: Key circular economy-related EU legislation affecting the automotive GVC

Value Chain Stage	Responsibility	Eco-design for Sustainable Products (anticipated 2024)	Other Legislative Initiatives
Design and Product Development: The EU aims to ensure products are designed and developed to be durable, reliable, reparable, recyclable and contain high amounts of recycled materials and have lower material requirements.	Original equipment manufacturer (OEM)	New design requirements for tires will reduce release allowances of microplastics, introduce minimum recycled content requirements, introduce design for recyclability requirement, and require design to allow for retreading. Automotive textiles will likely be covered by the textiles DA, requiring design for durability and minimum content of recycled materials. Intermediate products such as iron and steel, aluminum, glass, and plastics will likely have to be designed for recycling, affecting alloys and polymers that can be produced.	Battery Regulation (2023): Requires durability requirements by 2025 and minimum recycled content by 2031. Circular Vehicle Design and End-of-Life Vehicles Regulation (2023 Revision of End-of-Life Directive): Anticipated to establish mandatory recycled content requirements, particularly for plastics, and provide more detailed provisions to support the design for dismantling and recycling.
Raw Materials and Sourcing: The EU aims to encourage consumers to opt for more sustainable materials, by increasing information availability for each type of product.	OEM, intermediates and final goods manufacturers	New requirements for tires will likely include certification for sustainable sourcing that does not result in deforestation; increased use of recycled content. Intermediate products such as iron and steel, aluminum, glass and plastics will all likely be required to have a minimum recycled content; certification of sustainable sourcing.	Circular Vehicle Design and End-of-Life Vehicles Regulation (2023 Revision End-of-Life Directive): Anticipated to establish mandatory recycled content requirements, as well as promote the reuse and remanufacture of components. EU Deforestation Regulation: As of 30 December 2024, tires that enter the EU market will need to be accompanied by a due diligence statement confirming that the rubber used in tire production has not been a cause of deforestation in the sourcing country.

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Value Chain Stage	Responsibility	Eco-design for Sustainable Products (anticipated 2024)	Other Legislative Initiatives
Production Processes: The EU aims to reduce the environmental impacts of automotive production.	OEM, parts and components manufacturers	Measures for tires will likely require maximum use of water per unit; maximum greenhouse gas emissions per unit. Intermediate products such as iron and steel, aluminum, glass, and plastics will all likely be required to have a minimum greenhouse gas emissions requirement, maximum use of water, minimum requirement of low-carbon energy source in production, and energy efficiency requirements.	Battery Regulation (2023): Carbon Footprint Declaration for EV batteries (2025), maximum lifecycle carbon footprint for EV batteries (2028). Revision of REACH Regulation and Chemicals Strategy on Sustainability (2024): Restriction of hazardous chemicals in the materials; ban the most harmful chemicals in consumer products. Carbon Border Adjustment Mechanism (2023): This aims to level the playing field for EU producers who are subject to carbon pricing under the EU Emission Trading System. Initially, EU-bound exports of intermediate products such as iron and steel or aluminum are covered, while vehicles are outside the scope of the transitional regime.
Usage: The EU aims to reduce the overall environmental impact of automotive use as well as increase shared transportation use.	OEMs, tire manufacturers, raw materials suppliers	Tires must be longer lasting with a minimum of rolling resistance. Tires must also be repairable through retreading. Intermediate products such as iron and steel, aluminum, glass, and plastics will likely have to be designed for durability and repairability.	Fit for 55 (2023): Bans the sale of new ICE vehicles from 2035 unless they use e-fuels; promotes the transition to cars powered by renewable energy, including electric and hydrogen-based vehicles. This was incorporated into Regulation 2023/851 which requires 100% reduction in fleetwide emissions by 2035. Euro 7 legislative proposal (2023): Further reduces emissions potential for ICE vehicles. Also covers the reduction of the release of microplastics into the environment from tires and pollution from brakes (specific requirements anticipated end of 2024). Roadworthiness Package Revision (2023): Proposals include adjusting testing mechanisms to prevent tampering and ensure ongoing compliances on emissions requirements.

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Value Chain Stage	Responsibility	Eco-design for Sustainable Products (anticipated 2024)	Other Legislative Initiatives
End of Life: The EU aims to reduce total automotive waste that is destroyed or destined to landfills, either within the EU or abroad.	OEMs		Batteries Regulation (2023): Prohibits batteries from being disposed of; must be recycled in accredited centers. Circular Vehicle Design and End-of-Life Vehicles Regulation (2023 Revision End-of-Life Directive): Aims to reduce the overall environmental footprint of the production and dismantling of cars. Revision of the waste shipment regulation will address shipments of waste outside the EU, with reference to the Industrial Emission Directive which details requirements for environmentally sound treatment of waste.
Traceability: The EU aims to require brands to increase the transparency of their products, disclosing central circularity parameters of all stages of the value chain, to both regulators and consumers.	Parts and components producers	DPP based on mandatory information requirements on circularity and other key environmental aspects. Examples of information requirements that might be included in the DPP are master data such as product, manufacturer, composition, substances of concern, toxicity, sourcing; new data such as use, modification, maintenance, disassembly possibilities; and voluntary product information such as recycled content and product or carbon footprints in complex supply chains.	Battery Regulation (2023): Batteries must come with documentation reporting the amount of elements from secondary raw materials; information and activities related to repair, reuse, and dismantling; and treatment, recycling, and recovery methods the battery can undergo at the end of its life.

Sources: European Commission (2020a, 2022a, 2022d, 2022f, 2023a, 2023c); European Parliament (2022, 2023b), EU Deforestation regulation: https://environment.ec.europa.eu/topics/forests/deforestation/regulation-deforestation-free-products_en.

Note: Anticipated requirements for the tires ESPR are based on the measures suggested by the Joint Research Center for potential changes to improve the sustainability of the product and reviewed in the context of the Battery Regulation 2023 which provides similar provisions for batteries. The specific requirements remain subject to debate during the formulation of the DAs for each product category.

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Annex C. The Textiles and Apparel and Automotive Machinery and Equipment Industries in Türkiye

C.1 Industry Overview

The textiles and apparel and automotive sectors operate within different dynamics on a global scale. The textiles and apparel sector is characterized by its labor-intensive nature, high flexibility, and quick response to fashion trends, with a dominance of the 'fast fashion' supply chain model. On the other hand, the automotive sector emphasizes large-scale production, technology, longer product cycles, and long-term investments, including in R&D. In recent years, this industry is experiencing a significant shift toward EVs. This move is reshaping the automotive sector and the very nature of the supply chain, by integrating new technologies and components such as batteries and electric powertrains which require new manufacturing techniques and the creation of novel supply chains that include stakeholders from the electronics and battery domains. This shift can open new opportunities and create new challenges for incumbents, including Türkiye's manufacturers. As EVs rely more on sophisticated electronics and software, digital skills are becoming more crucial than traditional mechanical expertise. Furthermore, the simpler mechanics of EVs, with fewer moving parts than their combustion engine counterparts, are lowering the barriers to entry, allowing new companies with expertise in these non-traditional areas to challenge established automotive giants.

Currently, the value chain structures of the two industries post both—some differences and some similarities. The apparel-textile value chain is more fragmented and buyer-driven, while the automotive value chain is more consolidated, with few large automakers and suppliers dominating the industry and engaging in long-term relationships. Both industries, however, are characterized by significant power asymmetries between suppliers and global buyers. Türkiye's position in the apparel-textile and automotive value chains is affected by these global features, and hence it too reveals both similarities and differences in how the country engages within them:

Similarities

- **Global value chain participation:** Türkiye is actively involved in various stages of both the apparel-textile and automotive GVCs, from raw material production and component manufacturing to final product assembly and branding.
- **Supplier network:** In the automotive sector, Türkiye has a robust cluster of approximately 1,000 parts and components suppliers, including global Tier 1 suppliers and domestic firms. These suppliers produce a wide variety of products and serve multiple markets. This network's sophistication is somewhat mirrored in the textiles and apparel sector, where a variety of suppliers cater to different market segments.
- **Upgrading and innovation:** In both sectors, Turkish firms have engaged in extensive upgrading to meet the evolving demands of their markets. This includes product, process, and functional upgrading, such as developing new products, improving production processes, and taking on design and R&D activities. But there are nuances in the way the two industries innovate and upgrade (discussed below under 'Drive for innovation').
- **EU market dependency:** Both sectors are heavily reliant on the EU as a key market, with a significant portion of exports from Türkiye in both the textile-apparel and automotive sectors destined for EU countries. Hence, in both industries, compliance with EU regulations and environmental and sustainability standards is crucial for maintaining competitiveness in the EU market. The automotive sector is particularly affected by the European Green Deal, which necessitates fundamental changes in vehicle production and operation imminently.

Differences

- **Economic contribution:** While both sectors are key to Türkiye's economy, their contributions differ in scale and nature. The textile-apparel sector is a significant employer, especially in underdeveloped regions, and is a major contributor to the GDP. The automotive sector, with its higher value addition, is the largest generator of foreign revenue and has a more substantial impact on R&D and technology transfer.

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- **Global value chain position and competitive advantage:** Türkiye has established a leading position in the automotive GVC, integrating extensively into the European regional production network as a key supplier of both parts and final vehicles. Its competitive advantage lies in large-scale production capabilities, extensive supplier networks, and advanced R&D activities. This contrasts with the textiles and apparel sector, where Türkiye's competitive advantage is based on its vertical integration, quality, and flexibility, especially in small production runs.
- **Drive for innovation:** Turkish automotive suppliers and assemblers engage in significant R&D activities, with many companies establishing design and R&D centers. This focus on innovation and technological development is comparable to the R&D efforts seen in the textiles and apparel sector. The drive to innovate, however, is different. R&D and innovation initiatives appear more transformational in the textiles and apparel industry than in the automotive machinery and equipment industry. This is possibly explained by industry organization differences: the apparel industry is characterized by price sensitivity and transactional relationships, leading to heightened risks to respond to market changes and hence a bigger drive to proactive innovation. In contrast, the automotive industry's technology-driven platforms and a more capital-intensive nature support more stable long-term supplier relationships, suggesting that a strategy of reactive and adaptive transformation might be preferred.

In summary, while both industries are integral to Türkiye's economy, they differ in their specific challenges and advancements. In alignment with global trends, the Turkish automotive sector is heavily influenced by the shift toward EVs and stringent EU regulations, while the textiles and apparel industry's focus on sustainability is also driven by market demands, search for profit margins, and as a response to the challenges of having to deal with very fast-changing fashion trends.

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C.2 Initiatives, Challenges, and Opportunities in the Two-Focus Sectors: Evidence from Field Interviews and Desk Research

Stakeholders' interviews, held between May and September 2023, confirmed the above insights and provided specific, concrete examples of the challenges and opportunities faced by operators. The four main insights: *First,* the ongoing CE transformation initiatives in Türkiye are mostly consistent with a 'light transition' approach. The interviews confirmed Türkiye's robust capabilities and competitive advantage in both the automotive and textile-apparel sectors, driven by their integration within the EU and global production system, flexibility, and rapid market response. *Second,* the high degree of interdependence with the EU production system creates a need to adapt to EU regulatory shifts, which brings challenges but also important opportunities for industry upgrading and source of competitive advantages, given the EU's regulatory changes and the global trajectory of these industries. In particular, stakeholders view the country's proximity to the EU as a source of important benefits in terms of reduced transportation emissions, compared to non-EU peers. *Third*, there are varying levels of awareness and readiness across different tiers of the supply chain. Larger firms and first-tier suppliers show high awareness and adaptability, but understanding diminishes across the supply chain tiers, especially among SMEs. On the other hand, challenges increase across tiers. Key constraints hindering the green transition, according to stakeholders, reflect those highlighted by the desk analysis. The most frequent complaints include regulatory uncertainties, technological challenges, and financial limitations. The need for enhanced industry collaboration, skills development, and innovative solutions was also strongly emphasized by most local stakeholders, along with the necessity for strategic regulatory harmonization to support Türkiye's competitive edge in the global market. *Finally*, differences in key constraints across sectors also emerged. Stakeholders in the apparel sector indicated that they face technological challenges, especially in meeting quality and sustainability requirements, while the automotive sector identified as a key priority the need for more technology transfer, especially in electrification. Below we provide more specific examples of both the most notable CE initiatives in the two focus sectors, as well as the perceived challenges and opportunities:

C.2.1 Textiles and Apparel

Broadly speaking, Turkish firms in the textiles and apparel sector have upgraded their processes and expanded their fabric production to support ready-to-wear apparel lines. As a result, textile firms in Türkiye today not only produce apparel but also branded, technical, and specialty textiles for the automotive, industrial, and packaging sectors. They have upgraded their production to include a wide variety of options, shifting from primarily cotton products to include manmade fibers. They have also invested in cutting-edge automated production, such as fully integrated robotic dispensing machines, and R&D for sustainable innovation, particularly in smart textiles. Innovation in the textiles and apparel sector is concentrated in areas such as less water-intensive dyeing processes, recycling, and collaboration under Horizon Europe.

Notable initiatives:

- **Recycled pre-consumer textiles:** Turkish textile manufacturers are increasingly incorporating recycled content into their products. The proportion of recycled content varies from 10 percent to 50 percent, with cotton textiles predominantly using pre-consumer waste generated during production. This recycling initiative responds to the growing demand for sustainable products, with brands willing to pay a premium for recycled content.
- **Recycled polyester textiles:** In the synthetics segment, manufacturers are producing recycled polyester textiles from industrial waste and imported recycled PET pellets made from recycled plastic bottles. More recently, some companies have also started to produce yarn from postconsumer recycled textiles in Türkiye.
- **Closed-loop recycling initiatives:** There are limited activities in closed-loop recycling for European niche brands, such as GAMA, where postconsumer items are sourced from abroad as cut-up textile products that can no longer be used.
- **Waterless recycling initiatives:** A leading manufacturer of synthetic textiles is focusing on sustainability with initiatives like waterless dope-dyeing methodologies and a facility to produce recycled polyester chips from PET bottles using renewable energy and zero

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freshwater. This plant will help meet the demand for recycled raw materials in the textile and food sectors.

- **Advanced textile recycling:** A major textile producer in Türkiye has developed a green-tech venture that transforms postconsumer cotton, polyester, and polycotton waste into high-quality recycled raw materials. This technology can potentially help reusing half of the currently unusable textile waste and, in so doing, provide sustainable materials for the textile, automotive, and bedding industries.
- **Carbon emissions reduction and renewable energy:** Tier 1 firms in Türkiye have made significant strides in reducing carbon emissions by adopting renewable energy sources, particularly solar power. This shift has been accelerated due to rising energy costs and supportive licensing policies.
- **Water management and treatment:** There is an increased focus on water management, including the reuse and treatment of wastewater, especially in the textile sector in Bursa. One-third of wastewater undergoes treatment before release, partly in response to upcoming national legislation on wastewater management.
- **Sustainability performance tracking and digitalization:** Tier 1 firms have established sustainability departments and developed robust digitalization and information systems to demonstrate compliance with sustainability metrics. This includes participation in certification programs like the Higgs Index, SEDEX, and Join Life.

Perceived Opportunities:

- **Innovation in sustainable materials:** The shift toward CE emphasizes the development and use of sustainable materials, which, according to stakeholders, presents important opportunities for local innovation in recycled and ecofriendly fibers, fabrics, and textiles.
- **Enhanced brand value and market diversification:** Adopting CE practices can enhance a brand's value by aligning with the growing consumer demand for environmentally responsible and ethically produced goods. By integrating CE principles, forward-looking Turkish companies can differentiate themselves in a competitive market, offering products with a lower environmental footprint and appealing to eco-conscious consumers.
- **Extended product lifecycle:** Since CE encourages the design of apparel with longer lifecycles, promoting durability and quality, Turkish producers hope that this can lead to reduced waste (and hence lower costs of production) and increased customer loyalty.
- **Greater recycling and upcycling opportunities:** The transition to CE is viewed as opening up opportunities for recycling and upcycling initiatives, where postconsumer and postindustrial textile waste is transformed into new products, reducing waste and tapping into new market segments.
- **Regulatory compliance as source of competitive advantage:** According to some of the interviewees, staying ahead in compliance with evolving EU and global sustainability regulations can provide their businesses a competitive advantage, avoiding important potential market barriers and aligning the growing industrywide sustainability goals.

In summary, a relatively positive outlook emerged from the analysis and fieldwork. Despite the need for significant changes to meet new EU sustainability regulations, Türkiye has a critical opportunity to solidify its stance in the textiles and apparel GVC by shifting toward high-quality, sustainable production. As traditional cost-driven competition intensifies, Türkiye's future in the textiles and apparel sector appears uncertain, with limited prospects for redirecting its premium output to alternative markets. To maintain its global leadership, Türkiye must pivot toward supplying sustainable, high-end products, capitalizing on its rich experience and adaptable manufacturing capabilities. This strategic shift toward sustainability aligns with the EU's green transition as well as with the broader global shift toward sustainable and ethical fashion. It offers Türkiye a chance to distinguish itself from competitors and cater to niche, eco-conscious brands. Türkiye can enhance its sector by focusing on four key strategies:

- Target niche brands prioritizing sustainability, leveraging Türkiye's strength in producing diverse, low-volume orders efficiently, thus minimizing inventory burdens for these brands.

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- Implement process upgrades to boost environmental efficiency in textiles and apparel manufacturing, extending beyond energy, water, and chemical savings to include comprehensive documentation of these improvements, especially among SMEs.
- Become a hub for sustainable postconsumer recycled textile production, positioning Türkiye as a pioneer in supplying recycled materials to the European and global markets and supporting the growth of a new industry in response to the rising demand for closed-loop textiles.
- Develop and promote sustainable Turkish brands within the EU, utilizing Türkiye's design prowess and proximity to the EU, combined with ecommerce, to offer direct-to consumer sustainable products.

Perceived Challenges

However, there are some significant hurdles to be addressed despite Turkish firms being reliable EU suppliers for decades. These challenges include regulatory uncertainties, overwhelming informational demands from EU buyers, a scarcity of skilled personnel, technological hurdles, an underdeveloped recycling system, infrastructural deficits, and financial constraints, all compounded by a lack of coordinated action across the supply chain.

- Challenges preventing strengthening innovation and product/process upgrading in new sustainable materials:
    - **Technological limitations:** Certain sustainability goals, such as high recycled content and durable yet sustainable products, are technically challenging due to the nascent state of relevant technologies. This is particularly critical in areas such as recycled content, quality, and durability specifications; the recycling of postconsumer waste; and enhancements in sustainability throughout the dyeing process:
        - **Recycled content versus durability:** The drive toward 100 percent recycled or sustainable content by 2030, alongside enhanced product durability, faces a fundamental conflict. Virgin fibers, known for their quality and longevity, outperform recycled fibers, which often suffer from diminished quality and durability. This discrepancy hampers the reconciliation of sustainability with product longevity. For example, the mechanical recycling of cotton results in shorter fibers over time, leading to a degraded end product. This necessitates significant R&D in recycling and weaving technologies to overcome these limitations.
        - **Recycling of postconsumer waste:** The ambitious EU recycling targets for postconsumer textiles (55 percent by 2025 and 60 percent by 2030) face hurdles due to the need for pure and consistent inputs for quality recycled fibers. Many garments, especially those made from textile blends or lacking proper labelling, are not designed with recycling in mind, making their recycling challenging. This is particularly true for synthetic fibers like polyester, where the depolymerization process demands uncontaminated inputs. While new technologies for pure textile recycling are being explored and some progress has been made, commercial adoption is still in its early stages.
        - **Sustainability in dyeing process:** The Eco-design for Sustainable Products Regulation targets the reduction of water and chemical use, with the dyeing process being a significant contributor to global water pollution. Current waterless dyeing technologies, mainly applicable to synthetics, do not address the needs of cotton, which is a major export for some countries. The development of sustainable dyeing methods for cotton requires more research and collaboration with research institutions. Some innovative approaches, such as using printing techniques instead of traditional dyeing, are being explored but have yet to reach commercialization.
    - **Recycling system deficiencies:** Türkiye's inadequate postconsumer textile recycling infrastructure restricts the supply of recyclable materials, hindering the ability to meet

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demands for recycled content. This in turn limits firms' ability to create sustainable products. The key deficiencies in Türkiye's postconsumer textile recycling system include

- **Limited collection:** Less than 10 percent of postconsumer textiles are collected for recycling, hindered by low public awareness, insufficient incentives for recycling, and few collection points;
- **Low industry engagement:** Few firms invest in textile recycling due to high technology costs, estimated at over US$100 million for some, and uncertain market demand that fluctuates with the price of virgin materials;
- **Market dynamics:** The demand for recycled textiles is influenced by the cost of virgin materials; interest in recycled content declines when virgin prices are low, often due to subsidies; and
- **Regulatory and infrastructure gaps:** Ecolabelling regulations allow firms to meet recycled content thresholds with easier-to-process pre-consumer waste, reducing the focus on more challenging postconsumer waste. Additionally, the underdeveloped recycling infrastructure, particularly in bottle recycling, limits the availability of inputs for recycled polyester, forcing reliance on imports for recycled PET chips.

- Challenges in enhancing brand value and market diversification, including new collaborations and partnerships for targeting niche brands prioritizing sustainability:
  - **Coordination shortfalls:** Insufficient collaboration within the sector and between different supply chain tiers weakens the industry's collective response to sustainability challenges. The limited collaboration within the industry and across supply chain tiers also hinders efforts to align with niche brands that emphasize sustainability.
    - **Fragmented initiatives:** Limited collaboration across the sector leads to disjointed efforts in sustainability, making it difficult to implement industrywide strategies that could appeal to eco-conscious brands. Indeed, efforts by Turkish manufacturers to engage with international brands on sustainability issues have yielded varied responses, with some brands showing limited interest.
    - **Poor stakeholder engagement:** A significant portion of companies report no interaction with other stakeholders, hindering the development of synergies necessary for tackling sustainability challenges and diminishing the sector's leverage in discussions with government and EU bodies.
    - **Exclusion of smaller firms from discussions:** Smaller firms, particularly Tier 2 and 3 suppliers are often left out of major discussions and initiatives, weakening the supply chain's overall sustainability profile.
  - **Regulatory uncertainty, sustainability requirements, and brand expectations:** The environment of regulatory and market uncertainty prompts a cautious wait-and-see approach from Turkish suppliers:
    - **EU regulatory uncertainty:** Ambiguities regarding upcoming EU sustainability regulations create a complex landscape for Turkish suppliers, who are hesitant to commit to specific improvements without clear directives. By extension, the unclear regulatory landscape also makes it difficult for firms to align with the sustainability priorities of niche brands, and it negatively affects potential collaborations and partnerships. The evolving nature of the EU's legislative agenda, especially in the context of the European Green Deal and the CEAP, has led to changes in priorities and delays, creating confusion for Turkish producers.
    - **Sustainability requirements:** The broad range of potential sustainability requirements under discussion adds to the uncertainty, as suppliers are wary of making premature investments or prioritizing certain actions without clear directives. This is compounded by the lack of clarity on the exact sustainability criteria that need to be met first and to what extent.
    - **Brand expectations:** Conflicting signals from European brands regarding sustainability criteria, particularly in areas like recycled content targets and emissions reduction goals, exacerbate the uncertainty. With major buyers like H&M and Bestseller

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Group setting differing targets for recycled cotton content and emissions, suppliers serving multiple brands face the challenge of meeting varied and potentially conflicting demands without clear legislative guidance.

- Challenges in using sustainability and regulatory compliance as a driver for competitiveness:
  - **Information overload:** The surge in sustainability reporting requirements and the necessity to comply with multiple digital platforms for different buyers add complexity and resource demands on suppliers. It complicates firms' ability to showcase their sustainability efforts effectively. This is exemplified by
    - **Surging data demands:** Suppliers face increased requests for detailed sustainability data from buyers, covering everything from raw materials to production metrics;
    - **Multiple digital platforms:** The need to navigate and input data into various buyer-specific digital platforms adds complexity, requiring manual entry for each order;
    - **Diverse certification needs:** Suppliers must obtain different certifications, such as SEDEX for Bestseller and the Higgs Index for H&M, further complicating compliance. While the EU's eco-design rules and DPP requirements have the potential to unify the certification process, buyers might continue to ask for additional certifications; and
    - **Resource burden:** Meeting these requirements demands significant resources, including specialized software and personnel, straining suppliers' capacities.
  - **Internal cost of sustainability transition:** Larger firms are bearing the cost of transitioning toward sustainability internally, as buyers are not prepared to pay extra for sustainability gains. The significant costs associated with sustainability upgrades are exacerbated by limited financing options and buyers' reluctance to compensate for sustainability enhancements. This financial burden affects the international competitive positioning of Turkish Tier 1 suppliers, and it is especially challenging for smaller firms, potentially leading to their exit from the industry.
- Challenges in developing robust ecosystems of recycling and upcycling and in extending product lifecycle:
  - **Infrastructural gaps:** The lack of shared infrastructure leads to inefficiencies and fragmented efforts in sustainability initiatives, with firms shouldering the burden of individual investments. This hinders the development of an integrated ecosystem.
  - **Recycling system deficiencies:** The underdeveloped recycling infrastructure (already discussed in the first bullet) hampers efforts to create a circular economy within the textile industry, essential for extending product lifecycles and vertical integration.
- Challenges penalizing (particularly strongly) lower-tier firms and SMEs:
  - **Disproportionate challenges for Tier 2 and Tier 3 firms:** Smaller firms face challenges in adapting to sustainability requirements due to limited resources. Many are unable to participate in brand-specific certification schemes, leading to a risk of being excluded from the supply chain. The lack of skilled professionals in sustainability and digital fields also disproportionately affects SMEs, particularly in underdeveloped regions, limiting their ability to adapt to new sustainability standards. Similarly, the heavy resource and information demands disproportionately impact smaller Tier 2 and 3 firms, challenging their ability to compete and collaborate within the industry's tiered structure. Finally, smaller firms are excluded from all industrywide coordination initiatives, reducing their presence in wider sustainability discussions.
- Broader systemic issues affecting the industry:
  - **Regulatory uncertainty:** The overall uncertainty regarding future EU regulations, discussed in the bullet points above, affects the entire industry's ability to strategically plan for sustainability transitions.
  - **Internal cost of sustainability transition:** The broader issue is of the industry absorbing the costs associated with sustainability improvements without adequate financial support or incentives from buyers or the market. Existing tax incentives are the main form of financing, but they predominantly take the form of tax rebates, and there is still a lack of

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effective access to cash for the execution of essential projects. Multiple firms report they have not been able to proceed with investment-ready projects due to the lack of available finance within the Turkish banking system. Rising costs resulting from inflation and minimum wage increases have constrained firms' internal financing capacity. Tier 2 and 3 firms simply opted out from meeting new sustainability requirements for the time being.

- **Shortage of qualified professionals:** The professional figures most in shortage are sustainability and digital skill professionals. This gap hinders firms' ability to comply with emerging eco-design and sustainability regulations. While larger companies can somewhat mitigate this issue by hiring skilled professionals, SMEs and firms in less-developed areas face challenges due to limited access to such expertise, often resorting to costly consultants. This shortage is likely to become more acute as Türkiye aligns its regulations with the EU's CE standards, increasing the demand for these critical skills across the industry.

C.2.2 Automotive Machinery and Equipment

There are important examples of CE initiatives in the automotive machinery and equipment industry too. Türkiye's automotive sector has indeed undergone significant upgrading, with investments in the modernization of plants, increased automation, and a focus on EV production, with several companies establishing design and R&D centers aimed at this market segment. There has also been considerable acquisition of Industry 4.0 technologies by Tier 2 and Tier 3 suppliers to produce parts for the electric vehicle segment or install more energy-efficient machines. Generally speaking, the type of initiatives implemented by automotive firms are consistent with the role that Türkiye has established in recent decades in the automotive GVC, with the highly hierarchical nature of the industry, that is, with a primary view to adapt to the demands of large automotive brands and OEMs, which in turn are under pressure to comply with changing EU regulation and consumer demand for greener products.

Notable initiatives:

- **Compliance with EU regulations:** Turkish automakers and Tier 1 suppliers are adjusting to requirements for greening the existing automotive sector, focusing on carbon emissions, waste management, and chemical use. The electrification of the automotive sector and the retirement of the ICE fleet are critical parts of this transition.
- **Advancements in EV manufacturing:** Türkiye has made progress in manufacturing EVs for commercial trucks and buses, with examples of firms producing electric buses and EVs in the commercial van segment. In addition, global market leaders have established or are planning EV battery production facilities in Türkiye. For example, one international automotive supplier has started new production facilities focused on electric compressors.
- **Sustainability focus on raw materials:** The Turkish automotive sector is focusing on reducing carbon emissions in the raw materials stage, especially in steel, aluminum, and plastics. Efforts are being made to quantify carbon emissions from these materials and design them for reduction. There is an emphasis on using recycled content in aluminum and ongoing development for recycled or recyclable materials in textiles for vehicle seat production.
- **Carbon emissions reduction initiatives:** The sector has seen a significant installation of rooftop solar panels and solar farms, reducing carbon emissions. Major automotive assemblers and suppliers are committing to the Science Based Targets Initiative (SBTI) targets, requiring a substantial reduction in carbon emissions from their suppliers.
- **Waste management and environmental practices:** There have been significant advances in reducing industrial waste and chemical use, with a focus on improving water management. Over 97 percent of industrial waste in the sector is recovered, and gains have been made in reducing volatile organic compound emissions.

Perceived opportunities:

- **Digital and electronic integration:** The increasing importance of digital competencies and the integration of advanced electronics and software in EVs are viewed as opportunities for local automotive companies to develop new digital services, connectivity features, and eventually also autonomous driving capabilities.

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- **New market entrants and partnerships:** The simplified vehicle architecture of EVs and the reduced mechanical complexity lower barriers to entry, enabling new players to enter the automotive market, were viewed as important opportunities. This environment fosters collaboration and new partnerships between traditional automakers, tech companies, and startups, which local firms believe they could benefit from if the enabling environment is created.
- **Sustainability and regulatory compliance as driver of competitiveness and supply chain diversification:** All stakeholders understand that the transition to EVs aligns with global efforts to reduce carbon emissions and meet stricter environmental regulations. They believe it offers Turkish automotive companies the chance to lead in sustainability and gain a competitive edge, particularly on the regional markets moving rapidly toward greener transportation solutions. Moreover, the need for new components and materials for EVs is encouraging the diversification of supply chains, and this is understood as having the potential to lead to more resilient and innovative supply networks.

In light of the above, there are five key pathways and strategies for the automotive sector in Türkiye in response to the European Green Deal regulations:

- **Strengthening R&D and innovation in EV technologies:** Beyond transitioning to EV production and enhancing sustainability in manufacturing processes, Türkiye should invest in R&D and innovation within the EV sector. This includes developing advanced EV technologies, improving battery efficiency and lifespan, and exploring innovative materials for lighter and more energy-efficient vehicles. Strengthening R&D capabilities can position Türkiye as a leader in cutting-edge EV technology, attract foreign investment, and foster collaborations with global automotive players, further solidifying its competitive edge in the evolving automotive landscape.
- **Transition to EV production:** Türkiye should seize the opportunity to become a central hub for EV assembly and parts production, capitalizing on the EU's shift away from ICE vehicles by 2035. This includes supporting the establishment of EV battery manufacturing (battery systems, electric powertrains, and charging solutions) within the country and integrating state-of-the-art sustainable systems in new production facilities.
- **Sustainable production processes:** Automakers' stringent sustainability criteria necessitate significant enhancements in production processes. Türkiye must focus on increasing energy efficiency, adopting renewable energy sources, and minimizing water and chemical usage in manufacturing to meet these evolving requirements and maintain its supplier status.
- **Developing a robust ELV recycling ecosystem:** With the anticipated increase in ELVs due to the transition to EVs, Türkiye has the potential to expand its recycling operations. This would not only serve the Turkish and European markets but also supply recycled materials to the automotive industry, supporting closed-loop recycling initiatives and vertical integration into raw materials supply.
- **Vertical integration into sustainable raw materials supply:** Türkiye can leverage its position as a global leader in steel recycling to supply the automotive industry with sustainable steel and other materials. Utilizing steel scrap from recycled ELVs and plastics scrap for closed-loop recycling can significantly reduce the environmental impact of automotive production and strengthen Türkiye's role in the global automotive supply chain.

Perceived Challenges

Similar to the textile-apparel sector, the automotive GVCs also suffer from important challenges, which are particularly severe for lower-tier suppliers. Turkish automotive firms' main hurdles in aligning with the EU's green transition include slow technology transfer for EVs, underdeveloped ELV recycling, insufficient renewable energy sources, limited engagement in raw material sectors. Similar to the textiles and apparel sector, there are regulatory uncertainties, overwhelming sustainability reporting demands, a lack of skilled workforce, and restricted access to financing. Additionally, the industry suffers from poor coordination among manufacturers, suppliers, and recyclers, impeding a unified approach to sustainability:

- Challenges in strengthening innovation and upgrading product/process in new EV technologies:
    - **Relative novelty of technology required for the green transition:** Critical green technologies, particularly for EV production and sustainable steel making, are still

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emerging or have not fully reached Türkiye, hindering the adoption of environmentally friendly manufacturing practices. Specifically, the technology for EV production and sustainable steelmaking, crucial for environmentally friendly manufacturing practices, is just beginning to emerge or is not yet accessible in Türkiye. The production of EVs, for instance, has historically been on a smaller scale in developed markets where automakers can closely monitor the process. Only with the recent surge in global demand for EVs have automakers started to transfer these technologies, including those for EV battery production, to emerging market production sites for large-scale operations. This transition is crucial for scaling up production in line with environmentally sustainable practices.

  - **Technology transfer delays:** There is a slow pace of technology transfer to peripheral locations like Türkiye, particularly for large-scale EV and battery production. This is attributed to several factors. The substantial financial investments required for developing these technologies, which can exceed US$2 billion, have slowed the establishment of new operations. Additionally, the production processes for EV components, such as chassis, involve highly digitalized and automated systems, often necessitating technology acquisition from European manufacturers and significant workforce training. This high barrier to entry is especially challenging for smaller suppliers in the Turkish sector. Furthermore, other emerging technologies critical for reducing the industry's environmental impact, like commercial-scale green steel production using hydrogen and alternative fuels in paint shops, are still being developed and trialed in major markets. For instance, notable investments by BMW and Mercedes-Benz in green steel startups and trials of alternative fuels in their plants underscore the ongoing development and gradual adoption of these technologies.

- Challenges in developing robust ecosystems for recycling:
  - **Weak ELV recycling ecosystem:** The limited availability of inputs for recycling due to a low number of scrapped cars and restrictions on importing salvaged vehicles undermines the availability of secondary materials and reusable parts. In Türkiye, the low rate of vehicle scrappage—substantially below the rates seen in European and Japanese markets—results in scant supply of inputs for the recycling sector. With only 1,500 to 2,000 cars scrapped annually on average, compared to about 6 percent of in-use cars in other developed regions, the input for recyclers is markedly limited. Although initiatives in 2018 and 2019 to encourage vehicle deregistration temporarily increased the supply for ELV recycling, these were not sustained. Further complicating the issue is Türkiye's prohibition on importing salvaged or scrapped cars, eliminating a potential alternative source of ELVs.
  - **Underdeveloped ELV recycling segment:** The lack of a well-established system for recycling ELVs, coupled with the above-mentioned low supply of scrappable cars and import prohibitions limit the availability of recycled materials for automotive manufacturing. The ELV recycling stage in Türkiye is still nascent and primarily serves the domestic market. Recyclers focus on removing hazardous materials, dismantling vehicles, and sorting recovered materials for recycling. However, there is limited reuse or remanufacturing of used or ELV parts in the supply chain.
  - **Low demand for secondary materials:** The situation is exacerbated by the automotive sector's historically low demand for secondary materials, which has only recently begun to include requests for recycled plastic content. This lack of both supply and demand provides little motivation for recyclers to invest in the technology and infrastructure needed to upscale their operations or diversify into other recycling segments, such as EV battery recycling. This constraint is particularly concerning given the upcoming high secondary content requirements of new regulations like the Battery Regulation and potential revisions to the ELV Directive, which may mandate the sourcing of recycled plastic content from closed-loop systems.

- Challenges to vertical integration in sustainable raw materials:
  - **Low participation in raw materials segments:** Limited engagement in the procurement and processing of sustainable raw materials restricts vertical integration and control over the supply chain.
  - **Import dependence on raw materials:** Reliance on imported materials, particularly high-quality steel and plastics, limits control over sustainable practices, technological

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upgrading, and access to new market opportunities. As a result of demand and supply shortages, automotive manufacturers are increasingly forced to source recycled materials from international markets, increasing operational costs and missing out on opportunities within the post-consumer segment. The limited recycling and ELV management systems thus not only restrict the availability of secondary materials but also impede the progress toward a closed-loop circular economy.

  - **Lack of coordination across actors in all segments of the value chain**, particularly with respect to the key areas for circularity, raw materials supply, and ELV handlers. The principal stages of the automotive production industry in Türkiye, that is, assemblers and parts and components suppliers, are highly coordinated with well-articulated industry associations (OSD and TAYSAD) in each area and a common industry association focused on exports (OIB). These groups, however, are not coordinating with either raw materials suppliers in key areas, such as aluminum (TALSAD) or steel, or with downstream recyclers, represented by OTASAD. Given the increased emphasis on closed-loop recycling for recycled materials content in the EU's regulatory debate, there needs to be significantly more cooperation between these entities regarding how Turkish automotive production operations can meet the upcoming needs.

- Challenges to new firm-to-firm collaborations and partnerships:
  - **Lack of coordination:** Inadequate collaboration between automotive manufacturers, parts suppliers, raw material providers, and recyclers hampers a cohesive transition to sustainable and circular automotive production, risking the exclusion of smaller suppliers from the industry and offering less opportunity to local Tier 1 suppliers to develop new valuable cross-border collaborations and partnerships.
- Challenges in sustainability and regulatory compliance:
  - **Regulatory uncertainty and ambiguity:** Firms struggle to devise clear strategies due to uncertain regulations on sustainability, leading to varying requirements from automakers on recycled content and emissions reduction targets, complicating compliance efforts for suppliers serving multiple brands.
  - **Proliferation of sustainability reporting:** At the same time, there is a rise in sustainability reporting and certification demands. This burdens suppliers, especially smaller ones, with duplicating efforts and complex environmental performance metrics. These are further complicated by differing standards in the raw materials sector. Such requirements complicate compliance and divert resources from innovation.
  - **Lack of coordination:** The lack of coordination noted in earlier bullet points provides stakeholders with only a partial view of the scope of the regulatory changes under way and could result in assemblers stipulating requirements that cannot be met by upstream suppliers or downstream operators in the industry or establishing roadmaps with conflicting priorities for suppliers. For example, assemblers are currently only engaging with critical suppliers to ensure they will meet the requirements; Tier 2 and Tier 3 suppliers are not being engaged. This could result in their eventual exclusion from the chain. Greater coordination could also help establish a stronger platform for engaging with the EU stakeholders.
- Challenges penalizing particularly lower-tier firms and SMEs:
  - **Mismatch between SMEs' needs and design of incentives:** Smaller firms find it challenging to meet the scale and up-front investment requirements for green transitions, often finding themselves excluded from government incentive programs designed for larger projects. These programs, including those supporting the transition to EV production, are tailored for substantial, large-scale changes, such as the adoption of Industry 4.0 technologies and significant energy efficiency improvements (see Table 3). However, Tier 2 and Tier 3 suppliers typically focus on smaller, incremental upgrades that fall outside the ambit of these incentives, leading to a disconnect between the needs of these smaller suppliers and the available support structures.
  - **Overall high costs of financing:** Access to financing for sustainability and circularity changes is significantly impeded by the broader macroeconomic instability, characterized by high inflation and rising interest rates, which elevate the costs associated with

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traditional banking loans. The reliance on local banks for financing, compounded by the restricted availability of long-term loans, means that the financial burden of pursuing green transition efforts becomes prohibitively expensive for many firms. This situation is exacerbated by the short loan durations, typically capped at 12 months, which have resulted in the postponement of several sustainability projects in 2023. This financial bottleneck is particularly acute for Tier 2 and Tier 3 suppliers, placing them at a heightened risk of being marginalized in the transition toward more sustainable practices.

- **Traceability and sustainability performance tracking:** Strong traceability and sustainability performance tracking are observed among Tier 1 suppliers and assemblers, but there is a decrease in capability among smaller suppliers. Larger suppliers leverage existing information systems for certifications and compliance, but there is a disconnect with raw material suppliers who have different reporting systems.
- **Transition to commercial EV production:** Efforts are being made to transition to commercial EV production, driven by automaker demands and potential cost reductions. However, smaller Tier 2 and Tier 3 firms lag in this transition due to challenges like human capital shortage and access to finance and information.

- Broader systemic issues affecting the sector:
  - **Renewable energy and resource efficiency shortfalls:** Despite growth in renewable energy, Türkiye's reliance on fossil fuels for electricity generation challenges the automotive sector's efforts to reduce carbon emissions and meet EU standards. This has a negative impact on the overall resource efficiency efforts central to the CE transition.
  - **Shortage of qualified human capital:** The transition to EVs and greener practices necessitates new skills in electronics, sustainability, and recycling, yet Türkiye faces a talent shortage exacerbated by brain drain and a disconnect between educational institutions and industry needs. Specific examples of the problem include the following:
    - **Growing demand for EV-specific skills:** The surge in demand for EVs, driven by regulatory changes in major markets, necessitates a workforce with new competencies, particularly in electronics and mechatronics engineering, automotive-specialized IT professionals, and technicians proficient in Industry 4.0 production technologies, which are not easily available in the country.
    - **Need for sustainability professionals:** The shift toward greener practices requires additional human capital in sustainability to measure and implement necessary changes, indicating a demand for professionals with expertise in environmental sustainability.
    - **Recycling and dismantling technicians:** The CE aspect of the transition, particularly the dismantling and recycling of ELVs, calls for certified technicians with specific skills in these areas, further emphasizing the gap in specialized human resources.
    - **Challenges for smaller suppliers:** Smaller suppliers face particular difficulties in attracting talent due to less competitive compensation packages, which exacerbates the shortage of qualified workers in critical areas like engineering, sustainability, and recycling.

Addressing the above challenges is crucial for Türkiye to maintain its competitiveness in the automotive and textiles and apparel GVCs and capitalize on the opportunities presented by the EU's green transition. Specific policy recommendations and support mechanisms are needed to facilitate this complex transition.

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C.3 Expected Impact of Policy Recommendations on Enhancing Türkiye's Position in the Automotive and Textiles and Apparel GVCs

To address the challenges faced by Turkish firms and leverage opportunities presented by the EU's evolving regulatory landscape, a structured set of policy recommendations is proposed in Section 4. Here, we illustrate industry views on how some of the main policy recommendations can help in the two focus sectors.

1. **Institutional and coordination enhancements**
    - Foster collaboration among public stakeholders (Ministries of Trade, Environment, Urbanization and Climate Change, Industry and Technology) and private sector entities to unify the approach toward sustainability and CE transitions. This would help address the coordination shortfalls and promote innovation, observed in both analyzed sectors.
    - Establish industrywide platforms for PPPs to ensure comprehensive industry representation in sustainability initiatives. This would be particularly beneficial for the automotive sector's move toward EV production and the textiles and apparel sector's shift to sustainable materials.
2. **Regulatory clarity and market awareness**
    - Develop platforms or single-window systems providing up-to-date information on EU regulations and available incentives, directly addressing the challenge of regulatory uncertainty that hinders proactive sustainability and compliance efforts observed in both focus sectors.
    - Conduct training and awareness campaigns to elucidate the implications of noncompliance. Such an effort is particularly relevant to the textiles and apparel sector's need to target niche sustainability-focused brands.
3. **Human capital development**
    - Launch targeted training programs for existing workers and integrate sustainability and digital skills into the educational curriculum.
    - Promote partnerships of the industry with both local and international universities and other educational institutions to foster innovation and technology transfer. This is particularly crucial for the automotive sector's advancement in EV technologies.
4. **Innovation and technology support**
    - Channel additional resources into R&D, focusing on recycling technologies, sustainable material development, and EV supply chain innovations. The overarching objective should be to use these resources to directly tackle technological limitations and recycling system deficiencies.
    - Leverage international R&D programs like Horizon Europe for global collaboration and technology transfer.
5. **Infrastructure development**
    - Provide incentives for the creation of green industrial zones that offer shared sustainable infrastructure, thereby addressing infrastructural gaps and promoting vertical integration in sustainable raw materials.
    - Develop national digital platforms that seamlessly integrates with the EU's DPP and other infrastructure to support streamlined sustainability reporting and compliance. This measure is essential to reducing the information overload burden on firms, especially SMEs.
6. **Financial mechanisms for green transition**
    - Develop comprehensive financing frameworks offering long-term loans and financial incentives for sustainability projects, ensuring accessibility for SMEs.
    - Attract foreign direct investment and international financing for green infrastructure and technology development.

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Annex D. Global Best Practices

This annex compiles examples cited in the policy recommendations to illustrate successful implementations and strategies from around the world that can inform Türkiye's transition toward a CE.

1. **EU's waste framework directive:** Sets recycling goals, defines waste management principles, and encourages the reduction of waste generation, serving as a model for legislative frameworks to promote recycling and waste reduction.
2. **The Republic of Korea's waste management system:** Notable for its extensive collection infrastructure and advanced MRFs, contributing to high recycling rates.
3. **France's ELV recycling system:** France's system for ELV recycling is noted for its efficiency, with a strong national focus on EPR schemes and a regulatory framework that requires automakers to establish a network of approved ELV centers. The following are its key features:
    - **Evolution of ELV centers:** France transitioned from scrap dealers to ELV centers due to streamlined industrial processes and stricter regulations at both national and European levels. In 2019, France's 1,635 ELV centers processed a significant portion of the ELVs collected in the EU, showcasing the scale and efficiency of its recycling capabilities.
    - **EPR schemes:** The country has a strong focus on EPR schemes to promote recycling in the automotive sector. The French EPR system for ELV, in place since 2006, is recognized for its efficiency, with recycling and recovery rates exceeding EU standards. This system mandates automakers to establish a network of approved ELV centers responsible for recovering ELVs, including from their dealership networks, ensuring comprehensive traceability and proper handling of vehicles at the end of their life cycle.
    - **Legislative support for reuse and remanufacturing:** France has also been proactive in introducing legislation to encourage the reuse of automotive parts through remanufacturing and recycling markets. This approach aligns with the EU's CEAP and aims to reduce waste while promoting sustainability within the automotive industry.
4. **Keep America Beautiful's recycling education programs:** Provides resources and activities designed to increase recycling participation and awareness, exemplifying effective public awareness and education initiatives.
5. **Ellen MacArthur Foundation's Circular Economy Network:** Promotes collaboration across sectors to accelerate the transition to a circular economy, highlighting the importance of multistakeholder engagement.
6. **California's RMDZ Program:** Offers loans, technical assistance, and product marketing to businesses that use recycled materials, illustrating financial incentives for recycling.
7. **EU's Digital Single Market Strategy:** Aims to enhance Europe's position as a world leader in the digital economy by opening up digital opportunities for businesses and individuals.
8. **GDPR of the EU:** Ensures that data handling in digital monitoring systems respects privacy laws, serving as a model for data privacy and security regulations.
9. **IBM's Food Trust Network:** Uses blockchain to enhance traceability and transparency in the food industry, demonstrating the application of digital tracking technologies.
10. **Digital Skills and Jobs Coalition by the European Commission:** Aims to enhance digital skills across various sectors, exemplifying capacity building and training initiatives.
11. **Smart Cities Initiatives:** PPPs play a crucial role in developing digital infrastructure to enhance urban sustainability and efficiency.
12. **Global Partnership for Sustainable Development Data:** Brings together different stakeholders to harness the data revolution for sustainable development, highlighting the value of collaborative approaches.
13. **Eco-Industrial Park concept:** Shows how businesses in close proximity share infrastructure and resources to enhance their environmental, economic, and social outcomes.

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14. **Developing Green Industrial Parks in Central America:** Highlighted is the financing provided by IDB Invest to American Industrial Park (AIP) in El Salvador to develop a green industrial park that includes renewable energy sources, reforested green areas, a comprehensive recycling program, and efficient water management practices.
15. **CTCN under the UNFCCC:** Act as hubs for knowledge exchange, technical assistance, and capacity building in green technologies and sustainable practices.
16. **Austrade's 'No Wrong Door' Approach and 'One-Stop Shop' Access:** Trade promotion agencies provide seamless end-to-end services for firms in GVCs, reducing duplication and enhancing service quality.
17. **EU's Single Digital Gateway:** Offers easy access to information and administrative services across various sectors, which could be adapted to focus on environmental regulation and sustainability compliance.
18. **Green Climate Fund:** Supports projects in developing countries for a low-emission and climate-resilient transition, serving as a model for targeted financing solutions.
19. **Horizon Europe:** The EU's key funding program for research and innovation for 2021 – 2027, with a budget of €95.5 billion, focusing on climate change, achieving the UN's Sustainable Development Goals, and boosting the EU's competitiveness and growth. Türkiye is associated with Horizon Europe and has participated in several key initiatives under Horizon 2020, its predecessor.
20. **EU-US Trade and Technology Council:** Formal channel for regulatory dialogue, ensuring alignment with EU standards while voicing concerns and suggestions.
21. **German Federal Government's Sustainability Cabinet:** Coordinates sustainability efforts across various federal ministries, exemplifying inter-ministerial collaboration.
22. **Finland's National Circular Economy Strategy:** Provides a clear framework for action across various sectors and governmental levels, guiding national sustainability efforts.
23. **UK's WRAP:** Brings together stakeholders from various sectors to work on waste reduction and resource efficiency projects.
24. **European Commission's Circular Economy Stakeholder Platform:** Facilitates knowledge sharing and collaboration among various stakeholders in the circular economy.
25. **OECD's environmental performance reviews:** Assess and provide feedback on countries' progress toward environmental goals, adaptable for an interagency context within Türkiye.
26. **United Nations' capacity-building and training strategy on sustainable development:** Adapting its principles for interagency capacity building within Türkiye.
27. **Multistakeholder sustainable skills program in the Netherlands:** This Dutch initiative, led by the nonprofit organization 'Learning for Tomorrow' in collaboration with the Ministry of Infrastructure and Water Management and the Goldschmeding Foundation, focuses on identifying skills gaps in industries transitioning to CE strategies and has led to regional projects and educational reforms.

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Annex E. Achieving the EU's CE goals through Cooperation with Türkiye

A significant portion of the EU's material consumption and footprint is due to imports, with 11 percent of domestic material consumption and nearly 36 percent of the total footprint being imported (World Bank 2022). Türkiye is a central partner in the relevant industries, and because of its centrality, it has a significant influence on promoting sustainable practices and technologies also in the EU.

To support the above view, this summary first illustrates centrality of Türkiye's firms and why it implies that a successful transition in Türkiye can help the EU's CE goals of enhancing material efficiency and reducing environmental impact. Second, it discusses insights from academic research to substantiate further the thesis that given the tight firm-to-firm relationships between EU and Türkiye, the EU's transition to a circular economy is best achieved through cooperative and collaborative strategies with Türkiye's government and firms, including those on the periphery of the supply chain.

E.1. The Central Role of Türkiye in the EU Circular and Green Value Chains

The global economy is interconnected through a vast network of firms linked by supply relationships. Within this network, the green value chain involves a substantial number of firms participating in the production of environmentally friendly goods, services, and technology. This global ecosystem encompasses a diverse array of industries and sectors that are linked through supplier-buyer relationships and where the business focus is on reducing environmental impact, enhancing energy efficiency, and fostering innovation in green technologies.

Despite being a late developer, Türkiye's connectivity within global and EU green value chains positions it as a critical facilitator of sustainable development in the EU. This is illustrated by network analysis, which, by mapping firm connections, identifies potential key players connected to green industries. The visual representation of the buyer-seller relationships within the green sector is illustrated in Figure E.1 and generated using Gephi from data from the FactSet Revere Supply Chain Relationships database covering 18,234 firms connected through approximately 50,000 buyer-seller relationships.[27]

The graph depicts the relationships between different countries involved in the green supply chain. Each node in the graph represents a country, obtained by aggregating the network data to represent the buyer-seller relationships of a country's firms with other countries. The size of each node reflects its betweenness centrality, that is, the number of shortest paths passing through it. The location of each node corresponds to the latitude and longitude of the capital city, providing a geographic context. The arrows indicate the direction of the buyer-seller relationships, with the thickness of the arrows representing the relative importance of the supplier origin to the destination country. In this visualization, the EU countries are shown in light green, highlighting their collective involvement in the green value chain. The graph illustrates that Türkiye posts a betweenness centrality score on par with the EU member states of Poland, Bulgaria, Croatia, and Romania.

Figure E.2 **zooms into the Turkish perspective.** The graph shows the country-by-country network of the green supply chain involving firms in Türkiye in the sample. The arrow points in the direction of the customer. Like in the previous graph, the size of each node reflects the betweenness centrality (that is, the number of shortest paths through the node); the location of each node refers to the latitude and longitude of the capital city; and EU countries are shown in light green. The visualization indicates that there are 24 indegree links (foreign countries as suppliers of domestic Turkish firms) and 24 outdegree links (foreign countries as customers of domestic firms): this places the country around the EU average (26 indegrees and 29 outdegrees) and on par with Eastern EU members. This central position, as well as its significant linkages to non-EU partners too, allows Türkiye to serve as a hub for the propagation of EU green initiatives as much as the Eastern EU members.

[27] Firm sample of green value chain connected firms from FactSet Supply Chain Relationships, https://www.factset.com/marketplace/catalog/product/factsetsupplychainrelationships, accessed March 20, 2024.

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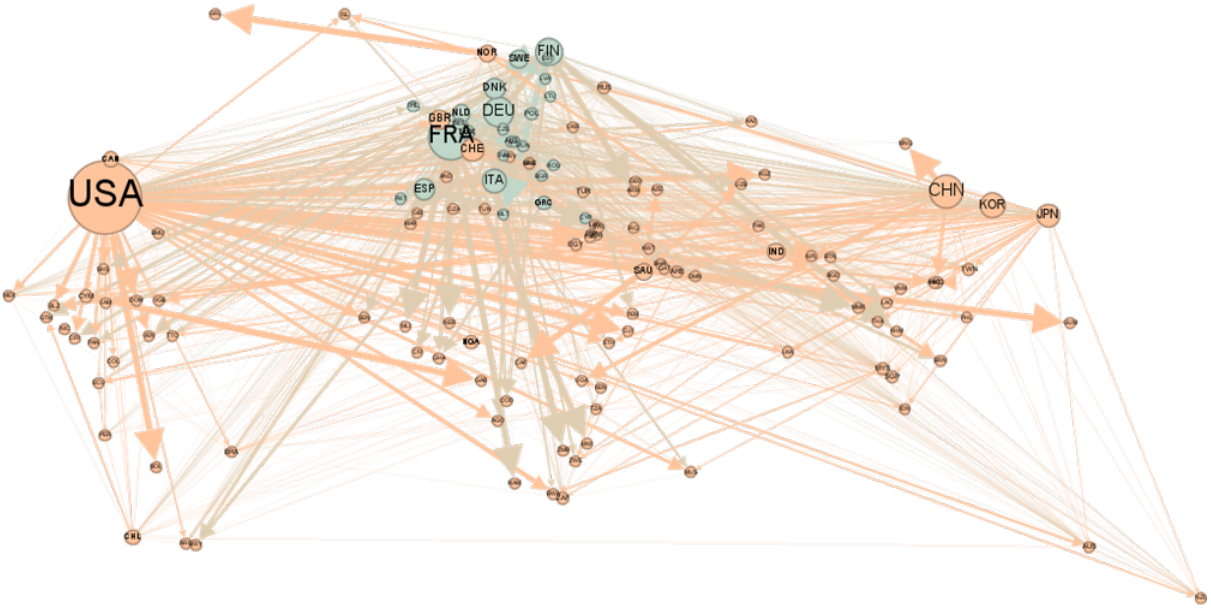
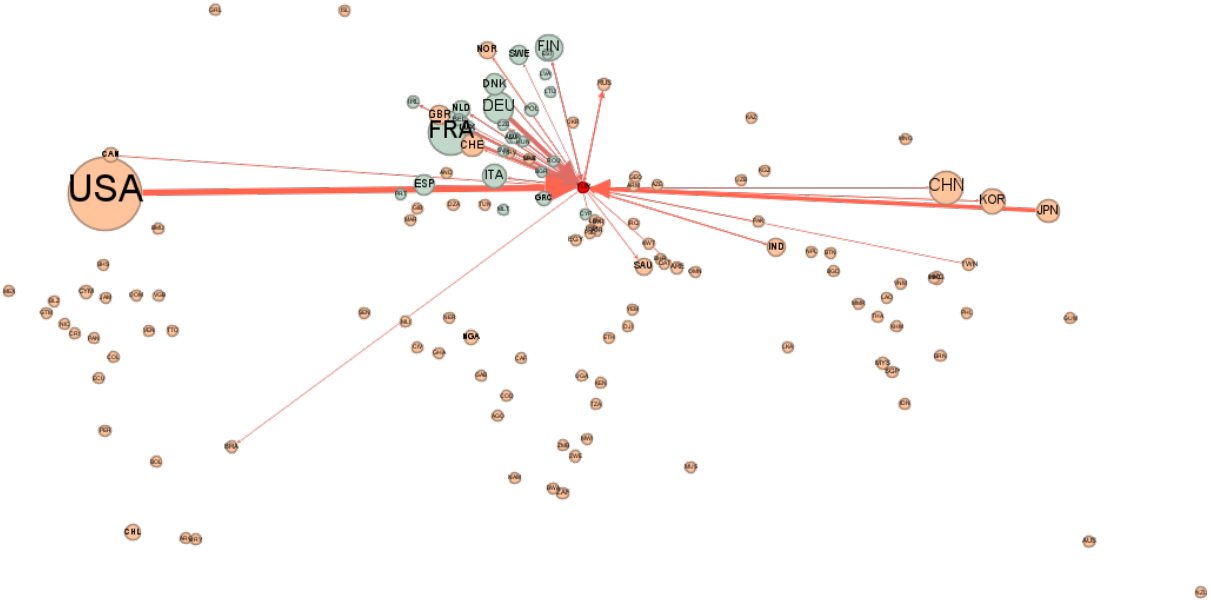
Figure E.1: Network representation of the country-level buyer-seller relations, global perspective



Source: Firm sample of green value chain connected firms from FactSet Supply Chain Relationships, https://www.factset.com/marketplace/catalog/product/factsetsupplychainrelationships, accessed March 20, 2024.

Figure E.2: Network representation of the buyer-seller relations, Türkiye perspective



Source: Firm sample of green value chain connected firms from FactSet Supply Chain Relationships, https://www.factset.com/marketplace/catalog/product/factsetsupplychainrelationships, accessed March 20, 2024.

A practical example of the importance of Türkiye's suppliers for EU firms can be seen in the case of H&M. According to its website and interviews with firm representatives, H&M recognizes Türkiye's strategic advantage in having a complete supply chain infrastructure, from fiber to finished products. This comprehensive supply chain is identified as a key enabler of Türkiye's ability to produce and deliver fashion items quickly and efficiently, minimizing the need for raw material imports and allowing for quick responses to market demands. H&M indicated that the robustness of Türkiye's textile industry, including the availability of local materials such as cotton and polyester, reduces dependency on foreign imports, making it well-suited for both high-value and basic products. Furthermore, H&M also emphasized that its collaboration with Türkiye's suppliers aligns with its long-term sustainability goals. Company sources mentioned that some factories in Türkiye are exceeding expectations by actively pursuing innovations in the textile sector, achieving high levels of recyclability, even up to 100 percent. This potential for significant recyclability, both pre-consumer and postconsumer (also documented in Annex C.2.1), is

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harnessed by the company and can potentially be expanded to make a more substantial impact on sustainability. With this goal in mind, H&M is actively fostering R&D projects and collaborations with recyclers in the Turkish market. In conclusion, the above discussion suggests that firms in Türkiye are important contributors to spreading green practices through the extensive supplier and customer networks of EU firms. This centrality means Türkiye can codrive the EU's circular economy goals and that the EU's pursuit of circular economy and sustainability objectives requires not only stringent internal measures but also cooperative strategies with such an important external partner to ensure material-efficient practices throughout the supply chain.

E.2 The Importance of Cooperation and Collaboration

Economic analysis offers many arguments in favor of cooperation and collaboration. A first point is that cooperation between the EU and Türkiye's firms can leverage their respective strengths, leading to enhanced capabilities and innovation that accelerate the transition. EU firms, often at the forefront of innovation, can benefit from Türkiye's robust production capabilities. This synergy can enhance resource efficiency and foster innovation in circular practices. The multinational production framework discussed in Arkolakis et al. (2018) illustrates the benefits of leveraging differences in production and innovation costs through specialization based on comparative advantages.

Second, material leakage, where stringent regulations in one jurisdiction lead to the relocation of material-intensive production to countries with lower standards, is a significant risk. Cooperation with Türkiye can help harmonize environmental standards, preventing the relocation of production and ensuring that material-intensive production does not undermine the EU's CE efforts. Carr, Markusen, and Maskus (2001), Gereffi (1994), Nunn (2007), and Rabellotti and Pietrobelli (2011) highlight the importance of coordinated policies to manage such risks and emphasize the role of institutional quality and cooperation in reducing negative externalities in GVCs.

Third, cooperative strategies that effectively manage trade dynamics can amplify the economic and environmental gains that reciprocal trade openness yields. Trade openness has complex effects on material consumption, influenced by income growth and production efficiencies. Collaborative strategies can align trade policies to support CE goals, as supported by studies from Atkeson and Burstein (2010); Bastos et al. (2016); Bustos (2011); and Kugler and Verhoogen (2012). These studies show that cooperative trade strategies maximize improvements in input and output quality and lead to increased innovation and productivity, essential for the transition to a circular economy. In short, because of the intricate relationship between the accumulation of new capabilities and the role of international trade, collaborative trade policies can help manage the impacts of trade openness, contributing to CE goals. On the other hand, a lack of collaboration may exacerbate material consumption.

Finally, throughout the report, we discussed how GVCs play a crucial role in facilitating learning and innovation. Collaborative efforts between the EU and Türkiye's firms can enhance the transfer of knowledge and technology, boosting productivity and innovation. Several studies support this thesis. Guadalupe, Kuzmina, and Thomas (2012) provide evidence that integration with multinationals leads firms in supplier countries to higher innovation returns and lower R&D costs.[28] This insight aligns with the work of Gary Gereffi and findings by Antr`as, Fort, and Tintelnot (2017) and Javorcik (2004), highlighting the importance of GVCs in promoting innovation and productivity through close cooperation.

E.3 Potential Consequences of Lack of Cooperation

The absence of cooperation can lead to several adverse outcomes. First, the risk of material leakage increases, with production relocating to regions with lower standards, increasing global resource exploitation and environmental degradation. Kee (2015) discusses the negative impacts of uncoordinated GVC activities on sustainability.

Second, uncooperative strategies may fail to achieve CE goals. Bloom, Draca, and van Reenen (2015) indicate that cooperation fosters innovation and advancement in CE practices by ensuring a

[28] Multinational firms acquire the most productive domestic firms, which then conduct more product and process innovation, adopt new machines and organizational practices, and embrace foreign technologies, leading to higher productivity. This innovation benefits the transition to CE models and can be amplified by coordinated strategies targeting peripheral firms in the productive ecosystem of both trading partners.

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level playing field across the EU and Türkiye. Increased competition drives firms to innovate, increase R&D, improve management quality, and raise skill levels, essential for the transition.

Third, uncooperative strategies may exacerbate economic disparities and trade imbalances, destabilizing both economies. Alfaro et al. (2015) and Javorcik (2004) stress the need for inclusive policies to ensure balanced economic development. Ederington, Levinson, and Minier (2005) show that environmental regulations significantly affect trade between industrialized and developing countries, emphasizing the need for coordinated efforts to ensure that specialization benefits all countries involved. The largest gains, according to this study are precisely achieved when coordination takes place between countries at different levels of industrialization.[29]

Finally, more stringent EU regulations without corresponding support for Türkiye's firms could destabilize economies by reducing demand for raw materials, leading to economic instability and adjustment costs: Arkolakis et al. (2018) show that specialization in production without corresponding support in innovation and technology transfer can harm developing countries, again emphasizing the need for coordinated efforts and support to ensure that specialization benefits all countries involved rather than causing harm to developing countries, with potentially destabilizing effects for all trade partners.

Additional insights from trade, GVCs, and innovation literatures reinforce the importance of cooperative strategies between the EU and Türkiye to achieve circular economy objectives. Cooperative strategies are critical to enhancing resource efficiency, reducing material leakage, and fostering economic and environmental benefits for all.

In conclusion, without such collaborations, efforts to establish a sustainable and circular economy may be compromised, leading to increased material leakage, economic disparities, and environmental degradation. The literature clearly supports the multifaceted benefits of cooperation and the potential risks of neglecting collaborative approaches.

[29] Ederington, Levinson, and Minier (2005) show that while most trade occurs among industrialized economies, environmental regulations significantly affect trade between industrialized and developing countries. Pollution abatement costs, though a small part of total costs, significantly affect trade flows in pollution-intensive industries. Despite high abatement costs, these industries are the least mobile. Therefore, it is in the EU's interest to establish cooperative strategies to help Türkiye's transition alongside the EU.

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Annex F. Data Sources

F.1 Stakeholders Interviews (May–September 2023)

Over 35 interviews with over 100 stakeholders were carried out between June and September 2023. Interviewees included key government agencies, private sector associations, global firms, domestic Turkish companies, and other relevant organizations. One-hour, semi-structured interviews were conducted, both in person and using web-based communication platforms.

F.2 Enterprise Survey Data

The evidence reported in this document is based on the latest survey for Türkiye, carried out from September 2018 to May 2019.[30] More recent evidence will be available in the fall this year, as a new WBES is slated for 2024.[31]

Sample design. The WBES uses stratified random sampling to obtain representative estimates of the underlying non-agriculture private sector firm population. Stratification allows to derive unbiased estimates for subgroups of the population along predefined sample strata with some known precision level. For Türkiye, the sample was stratified along three dimensions: establishment size (small: 5 to 19 employees, medium: 20 to 99 employees, and large: more than 100 employees), region (12 NUTS-1 level regions), and industry—food and beverages (ISIC 10, 11), textiles (ISIC 13), garments (ISIC 14), fabricated metal products (ISIC 25), machinery and equipment (ISIC 28), other manufacturing (ISIC 12, 15–24,26, 27, 29–33), construction (ISIC 41–43), retail (ISIC 47, 95), and other services (ISIC 45, 46, 49–53, 55, 56, 58, 61, 62, 79, and 95). Four of the sector strata coincide with CE priority sectors selected for detailed assessment in this report: fabricated metal products, garments, machinery and equipment, and textiles. Overall, 1,663 firms were interviewed (World Bank Group, European Bank for Reconstruction and Development, European Investment Bank 2019).[32]

Export status. During the survey, firms were questioned on their direct exports in total sales volume. Surveyed firms with a direct export share exceeding 10 percent of total sales were classified as exporters. Since the grouping is determined after the sample of firms has been selected, it is not guaranteed that the derived group-level statistics are representative of the underlying subpopulations of exporting and non-exporting firms with a certain precision level (ex post grouping). No-confidence levels are hence included when showing the breakdown by export status.

Europe and Central Asia peers for industry-level comparisons. For the four CE priority sectors with representative subgroup coverage, firm statistics from surveyed Europe and Central Asia countries with the same industry stratum are used for within-industry comparisons. For fabricated metal products, the set of countries includes Hungary, Poland, and Romania. For machinery and equipment, other Europe and Central Asia countries include Bulgaria, Hungary, Poland, and Romania. Despite the notable differences in the sophistication of the textiles and apparel sector between Uzbekistan and Türkiye, Uzbekistan represents the only other Europe and Central Asia country surveyed by the WBES where textile firms make up their own sample stratum, thus allowing for the computation of an average representative of the underlying population. For garments, the set of countries consists of Kazakhstan, Poland, and Uzbekistan.

Europe and Central Asia average. This average is computed as the unweighted mean across all surveyed Europe and Central Asia economies, using the latest data for each economy. The list of surveyed countries, besides Türkiye, includes Albania (2019), Armenia (2020), Austria (2021), Azerbaijan (2019), Belarus (2018), Belgium (2020), Bosnia and Herzegovina (2019), Bulgaria (2019), Croatia (2019), Cyprus (2019), the Czech Republic (2019), Denmark (2020), Estonia (2019), Finland (2020), France (2021), Georgia (2023), Germany (2021), Greece (2018), Hungary (2019), Ireland (2020), Italy (2019), Kazakhstan (2019), Kosovo (2019), the Kyrgyz Republic (2019), Latvia (2019), Lithuania (2019), Luxembourg (2020), Moldova (2019), Montenegro (2019), the Netherlands (2020), North Macedonia (2019), Poland (2019), Portugal (2019), Romania (2019), the Russian Federation

[30] World Bank Enterprise Surveys, https://www.enterprisesurveys.org/en/enterprisesurveys, accessed: December 5, 2023.
[31] World Bank Enterprise Surveys. 2023. "Current Projects." https:// www .enterprisesurveys.org/en/currentprojects.
[32] World Bank Group, European Bank for Reconstruction and Development, and European Investment Bank. 2019. "The Turkey 2019 Enterprise Surveys Data Set." https://microdata. worldbank.org/index.php/catalog/3558/download/47686.

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(2019), Serbia (2019), the Slovak Republic (2019), Slovenia (2019), Spain (2021), Sweden (2020), Tajikistan (2019), Ukraine (2019), and Uzbekistan (2019).

For all indicators, unless otherwise mentioned, the share of firms answering a certain question with "yes" or "no" is derived excluding respondents with missing answers such as "don't know" (spontaneously).

F.3 Other Data Sources

Türkiye's trade exposure and interdependency with the EU were analyzed using international trade data available from the United Nations Comtrade dataset and the OECD's Trade in Value Added database.[33] Additional cross-country evidence was collected from Eurostat as detailed in the respective references. The FactSet Revere Supply Chain Relationships database instead provided comprehensive firm-level data on supply chain relationships for 18,234 firms worldwide, connected through approximately 50,000 buyer-seller relationships. This dataset is used in Annex E.[34]

Multiple secondary sources were also reviewed in the preparation of this report, including global market studies on textiles and apparel and automotive; international literature on industry sustainability; firm annual reports and websites; and Turkish policy documents including strategies, road maps, and initiatives, as well as both EU and Turkish legislation related to the topic. Finally, numerous global policy practices were considered to identify best practices to inform Turkish policy setting as the country moves to a greener economy.

[33] UN Comtrade, World Exports and Imports by Reporter and Partner, 2011–2021, HS06 (6-digits), http://comtrade.un.org, accessed January 15, 2023; and OECD Trade in Value Added, https://www.oecd.org/sti/ind/measuringtradeinvalueadded.htm, accessed March 27, 2023.
[34] FactSet Supply Chain Relationships, https://www.factset.com/marketplace/catalog/product/factsetsupplychainrelationships, accessed March 20, 2024.

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T.C.
Ticaret Bakanlığı
Uluslararası Anlaşmalar ve AB Genel Müdürlüğü
AB Tek Pazar ve Yeşil Mutabakat Dairesi

TÜRKİYE'NİN DÖNGÜSEL EKONOMİYE GEÇİŞİNİN EKONOMİK, TİCARİ VE SANAYİYE ETKİLERİ RAPORU BİLGİ NOTU

Dünya Bankası tarafından yürütülmekte olan "Türkiye Yeşil Büyüme Analitik Danışmanlık Programı"nın Döngüsel Ekonomi başlığında, Türkiye'nin döngüsel ekonomiye geçişinin makroekonomik ve ticari etkileri ile döngüsel ekonomiyi hızlandıracak öncelikli sanayi sektörlerinin değerlendirilmesine ilişkin bir çalışma yürütülmüştür. Söz konusu çalışma kapsamında üç ana rapor oluşturulmuş olup, bu çerçevede yayımlanan özet belgede ön plana çıkan hususlar aşağıda özetlenmektedir.

Makroekonomik etkiler

- Raporda Türkiye'de döngüsel ekonomiye geçişin makroekonomik etkilerini değerlendirmek için yenilikçi bir hesaplanabilir genel denge (CGE) modelleme çerçevesi kullanılmıştır.

- Birincil üretim teknolojileri daha fazla enerji tüketmekte olup, ikincil üretime geçiş yeşil dönüşüm açısından önemli bir potansiyele işaret etmektedir. Türkiye'de çelik ve alüminyum gibi sektörlerde ikincil üretim payları %70–80 aralığında oldukça yüksekken, diğer demir dışı metaller ve plastik gibi sektörlerde bu oran %7–25 aralığında oldukça düşüktür. Birincil üretim teknolojileri fosil yakıt girdilerine dayandığı için daha yüksek bir Kapsam 1 (doğrudan) emisyon payına, ikincil üretim ise daha fazla elektrik tüketimine sebep olduğu için daha yüksek bir Kapsam 2 (dolaylı) emisyon payına sahiptir. Bu nedenle, düşük karbonlu elektrik üretimine geçiş, ikincil üretimin emisyon yoğunluğunu birincil üretime kıyasla daha fazla düşürebilecektir.

- Döngüsel ekonomiye geçişte döngüsel tasarım ile kaynak kullanımının azaltılmasına yönelik talep bazlı önlemler ile birincil üretime vergi, ikincil üretime teşvik, metalik olmayan mineral madenciliğine yönelik çıkarım vergisi getirilmesi gibi mali önlenmelerin birleşiminden oluşan karma politikalar benimsenebilecektir.

- Türkiye'de geri dönüşüm potansiyeli düşük olan metalik olmayan mineraller (çakıl, kum, kireç taşı vb.) %85-90 oranla Türkiye'nin malzeme yoğunluğunun merkezinde yer almaktadır. 2022 ile 2030 yılları arasında üretim bazlı malzeme kullanımı kömür için %3, metal cevherleri için ise neredeyse %40 oranında artış göstermektedir.

- İklim değişikliği ile mücadele kapsamında, ulusal katkı beyanı (NDC) çerçevesinde atılacak politikalar fosil yakıt kullanımını azaltırken, kaynak kullanımına daha az etki etmektedir. Öte yandan, döngüsel ekonomiye geçiş ile baz senaryoya göre 2030 yılına kadar kaynak kullanımında %14 oranında düşüş sağlanması mümkündür. Bu noktada, kaynak kullanımının azaltılması gibi talep bazlı politikalar ile ikincil kaynak kullanımının artırılması gibi arz bazlı politikaların beraber uygulanması önem arz etmektedir. Talep bazlı politikaların metalik olmayana minerallerin kullanımında etkili olduğu görülürken, arz bazlı politikalar ise geri dönüşüm potansiyeli olan kaynaklarda etkin olmaktadır.

- Döngüsel ekonomi politikalarının iklim değişikliği ile mücadelede NDC politikalarını tamamlayıcı olduğu görülmektedir. Nitekim NDC ile baz senaryoya göre 2030 yılına kadar

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%22'lik emisyon azaltımı sağlanırken, döngüsel ekonomi politikaları ilave %7'lik bir oranda azaltım sağlanmaktadır.

- Döngüsel ekonomiye geçiş GSYİH'nın %0,5'i ila %1,7'si oranında maliyete yol açması beklenmekte olup, söz konusu maliyetlerin yeni teknolojik gelişmeler, kaynak verimliliği ve çevresel faydalar ile telafi edilmesi öngörülmektedir. Öte yandan, birincil hammaddeler yerine ikincil hammaddelere yönelik talebin artması, Ar-Ge ve inovasyon faaliyetlerini gerçekleştirebilecek yetenekli iş gücüne ihtiyacı artıracaktır.

Ticari etkiler-Döngüsel ekonomiye geçişte Türkiye'nin küresel değer zincirindeki yeri

- Türkiye'deki firmaların neredeyse beşte biri, atık minimizasyonu, geri dönüşüm veya atık yönetimi uygulamalarını içeren kaynak verimli üretim teknolojilerini benimsemiştir. Özellikle, hazır giyim ve tekstil sektörlerindeki firmalar, atık ve geri dönüşüm yönetimini uygulamada metal ürünler ve makine sektörlerindeki firmalara kıyasla çok daha başarılı olmuştur. Türk hazır giyim ve tekstil sektörlerindeki firmaların %40'ından fazlası döngüsellik uygulamalarını benimsemiş olup, bu oran Avrupa ve Orta Asya'daki sektör paydaşlarına kıyasla oldukça yüksektir.

- Ankete katılan firmaların neredeyse %35'i enerji verimliliğini artırmaya yönelik adımlar atmış olup, bu tür girişimler daha çok büyük ölçekli şirketlerde yaygındır. Tekstil sektöründeki firmalar, enerji verimliliği konusunda önemli faaliyetler göstermekte ve bazı bölgesel rakiplerinin önüne geçmektedir.

- Döngüsel ekonomiye (DE) geçiş, için "hafif" ve "iddialı" olmak üzere iki geçiş senaryosu belirlenmiştir.

  Hafif Geçiş: Halihazırda devam eden veya yakın gelecekte uygulanabilecek tedbirlerle malzeme kullanımının daha verimli hale getirilmesini, yeniden kullanım ve geri dönüşümün artırılmasını hedefleyen muhafazakâr bir stratejidir.

  İddialı Geçiş: Daha yüksek çevresel standartların benimsenmesi, ürünlerin, iş modellerinin ve finansman mekanizmalarının kapsamlı bir şekilde yeniden tasarlanmasını içerir. Yüksek riskli ancak yüksek getiri potansiyeline sahip bir strateji olarak, Türk firmalarının daha yüksek katma değerli mal ve hizmetler üretip ihraç etme potansiyelini artırabilir.

- Döngüsel ekonomiye geçişte ön plana çıkan unsurlar arasında karbon ve malzeme verimliliğini artırmak, kaynak akışlarını takip etmek, verimsizlikleri tespit etmek ve atıkları en aza indirmek için etkili ***izlenebilirlik ve sağlam dijital izleme sistemleri*** yer almaktadır. Buna ek olarak, ***geri dönüştürülmüş girdilere erişim ve bunların etkin kullanımı*** önem arz etmekte olup, zayıf döngüsel ekonomi modellerinde geri dönüştürülmüş girdilere olan talep artış eğilimindedir. Bu nedenle yabancı geri dönüştürülmüş malzemelere erişimi güvence altına almak veya yerel geri dönüşüm endüstrisi geliştirmek bu gibi geçiş ülkeleri açısından önemli olmaktadır. Ekonomiler "hafif" döngüsellikten tam döngüselliğe geçtikçe, odak noktası geri dönüştürülmüş girdilere erişimden, ürünlerin kullanım döngüsünde daha uzun süre tutulmasına kaymaktadır. Bu da ***hem yeni malzemelere hem de geri dönüştürülmüş malzemelere olan bağımlılığı azaltmaktadır***.

- Döngüsel ekonomiye geçiş, ekonominin tüm sektörlerinde önemli kaynakları koruyan teknolojilerin devreye alınması, makine modernizasyonu ve iş gücünde malzeme ayak izini azaltacak becerilerin geliştirilmesi gibi ***teknolojik ilerlemeler*** gerektirmektedir. Ancak

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etkili bir geçiş, teknolojik ilerlemelerin ötesinde güçlü bir inovasyon ve Ar-Ge odaklı yaklaşımı da gerektirmektedir.

- Döngüsel ekonomiye geçişin kapsamlı bir finansman mekanizmasına ihtiyaç duyduğu vurgulanmaktadır.

Döngüsel ekonomiye geçişte öncelikli sektörler

- Türkiye’de döngüsel ekonomi potansiyeli yüksek sektörler (örneğin, kimyasallar, temel metal üretimi, plastikler ve metal olmayan mineraller) ile bu sektörlere dayanan temel endüstriler (örneğin, bilgisayarlar, elektronik, gıda ürünleri, makine ve ekipman, motorlu taşıtlar ve tekstil) arasındaki bağlantıların zayıf olduğu tespit edilmiştir. Aynı şekilde, bu temel endüstriler ile iş hizmetleri, taşımacılık ve depolama, toptan ve perakende ticaret gibi hizmetler arasındaki bağın zayıf olması sanayide kaynak paylaşımını zorlaştırmaktadır.

- Bu raporda, TÜBİTAK tarafından belirlenen altı öncelikli sektörde (demir ve çelik, alüminyum, çimento, plastikler, gübreler ve kimyasallar) döngüsel ekonomiye geçişe ilişkin temel boşlukların tespit edilmesi ve politika alanlarının belirlenmesi amaçlanmıştır.

- Türkiye'de döngüselliği teşvik etmeye yönelik düzenlemeler, ağırlıklı olarak atık yönetimi ve geri dönüşüm üzerine odaklanmaktadır. Ancak, değer zincirlerinde daha yukarı yönlü (kaynak kullanımını azaltmaya, kritik hammaddelerin geri kazanılmasına yönelik tasarım, ikincil hammadde kullanımı vb) müdahaleler teşvik edilmelidir.

- ***Çelik/Alüminyum*:** Hurda metalin, alaşımlar veya diğer malzemelerle kirlenmesini önlemek için, ürünlerin daha az alaşım kullanımıyla tasarlanmasını ve metal parçalarının kolayca sökülebilmesi veya ayrıştırılabilmesini sağlayan düzenlemelere ihtiyaç duyulmaktadır. Bu çerçevede bir eko-tasarım mevzuatı ile, geri kazanım sürecinde ana parçaların kolay ayrıştırılması ve alaşımların maksimum içeriği gibi ürün tasarımına ilişkin ana unsurlar belirlenebilir. Bu, geri dönüşüm süreçlerini ve kaynak kullanımını daha verimli hale getirecektir.

- **Çimento:** Malzeme kazanımı sağlanması amacıyla inşaat yıkımının yerini söküm almalıdır. Öte yandan, yeni mevzuatlar ile binalarda modüler tasarımın yaygınlaştırılması, binada kullanılan malzeme envanteri oluşturulmasının malzeme geri kazanımını kolaylaştıracağı değerlendirilmektedir. Yeni yapılarda eski binaların sökümünden elde edilen malzemelerin kullanımına yönelik zorunlu asgari oran belirlenmesi gibi politika seçenekleri değerlendirilmelidir.

- **Plastik:** Türkiye’de plastik geri kazanımı, plastik atıkların kontaminasyonu nedeniyle düşük seviyelerde gerçekleşmektedir. Plastik sektöründe döngüselliği artırmak amacıyla, ürünlerde asgari geri dönüştürülmüş plastik oranı belirlenmesi, üretimde kullanılan katkı maddelerinin sınırlandırılması ve ürün tasarımında çok katmanlı plastiklerin kullanımının azaltılması gibi politikalar belirlenebilecektir.

- **Kimyasallar:** Döngüselliği olumsuz etkileyen katkı maddelerinin kullanımının kısıtlanması gerekmektedir.

- **Gübre:** Fosfor gibi kaynakları yoğun bir şekilde tüketen kimyasal ve mineral gübrelerin sürdürülebilir kullanımı için akıllı tarım uygulamalarını destekleyen düzenlemelerle gübre kullanımının optimize eden ve alternatif biyolojik temelli gübrelerin kullanımını teşvik eden politikalar geliştirilmelidir.

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T.C.
Ticaret Bakanlığı
Uluslararası Anlaşmalar ve AB Genel Müdürlüğü
AB Tek Pazar ve Yeşil Mutabakat Dairesi

AVRUPA BİRLİĞİ'NİN KÜRESEL DEĞER ZİNCİRİ EKOSİSTEMİNDE TÜRKİYE'NİN DÖNGÜSEL EKONOMİYE GEÇİŞİ RAPORU BİLGİ NOTU

Malumları olduğu üzere, Dünya Bankası (DB) tarafından yürütülmekte olan "Türkiye Yeşil Büyüme Analitik Danışmanlık Programı"nın Döngüsel Ekonomi başlığında, Türkiye'nin döngüsel ekonomiye geçişinin makroekonomik ve ticari etkileri ile döngüsel ekonomiyi hızlandıracak öncelikli sanayi sektörlerinin değerlendirilmesine ilişkin bir çalışma yürütülmüştür. Bu çalışmanın ticari etkiler başlığında, Avrupa Birliği'nin (AB) döngüsel ekonomi politikalarının tekstil ve konfeksiyon ile otomotiv ve yan sanayi sektörlerinde Türkiye-AB ticaretine etkileri ele alınmıştır.

Duke Üniversitesi'nden araştırmacılar ile yürütülen çalışma kapsamında, 5-14 Eylül 2023 tarihlerinde ülkemize bir çalışma ziyareti gerçekleştirmiştir. Ziyaret kapsamında, 5 Eylül 2023 tarihinde Bakanlığımızda gerçekleştirilen toplantıda, tekstil ve otomotiv sektörü özelinde Yeşil Mutabakat ve döngüsel ekonomi politikalarına ilişkin atılan adımlar ve önümüzdeki dönemde gerçekleştirilmesi öngörülen mevzuat düzenlemelerine ilişkin olarak, Bakanlığımız, Çevre, Şehircilik ve İklim Değişikliği Bakanlığı ile Sanayi ve Teknoloji Bakanlığı tarafından Dünya Bankası ekibine bilgi verilmiştir. Ziyaretin devamında, 6-13 Eylül 2023 tarihlerinde Bursa ve İstanbul'a saha ziyareti gerçekleştiren ekip, Bakanlığımız koordinasyonunda İhracatçı Birlikleri (UİB-İTKİB) desteği ile otomotiv ve yan sanayi ile tekstil ve konfeksiyon sektöründe önde gelen firmalar ile görüşmeler gerçekleştirmiştir.

AB'nin Küresel Değer Zinciri Ekosisteminde Türkiye'nin Döngüsel Ekonomiye Geçişi Raporunda özetle aşağıdaki hususlar ön plana çıkmaktadır:

- AB tarafından öncülük edilen döngüsel ekonomiye geçiş süreci Türkiye'nin küresel tedarik zincirindeki konumunu güçlendirecek bir fırsat olarak değerlendirilmektedir.

- Döngüsel ekonomiye geçişte sektörel ihtiyaçların göz önünde bulundurulması ve buna göre farklılaştırılmış modellerin uygulanmasının önemi vurgulanmaktadır. Bu çerçevede, kaynakların daha etkin kullanımını, yeniden kullanım ve geri dönüşümü esas alan hafif geçiş senaryosu; innovatif ekosistemin geliştirilmesi, dijitalizasyon, kalifiye yeşil istihdamın geliştirilmesi, ürünlerin, iş modellerinin ve finansmanın kapsamlı bir şekilde yeniden tasarımını içeren iddialı geçiş senaryosu iki alternatif olarak değerlendirilmektedir.

Hafif geçiş senaryosunda;

(i) Firmaların geri dönüşüm hammaddesine ve teknolojilerine erişimi, üretimin izlenmesi için dijital altyapıların tesis edilmesi,
(ii) Özellikle tedarik zincirindeki küçük firmaların dönüşümü için gerekli olan hedefe odaklı finansman ihtiyaçlarının formüle edilmesi (örn. Ortak atık su yönetimi veya çevresel izleme tesislerinin desteklenmesi),
(iii) AB mevzuatlarına vakitli uyum sağlanabilmesi amacıyla AB ile diyaloğun düzenli hale getirilerek artırılması ve döngüsel ekonomiye geçiş konusunda Ticaret Bakanlığı, Çevre, Şehircilik ve İklim Değişikliği Bakanlığı ile Sanayi ve Teknoloji

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Bakanlığı arasındaki koordinasyonun güçlendirilmesi temel adımlar olarak belirlenmiştir.

İddialı geçiş senaryosunda ise;

(i) Kalifiye yeşil yeteneklerin geliştirilmesi ve firmaların döngüsel ekonomiye yönelik farkındalıklarının artırılması,
(ii) Araştırma ve Geliştirme faaliyetlerinin artırılması, yenilikçi sürdürülebilir iş modellerinin geliştirilebileceği bir ekosistem oluşturulması, teşvik ve finansman imkanları oluşturulması,
(iii) Yatırım cazibesinin artırılması amacıyla döngüsel ekonomiye geçişe yönelik uzun vadeli politik kararlılık ve politika tutarlılığı ile güçlü sinyaller verilmesi ön plana çıkmaktadır.

- Türkiye'nin Orta ve Doğu Asya'daki rakiplerine göre Ar-Ge yatırımlarında geride olduğuna, AB tedarik zincirinde yer alan bazı Türk firmalarının polyester geri dönüşümü ve sentetik liflerin susuz boyanması gibi yeni teknolojilere yatırım yaptığından hareketle, döngüsel ekonomiye geçişin bu alandaki boşluğun kapanmasını sağlayacağına işaret edilmektedir. Döngüsel ekonomiye geçiş yönünde ulusal politikalar belirlenmesinin bu süreci hızlandıracağı vurgulanmaktadır.

- Bu çerçevede, kamu ve özel sektör işbirliği ve koordinasyonunun artırılması, yeşil dönüşüm ve ilgili AB mevzuatına uyum kapsamında özellikle KOBİ düzeyinde farkındalığın artırılması, kalifiye personel ihtiyacının giderilmesine yönelik politikalar geliştirilmesi, özellikle geri dönüşüm teknolojileri, sürdürülebilir materyallerin geliştirilmesi gibi alanlarda AR-GE için finansman imkanlarının artırılması, yeşil sanayi bölgeleri ile firmaların yeşil dönüşüm için altyapı imkanlarına erişiminin kolaylaştırılması ortak politika alanları olarak belirlenmektedir.

- Tekstil ve konfeksiyon sektöründe, özellikle tüketim sonrası ürünlerin geri dönüştürülmesine yönelik mevzuat ve altyapı çalışmalarının yapılması, sürdürülebilir tekstil ürünlerine yönelik AR-GE ve yatırımların artırılması ihtiyacı vurgulanmaktadır.

- Otomotiv sektöründe ise elektrikli araca yönelik teknoloji transferinin ve yatırımların artırılması, geri dönüştürülmüş içerik ihtiyacının karşılanması amacıyla ömrünü tamamlamış araç geri dönüşümüne yönelik çalışmalarının artırılması, sadece büyük projelerin değil KOBİ'lerin de ihtiyaç duyduğu finansmana erişimin kolaylaştırılması gibi hususlar ön plana çıkmaktadır.

Döngüsel Ekonomiye geçişte Dünya Bankası tarafından önerilen somut politikalar

1. Geri Dönüşüm Ekosisteminin Geliştirilmesi

a. Mevzuat Düzenlemeleri:
- Geri dönüşümü ve geri dönüştürülmüş içerik kullanımını artıracak teşviklerin sağlanması,
- Malzeme imhasına yönelik vergi teşviklerinin kaldırılması,
- Asgari yatırım limitinin kaldırılması, yatırım süreçlerinin kolaylaştırılması,

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- Ömrünü Tamamlamış Araç (ÖTA) geri dönüşümünün teşvik edilmesi (Fransa örneği[1]), geri dönüştürmek üzere AB'deki ÖTA'lara erişimi kolaylaştıracak mevzuat çalışmaları yapılması, elektrikli araç bataryaları geri dönüşümüne yönelik mevzuat uyumu yapılması,
- Net geri dönüşüm hedefleri, standartları ve sorumlulukları belirleyen mevzuat düzenlemeleri yapılması,
- Atıkların kaynağında ayrı toplanmasını sağlayan ve güçlü uygulama hükümleri bulunan mevzuat düzenlemeleri yapılması,

b. Geri dönüşüm altyapısının geliştirilmesi:
- Gelişmiş geri dönüşüm merkezleri kurulması,toplama merkezlerinin genişletilmesi,
- Yeşil Dönüşüm Merkezi ve Geri Dönüşüm İşleme Bölgesi gibi özel alanlar ile hem ülke içinde toplanan hem ithal edilen atıkların toplanması, ayrıştırılması, geri dönüştürülmesi, sertifikalandırılması gibi tüm işlemlerin tek merkezde yapılabildiği alanlar kurulması, böylelikle Türkiye'nin AB için bir geri dönüşüm merkezi haline gelmesi,
- KOBİ'lerin çevre ayak izi izleme, atık su yönetimi gibi faaliyetlere kolay erişimini sağlayacak paylaşımlı altyapı mekanizmaları kurulması,
- Geri dönüşüm teknolojilerine erişim sağlayacak merkezler kurulması,

c. Farkındalığın artırılması:
- Tekstil ve konfeksiyonların toplanması için depozito uygulaması getirilmesi,
- Kamuoyunda geri dönüşüme ilişkin farkındalık artırıcı faaliyetler yapılması,
- Geri dönüşüm ve atık yönetiminin okul müfredatına eklenmesi

d. Paydaş etkileşimi ve ortaklık gelişimi:
- Geri dönüşüm sektöründeki paydaşları bir araya getirecek platformlar tesis edilmesi
- Yeni oluşacak geri dönüşüm şirketleri için teknik destek gibi imkanlar sağlanması,

e. Finansal teşvik ve destek mekanizmaları:
- Geri dönüşüm tesisi kurulması ve mevcut olanların geliştirilmesi için teşvikler sağlanması,
- Çöp sahasına giden atığın azalmasına katkı sağlayan işletmelere vergi avantajı sağlanması

2. İzleme ve İzlenebilirlik için Dijital Altyapı

a. Ulusal dijital altyapı çerçevesi tesis edilmesi: Dijital Ürün Pasaportu kapsamında talep edilecek bilgilere erişimin kolaylaştırılması için çevresel veriler, yaşam döngüsü analizi, çevre ayak izi gibi verilere erişimin kolaylaştırılması, DÜP altyapısını sağlayacak standart, protokol ve teknolojilere yönelik ortak çerçeve oluşturulması.
Örn: AB Dijital Tek Pazar stratejisi

b. Mevzuat ve idari destek sağlanması:
- Dijital izlemenin zorunlu olacağı mevzuat düzenlemeleri yapılması,
- Dijital izleme sistemlerinde veri güvenliği sağlayacak yasal güvencenin getirilmesi
Örn: AB Genel Veri Koruma Tüzüğü (GDPR) mevzuatı

[1] ÖTA toplama ve geri dönüşüm merkezleri kurulmasını dağlayan mevzuat çıkarılmıştır, ÖTA'lar 2006 yılından beri Genişletilmiş Üretici Sorumluluğu uygulamalarına tabi olup, araç satıcılarının araçların toplanması ve geri dönüştürülmesinden sorumlu ÖTA merkezleri ile ağ kurması zorunludur. Fransız mevzuatı ile eski otomotiv parçalarının yeniden kullanımı teşvik edilmektedir.

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c. Dijital İzleme Teknolojileri:
- DÜP için gerekli olacak verilerin paylaşımı için Ulusal Dijital Platform kurulması,
- Donanım ve yazılım altyapı tesisi için yatırımların teşvik edilmesi, bu altyapıya sahip yeşil sanayi parkları kurulması,
- Nesnelerin interneti (IoT) ve blockchain teknolojilerinin kullanımının yaygınlaştırılması, pilot projeler geliştirilmesi,

d. **Kapasite gelişimi ve eğitim:** Dijital teknolojilerin kullanımı için eğitim programları düzenlenmesi,
Örn: AB Dijital Yetenekler ve İşler Koalisyonu

e. Altyapı gelişimi içim kamu-özel işbirliği:
- Ortak dijital altyapı geliştirilmesi,
- Özel sektörün dijital izlenebilirlik teknolojilerine yatırımını özendirici finansman mekanizmaları veya vergi avantajları sağlanması,
Örn: Akıllı Şehirler Girişimi

f. Paydaş etkileşimi ve işbirliği: Kamu, endüstri, akademi ve sivil toplumun işbirliği yapabileceği platformlar kurulması
Örn: Sürdürülebilir Kalkınma Verisi için Küresel İşbirliği

g. **Finansal destek:** KOBİ'lere sürdürülebilirlik sertifikalarına ve danışmanlara erişim için finansman desteği sağlanması,

h. **Tek pencere internet sitesi:** AB mevzuatlarına ilişkin tüm bilgilere erişim sağlayacak bir internet sitesi kurulması, bu sitenin KOBİ'lerin izlenebilirlikle ilgili enstrümanlara erişimini kolaylaştırması,

3. Döngüsel Ekonomi Dönüşümü Maliyetini Düşürecek Ortak Altyapı Tesisi

a. Ortak çevresel altyapı tesisi:
- Sanayi bölgelerinde ortak atıksu yönetimi altyapısı tesis edilmesi,
- Ortak emisyon, atık, kaynak kullanımı izleme sistemi tesis edilmesi,
- KOBİ'ler için kullandıkça öde modeli sistemler tesis edilmesi,
Örn: ortak çevresel altyapıların kullanıldığı yeşil sanayi bölgeleri

b. Yeşil dönüşüm merkezi, yeşil sanayi parkı kurulumu:
- Yeşil dönüşüm merkezi ve yeşil sanayi parklarının taşıması gereken kriterlere ilişkin bir sertifikasyon sistemi çıkarılması, söz konusu kriterlere uygun alanlara teşvik verilmesi, bu alanları kullanan firmalara vergi avantajı sağlanması,
- Bu alanlar vasıtasıyla yeşil dönüşüm için teknolojik ve teknik danışmanlık sağlanması, firmalara yeşil uygulamalara ilişkin eğitim sağlanması

c. **Mevzuat uyumunu kolaylaştırıcı uygulamalar**: Tüm ilgili mevzuat ve kılavuzları bir arada sunan bir internet portalı oluşturulması, mevzuatlara ilişkin danışmanlık hizmeti sağlanması
Örn: AB Dijital Tek Geçiş-EU Single Digital Gateway ile tüm çevre mevzuatına tek kanaldan erişim sağlanmaktadır.

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d. **Bilgi paylaşımının kolaylaştırılması**: Kamu ve özel sektörün düzenli bilgi paylaşımı için mekanizmalar tesis edilmesi, işletmelerin bilgiye erişebileceği dijital platformlar kurulması

4. Yeni Finansman Mekanizmaları Tesis Edilmesi

a. **Yeni finansman modelleri**: büyük firmaların sağlayacakları garanti ile tedarik zincirindeki küçük firmalara uygun koşullarda finansman sağlanması

b. Odaklı finansman çözümleri:

- Yeşil dönüşüm ve teknolojileri kullanan firmalara vergi avantajı sağlaması, avantajlı finansman imkanları sağlanması, teşviklere erişimin kolaylaştırılması
- KOBİ'lerin sürdürülebilirlik sertifikalarına erişimi için finansman sağlanması,
- AR-GE merkezleri için ilave finansman imkanları sağlanması,
- Kamu-özel işbirliği modeli ile finansmana erişim sağlanması,
- Finansman imkanlarının çeşitlendirilmesi

5. AB ile İşbirliği

a. **Türkiye-AB idari diyalog platformu:** AB mevzuatlarının daha doğru anlaşılması ve mevzuat uyumunun kolaylaştırılması için düzenli diyalog mekanizması tesis edilmesi

- Ticaret Bakanlığı, Çevre Şehircilik ve İklim Değişikliği Bakanlığı ve Sanayi ve Teknoloji Bakanlığı ile Avrupa Komisyonu muhataplarının düzenli bir araya gelebileceği ikili bir komite tesis edilmesi, söz konusu komitenin 3 ayda bir toplantı gerçekleştirmesi,
  Örn: AB-ABD Ticaret ve Teknoloji Konseyi

b. **AB mevzuatlarına uyum takviminin belirlenmesi**: Uyumun getireceği finansal maliyetler dikkate alınarak en doğru zamanlamanın belirlenmesi

- Uyum maliyetlerine ilişkin sektörel etki analizi çalışmaları yapılması, öncelikli alanların ve sektörlerin belirlenmesi

c. AB mevzuatlarına ilişkin farkındalık artırıcı faaliyetler: AB mevzuatlarına ilişkin güncel bilgilere erişim için çevrimiçi platform tesis edilmesi, KOBİ'lere yönelik sektör spesifik eğitim faaliyetleri yapılması

d. AB kamu ve özel sektör yatırım ve finansman imkanlarının artırılması

e. AB'den teknoloji transferi için işbirliği mekanizmaları: Üniversiteler ile işbirliği tesis edilmesi, AB üniversitelerinde burs imkanları sağlanması

6. Kamuda Kurumsal Koordinasyonun Artırılması

a. **Döngüsel ekonomi komitesi tesis edilmesi:** Ticaret Bakanlığı, Çevre Şehircilik ve İklim Değişikliği Bakanlığı ve Sanayi ve Teknoloji Bakanlığı'ndan oluşan bir döngüsel ekonomi komitesi kurulması,

b. **Ulusal döngüsel ekonomi çerçevesi uygulanması**

c. **Tüm sektörleri ilgilendiren yatay alanlara ilişkin çalışmalar yapılması**: Atık yönetimi, geri dönüşüm, dijital izleme ve izlenebilirlik gibi öncelikli alanlarda çalışma grupları tesis edilmesi

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d. **İşbirliği ve bilgi paylaşımı için dijital imkanların kullanılması**: Farklı Bakanlıklar arasında gerçek zamanlı bilgi değişimini sağlayacak dijital platform tesis edilmesi, Bakanlıkların araştırma, iyi uygulama örnekleri, politika belgeleri ve proje sonuçları gibi faydalı bilgilere erişiminin kolaylaştırılması

Örn: Avrupa Komisyonu Döngüsel Ekonomi Paydaş Platformu- Circular Economy Stakeholder Platform

e. Kurumlar arası inceleme ve geri bildirim mekanizmaları kurulması: Sürdürülebilirlik girişimlerini izlemek, değerlendirmek ve gerekli düzenlemeler yapmak için yapılandırılmış süreçler oluşturmak.

- Yıllık koordine toplantıları düzenlenmesi.
- Geri bildirim ve uyum süreçlerinin oluşturulması.

Örn: OECD'nin Çevresel Performans İncelemeleri modelinin Türkiye için uyarlanması.

f. Kapasite geliştirme ve kurumlar arası eğitim programlarının güçlendirilmesi: Kamu personelini sürdürülebilirlik ve döngüsel ekonomi girişimlerine katkı sağlayacak şekilde eğitmek.

- Eğitim programları geliştirilmesi.
- Kurumlar arasında değişim programlarının uygulanması.

Örn: Birleşmiş Milletler Sürdürülebilir Kalkınma Kapasite Geliştirme Stratejisi.

7 Kamu ve Özel Sektör Arasında İşbirliğinin Artırılması

a. Ulusal bir sürdürülebilirlik ve döngüsellik konseyi kurulması.

- Çevre, Ticaret ve Sanayi Bakanlıkları ile özel sektör, akademi ve STK'lardan müteşekkil bir komite tesis edilmesi
- İlerlemenin takibi için iki ayda bir toplantı gerçekleştirilmesi

Örn: Finlandiya'nın Sürdürülebilir Kalkınma Komisyonu.

b. Politika entegrasyonunun artırılması

- Mevcut politikaların ve eksikliklerin tespit edilmesi için bir çalışma yapılması,
- Tüm ilgili politikaları uyumlaştıran net hedef ve takvimi olan bir politika belgesi hazırlanması

c. Kamu-Özel İş Birliklerini Güçlendirme (PPP): Kamu ve özel sektörün kaynak ve yetkinliklerini birleştirerek sürdürülebilirlik ve döngüsel ekonomi geçişini hızlandırmak.

- Kamu-özel iş birliklerini desteklemek için bilgi, rehberlik ve eşleştirme hizmetleri sunacak bir platform oluşturulması.
- Özel sektörü teşvik etmek amacıyla vergi indirimleri, ortak finansman seçenekleri ve düzenleyici kolaylıklar sağlanması.

Örn: Atık yönetimi, geri dönüşüm ve izleme altyapısı gibi alanlarda PPP pilot projeleri

d. **Kamu kurumları ve özel sektör arasında bilgi akışını ve koordinasyonu artırmak.**

- Kurumlar arası çalışma grupları kurulması.
- Dijital platformlar aracılığıyla gerçek zamanlı bilgi paylaşımı ve proje koordinasyonu.

Örn: Sürdürülebilirlik projelerine özel bir çevrimiçi portal geliştirilmesi.

e. Kapasite Geliştirme ve Eğitim Programlarının Yaygınlaştırılması

- Sürdürülebilirlik ve döngüsel ekonomi eğitimi için modüller geliştirilmesi.
- Özel sektör liderleri için liderlik programları sunulması.

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Örn: Hollanda'nın Çok Paydaşlı Sürdürülebilir Beceri Programı.

f. Şeffaflık ve Paydaş Katılımının Teşvik Edilmesi

- Kamuya açık istişareler düzenlenmesi.

- Sürdürülebilirlik hedeflerine dair ilerleme raporlama sisteminin oluşturulması.

Örn: Ulusal Sürdürülebilirlik Forumu düzenlenmesi.

8. Tam dönüşüm için uzun vadeli stratejiler

Türkiye'yi küresel pazarda sürdürülebilir üretim merkezi olarak konumlandırmak amacıyla atılabilecek adımlar

a. İnsan kaynağı gelişimi ve farkındalık artışı

- Yeşil beceriler geliştirilmesi ve döngüsel ekonomi farkındalığının artırılması.

b. **Yenilikçi ekosistem geliştirilmesi:** Ar-Ge ve inovasyonun teşvik edilmesi, teknoloji transferi için AB yenilikçi ekosistemi ile işbirliği

c. Sürdürülebilir, kapsayıcı ve döngüsel ekonomi için ulusal politika oluşturulması

- Değişen döngüsel ekonomi ekosisteminin Türkiye'nin küresel pozisyonunu güçlendirmek için bir fırsat olarak değerlendirilmesi, AB döngüsel ekonomi mevzuatlarına uyumun sanayiciler için az maliyete yol açarken AB pazarına giriş için avantaj sağlayacak şekilde doğru takvimlendirilmesi,
- Tekstil ve hazır giyim sektöründeki iyi uygulama örnekleri ve politika önerilerinden faydalanılması

  Örn. Hazır giyim atığının toplanması için depozito sistemi geliştirilmesi
- Yeşil yeteneklerin geliştirilmesi, yeşil altyapı ve geri dönüşüm ekosistemi tesis edilmesi, finansmana erişimin kolaylaştırılması
- Türkiye'nin bir **sürdürülebilir üretim üssü** olarak markalaştırılması,
- Uluslararası bir ajans ile "Sürdürülebilir Türkiye" markasının geliştirilmesi.

  Örn.Sürdürülebilir Moda Haftası gibi etkinliklerin düzenlenmesi.

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Table of Contents

Introduction 1

1. Macroeconomic Impacts of the CE Transition in Türkiye 3

An innovative analytical framework tailored to Türkiye 3
Türkiye's material demand is expected to increase despite improvements in material intensity 5
CE policies can support the achievement of Türkiye's climate mitigation objectives 6
Rather than single measures, supporting the transition will require policy packages 6
The economic dividend of supporting the transition can be reaped by addressing Türkiye's existing skills gap 8

2. Positioning Turkish Industry in Circular Global Value Chains 10

Adoption of CE practices in Turkish industry 10
Two possible CE futures for Türkiye 11
Factors enabling CE readiness 12
The way forward under a 'light' CE transition 13
The way forward under an 'ambitious' CE transition 13

3. Prioritizing Industries for Building a Competitive Circular Economy in Türkiye 15

Key characteristics of circular networks 16
Policies for a competitive CE transition in targeted sectors 16
Next steps 17

Conclusions 20

ANNEX 1: Industries Related to TÜBİTAK's Priority Products and Strongly Related to Them—Industries with Potential for Circularity 21

ANNEX 2: Industries (NAICS4) Supporting TÜBİTAK's Priorities and Strongly Related Products 25

Figures:

Figure 1. Carbon intensity by emission scopes (kg CO_2 per US$) and shares in total output for selected sectors in Türkiye 4
Figure 2. Scenario framework 5
Figure 3. Economy-wide CO_2 emissions from NDC implementation and CE measures 6
Figure 4. Impact of different policies on material use (right axis) and GDP material intensity (left axis) (2030 with respect to baseline, percent) 7
Figure 5. Change in real GDP across scenarios with respect to baseline, percent 8
Figure 6. Adoption of CE practices 11
Figure 7. Two CE transition scenarios for Türkiye 12
Figure 8. Core, strongly related, and supporting industries with the most extensive connections to other industries 18

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Introduction

Economic and population growth over the past 50 years have increased global natural resource use to levels that severely affect human well-being. Global demand for material resources has increased more than three times over the past 50 years and could increase by almost 60 percent from 2020 levels by 2060, from 100 to 160 billion tons (UNEP 2024).[1] Already today resource extraction and use are key drivers of natural resource degradation, pollution, climate change, and biodiversity loss. For example, materials management, including the production, consumption, and disposal of materials, products, and infrastructure, contributes up to two-thirds of global greenhouse gas (GHG) emissions. Similarly, 90 percent of total biodiversity loss and water stress impacts and 33 percent of health effects of air pollution are directly linked to resource extraction and processing (UNEP 2019).[2] Ballooning resource consumption also has trade and security implications, raising concerns over potential future resource shocks and supply failures worldwide. As material extraction and use attain ever higher levels, so do the corresponding environmental, social, and economic impacts.

In Türkiye, as elsewhere, economic and population growth have been accompanied by increasing levels of material consumption and waste. Domestic extraction of natural resources increased from 558 million tons in 2000 to over 2 billion tons in 2021.[3] At the same time, domestic material consumption (DMC) increased from 630 million tons in 2000 to 980 million tons in 2021.[4] While the generation of Türkiye's municipal waste is below the average of the Organisation for Economic Co-operation and Development (OECD) and the recycling rates are increasing, a large share of municipal waste is sent to landfills. Even though recycling of municipal waste has increased from 13 percent in 2017 to 27.2 percent in 2021 and further to almost 35 percent in 2023,[5] the goal stated in the "Zero-Waste Initiative" (see below) is to reach 60 percent by 2035. Some 30.3 million tons of municipal waste was generated in a single year (2022)[6] compared to less than 60 million tons of recycled waste collected over seven years in 2017–2023, which indicates opportunities for further improvements in this important aspect of circularity. In terms of individual materials, a share of secondary steel production is significant (over 70 percent), while the recycling rate of plastics is less than 6 percent.[7]

The need to transition away from current 'linear' resource use patterns is conceptualized and promoted within the circular economy (CE) concept. In the linear 'take-make-use-dispose' economy, products generally become waste once they have reached the end of their useful life. The transition to a low-carbon and circular economy requires a change of approach aimed at decoupling natural resource extraction and use from economic output.[8] In the European Union (EU), the CE is defined as an economic system where the value of products, materials, and other resources in the economy is maintained for as long as possible, enhancing their efficient use in production and consumption, thereby reducing the environmental impact of their use and minimizing waste and the release of hazardous substances at all stages of their life cycle, including through the application of the waste hierarchy (EU

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[1] UNEP (United Nations Environment Programme). 2024. "Global Resources Outlook 2024: Bend the Trend - Pathways to a Livable Planet as Resource Use Spikes." International Resource Panel. Nairobi, Kenya.
[2] UNEP (United Nations Environment Programme). 2019. "Global Resources Outlook 2019: Natural Resources for the Future We Want." International Resource Panel. Nairobi, Kenya.
[3] https://www.materialflows.net/visualisation-centre/country-profiles/.
[4] https://data-explorer.oecd.org/vis?lc=en&tm=Material%20resources&pg=0&snb=17&df[ds]=dsDisseminateFinalDMZ&df[id]=DSD_MATERIAL_RESOURCES%40DF_MATERIAL_RESOURCES&df[ag]=OECD.ENV.EPI&df[vs]=1.0&pd=2000%2C2021&dq=TUR.A.DMC.T.TOT&ly[cl]=TIME_PERIOD&to[TIME_PERh.
[5] Ministry of Environment, Urbanization and Climate Change. https://cygm.csb.gov.tr/sifir-atik-ile-geri-kazanim-orani-35e-ulasti.-haber-286897.
[6] Turkish Statistical Institute, https://data.tuik.gov.tr/Bulten/Index?p=Waste-Statistics-2022-49570&dil=2.
[7] Karasik, R. 2022. "Plastic Pollution Policy Country Profile: Turkey." Duke Nicholas Institute for Environmental Policy Solutions, Policy Brief. https://nicholasinstitute.duke.edu/sites/default/files/projects/Plastic-Pollution-Policy-Country-Profile-Turkey.pdf.
[8] Decoupling refers to a state of the economy that shows growth which is not accompanied by increases in environmental (for example, material use) pressures. Under *absolute decoupling,* the environmental pressures decline or stay stable over time. Under *relative decoupling,* the environmental pressures increase at a lower rate than the growth of the economy (for example, gross domestic product [GDP] growth rate).

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2020).[9] However, getting there requires political commitment and long-term targets, as well as economic incentives and support for businesses and consumers to change course.

Türkiye recognizes that it must transition to a more 'circular' and material-efficient growth model. Türkiye launched its Zero-Waste Initiative in 2017 and the CE is flagged as a priority in the 2021 Economic Reform Program. Türkiye's ambitious goals include creating 100,000 new jobs in zero-waste management systems, achieving over US$2 billion savings by 2023, and reaching a recycling rate of municipal waste 60 percent by 2035. Türkiye has also ratified the Paris Agreement, developed the country's Nationally Determined Contribution (NDC), and announced the net zero emissions target by 2053. In addition, the Green Deal Action Plan of Türkiye was published in 2021 with the aim of establishing Türkiye's alignment with the European Green Deal, including on issues related to the green and circular economy. To complement the net zero emissions target and the objectives of the Green Deal Action Plan of Türkiye, in 2022, the government announced a multitude of decisions (217) taken by the Climate Council, contributing to the fight against the impacts of global warming and waste management. One decision, for example, involves the acceleration of separate waste disposal with a focus on recycling and the rejection of waste not pre-processed from disposal facilities. CE is also prominently featured in the Twelfth Development Plan (2024-2028), adopted in October 2023, which includes sector-specific objectives for the manufacturing, chemicals, electrical equipment, automotive, agriculture and food, energy, and construction. Currently, the government is finalizing a national CE Strategy and Action Plan.

Türkiye's membership in the EU-Türkiye Customs Union is a key driver of the CE transition in Türkiye. The EU is by far Türkiye's main trade partner, with trade relations based on an Association Agreement from 1963 and a Customs Union Agreement, which entered into force in 1995. In 2023 over 41 percent of Türkiye's exports went to the EU, led by machinery and transport equipment (automotive), clothing, chemical products, agriculture and raw materials. As the EU's CE policies evolve and become more stringent, for example with the introduction of product-level standards such as recycled material use requirements and product environmental footprints, Türkiye will need to ensure regulatory alignment to maintain preferential access to the EU internal market.

A successful CE transition in Türkiye will also help the EU achieve its CE goals of enhancing material efficiency and reducing environmental impact. A significant portion of the EU's material consumption and footprint is based on imports, with 11 percent of domestic material consumption and nearly 36 percent of the total footprint being imported.[10] A CE transition in Türkiye will therefore also benefit the EU's CE transition, as it will be difficult for the EU to achieve CE objectives alone, especially in textile and automotive sectors for which it has highly intertwined value chains. Türkiye is a central partner in these industries and therefore has a significant influence on promoting sustainable practices and technologies also in the EU. Given the tight trade relationship between the EU and Türkiye, the EU's transition to a CE is best achieved through cooperative and collaborative strategies with Türkiye's government and firms, including those on the periphery of the supply chain.

This report[11] highlights the importance of a deliberate, strategic, and articulated approach toward transitioning the Turkish economy to a CE, blending immediate actionable steps with a forward-looking long-term strategy. By moving forward with flexibility and vision, Türkiye can use its distinct advantages to not only respond to the changing global economy but also to lead in sustainable innovation and resilience, establishing a model for others in the worldwide move toward a more circular and thriving future.

[9] EU (European Union). 2020. "Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088." https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32020R0852.

[10] World Bank. 2022. *Squaring the Circle - Policies from Europe's Circular Economy Transition*.

[11] This paper presents the summary of World Bank policy analytics focused on the economic, trade, and industry aspects of the CE transition in Türkiye. The analysis summarized in this report, focuses on three components: (a) macroeconomic impacts of CE policies, (b) exposure to evolving CE policies in major trade partners, and (c) prioritization of the industrial sectors that can accelerate the CE transition.

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1. Macroeconomic Impacts of the CE Transition in Türkiye

To understand the opportunities and challenges of the CE transition in Türkiye, this chapter explores a set of policy scenarios, using an economy-wide modeling framework. The chapter investigates the implications of CE-specific policy measures on various dimensions of Türkiye's economic, social, and environmental well-being, such as resource productivity, competitiveness, environmental sustainability, inclusion, economic security, and developmental impacts. The analysis uses a baseline scenario in which Türkiye and other countries implement their NDCs[12] and a stylized representation of the policy package necessary to support Türkiye's CE transition, thus allowing quantification of their potential economic impacts and trade-offs.

An innovative analytical framework tailored to Türkiye

This analysis deploys an innovative computable general equilibrium (CGE) modeling framework to assess—for the first time—the macroeconomic impacts of the CE transition in Türkiye. The economy-wide CGE framework[13] uses a specific version of the Global Trade Analysis Project (GTAP) Circular Economy Database (GTAP-CE), which introduces additional disaggregation of certain sectors and incorporates material flow accounting for the selected commodities.[14] In addition to allowing for a detailed representation of the alternative production technologies[15] and underlying virgin materials, this framework enables an understanding of the effects of specific CE policies and measures, including by modelling the GHG emission effects of alternative production technologies and materials.

A central goal of the analysis is to understand the interaction between CE policies and objectives and Türkiye's climate-change-related policies and objectives. Figure 1 provides an overview of carbon intensity by emission scopes[16] and the share of output across production technologies[17] for selected sectors in Türkiye as represented in the GTAP-CE Database. Three important observations arise from this representation. *First,* there is a substantial gap in emission intensities between primary and secondary production technologies as primary production technologies require more substantial energy inputs. Such a gap in emission intensities requires a mitigation potential for transitioning from primary to secondary production technologies. *Second,* there is a substantial variation in primary versus secondary output shares across sectors in Türkiye. While sectors like steel and aluminum have relatively high secondary production shares (in a range of 70–80 percent), other sectors, including other non-ferrous metals and plastic show substantially lower shares of secondary production (in a range of 7–25 percent), thus indicating different opportunities in improving circularity practices across various activities. *Finally,* there is a difference in the composition of emissions by scope across primary and secondary production technologies. In a number of commodity cases, such as steel, copper, aluminum, and other metals, primary production technologies have a higher share of scope 1 emissions because they rely on fossil fuel inputs. Secondary production is more electricity intensive and thus has a higher share of scope 2 emissions. This also means that decarbonization of electricity generation would reduce the emission intensity of secondary production more (in relative terms) than of primary production.

[12] Based on the first round of NDC submissions.
[13] The analysis relies on the recursive dynamic global CGE model ENVISAGE, calibrated to the GTAP-CE database (van der Mensbrugghe 2019). The model captures the transactions between all key agents in the economy. Firms purchase input factors (for example energy, materials, labor and capital) to produce goods and services. Households receive the factor income and in turn demand the goods and services produced by firms. Equality of supply and demand determines equilibrium prices for factors, goods and services. (van der Mensbrugghe, D. 2019. "The Environmental Impact and Sustainability Applied General Equilibrium (ENVISAGE) Model. Version 10.01." Center for Global Trade Analysis, Purdue University. https://mygeohub.org/groups/gtap/envisage-docs.)
[14] The GTAP-CE database introduces sectors splits, which provide a more detailed representation of categories like metallic and non-metallic minerals mining, rubber and plastic products, iron and steel, as well as non-ferrous metals. Corresponding sectoral splits are developed for all 141 regions reported in the GTAP database, including Türkiye as an individual country. Implemented disaggregation utilizes data on cost structures and output values of the sectors under split, as well as captures the bilateral trade patterns of the commodities in focus. Introduced distinction in production technologies for such sectors as plastic, iron and steel, aluminum, copper, and other non-ferrous metals allows to separate primary (relying on virgin materials, for example, iron ore) and secondary (for example, production using recycled scrap) production processes.
[15] These might include a representation of the primary and secondary production processes, recycling activities versus activities using virgin inputs (for example, metal ores, fossil fuels, non-metallic minerals, and so on).
[16] Carbon intensity refers to emissions per USD 1 of final use (consumption or export) of the corresponding product.
[17] Output refers to domestic (Türkiye's) output/production of the corresponding commodity.

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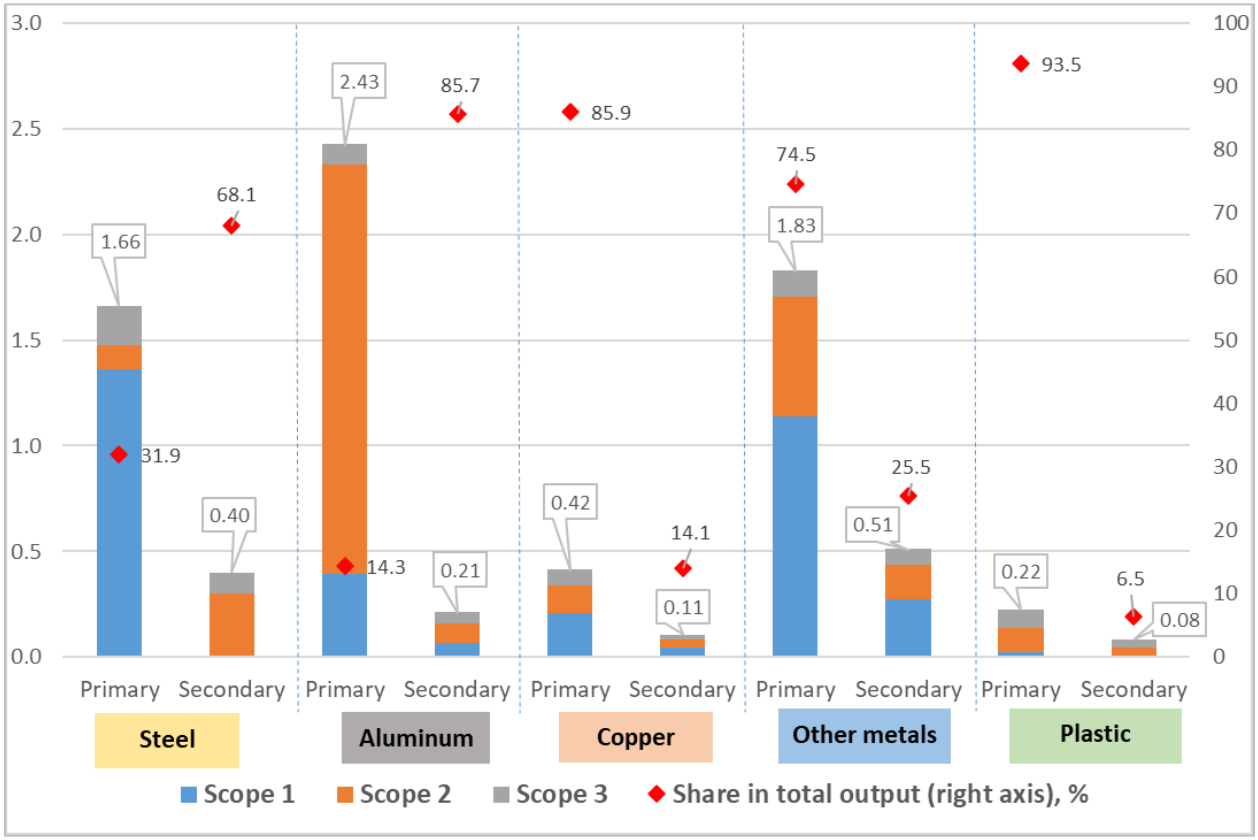
Figure 1. Carbon intensity by emission scopes (kg CO_2 per US$) and shares in total output for selected sectors in Türkiye



Source: Original elaboration.
Notes: Scope 1 emissions correspond to direct emissions from the combustion of fossil fuels. Scope 2 emissions are associated with emissions from the generation of electricity used in the corresponding production process. Scope 3 emissions are all the remaining emissions throughout the value chains embodied in the corresponding commodity (for example, emissions from the production of tires used in the car manufacturing).

The analysis consists in testing the effects of a set of CE-specific measures imposed on top of a baseline and a climate mitigation scenario. The baseline scenario covers 2014–2030 with given growth rate assumptions for GDP and population and static fiscal policies. The mitigation scenario incorporates Türkiye's NDC from 2021, which assumes a 21 percent reduction in GHG emissions in 2030 compared to the baseline. The CE-specific measures cover both demand/use-side interventions, as well as fiscal measures (see Figure 2). Demand-side measures include a consumption bundle shift (reduction in demand for material-intensive sectors with a compensating increase in demand for other goods and services), change in material design (reduction in the intermediate use of materials with a compensating increase in demand for services such as engineering and design), and lifetime extension (reduction in the final consumption of manufactured goods and increasing demand for services to maintain a longer lifetime for these commodities). Fiscal measures include an extraction tax on non-metallic minerals mining, production tax on primary activities and subsidy to secondary activities for metals and plastic, subsidy to the secondary production of metals and plastic, and a combination of extraction taxes and taxes on primary production activities. In addition, to explore the potential synergies and tradeoffs across various policies and measures, the combined scenario is developed, which merges a consumption bundle shift, design change, and an extraction tax.

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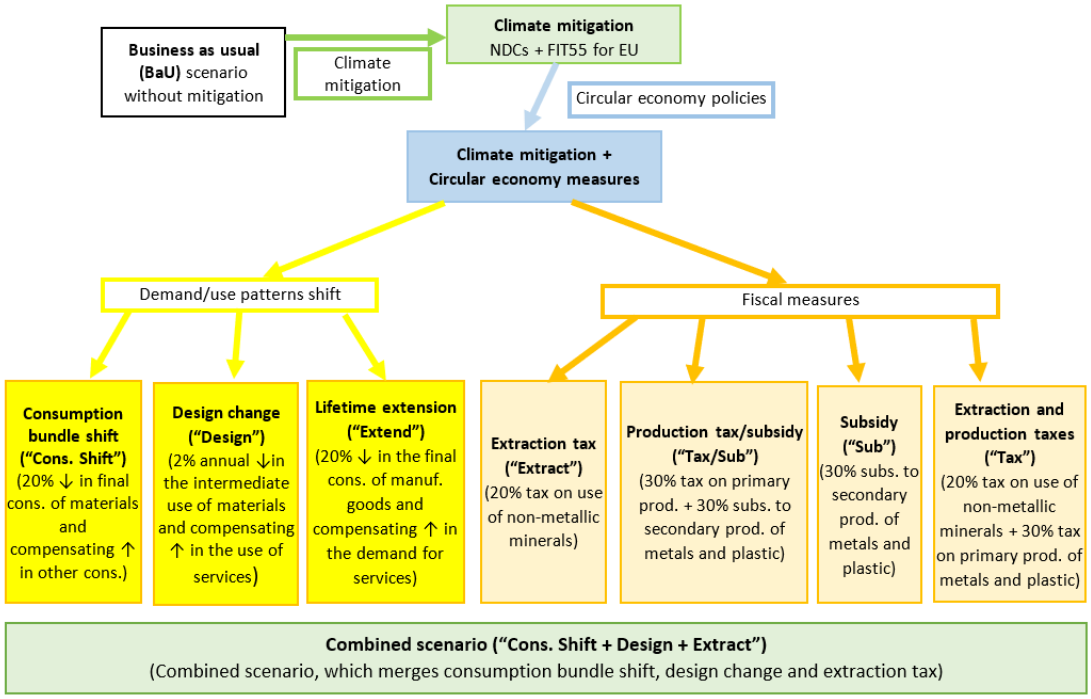
Figure 2. Scenario framework



Source: Original elaboration.

Türkiye's material demand is expected to increase despite improvements in material intensity

Non-metallic minerals currently dominate supply and demand and are central to Türkiye's material intensity. In volume terms, both from the production- and consumption-based perspectives,[18] non-metallic minerals (gravel, sand, limestone, and so on) dominate the mix, accounting for around 92 percent and 85 percent of the composition, respectively. This share is lower from the consumption-based perspective, reflecting that Türkiye is an importer of fossil fuels. In general, non-metallic minerals and their products (for example, concrete) have lower recycling opportunities compared to some other raw inputs, such as metal ores, partly reflecting their relatively low economic value and thus the economic benefit from recycling (for example, it is much more economically attractive to recycle copper or gold than concrete or asphalt). In this regard, if one focuses on the reduction in economy-wide material intensity considering all material inputs, non-metallic minerals is the commodity group that could allow achieving major progress in this regard.

Türkiye's economy is projected to see an absolute increase in the use of all material inputs, tempered by a moderate reduction in material intensity for all virgin inputs except metal ores. The increase in material use is driven by GDP growth and—to a lesser extent—population growth. Between 2022 and 2030, production-based material use increases anywhere between 3 percent in the case of coal and up to almost 40 percent in the case of metal ores. Similar trends are observed in the case of consumption-based accounting. When these trends are translated to material intensities per unit of GDP, that is, use of materials per US$1000 of GDP (in constant prices), results suggest that the material intensity declines for all commodities except metal ores. The most substantial improvements in material intensity are observed for coal—16–20 percent in 2030 compared with 2022, depending on the accounting approach.

[18] This analysis distinguishes between production-side and consumption-side accounting. *Production-based* accounting adds domestic extraction and imports of the corresponding raw commodity and subtracts exports (all in volume terms). From a *consumption perspective*, raw materials used in the production of exported goods should be considered in the importing country.

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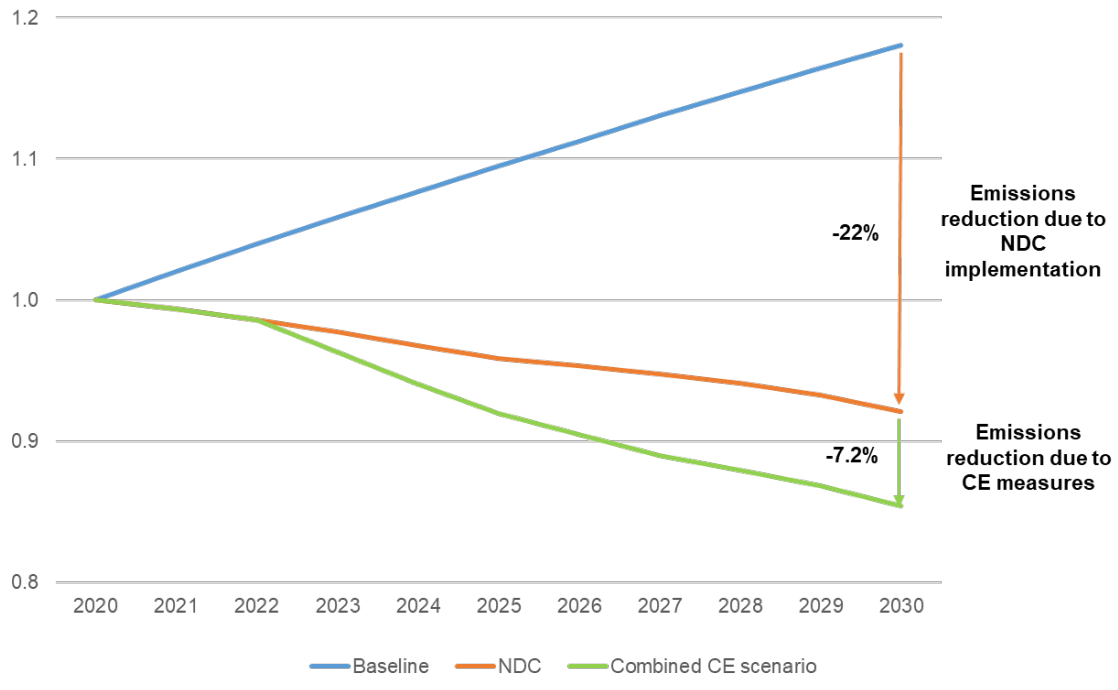
CE policies can support the achievement of Türkiye's climate mitigation objectives

Climate policies alone will not be sufficient to induce circularity and reduce material consumption. The implementation of Türkiye's NDC will reduce fossil fuels use and CO_2 emissions, however, with limited impacts on the use of other materials. In the baseline scenario economy-wide fossil fuel combustion CO_2 emissions increase by around 18 percent in 2030 relative to 2020 levels. In the climate mitigation scenario, emissions from fossil fuel combustion are 22 percent below the baseline or some 8 percent below 2020 levels. In particular, NDC implementation leads to a substantial reduction in the use of coal and—to a lesser extent—gas. The impact of mitigation policies on the use of other materials is less substantial.

However, increasing circularity can help reduce CO_2 emissions in Türkiye. Results suggest that the CE policies in Türkiye can contribute to additional reductions in the fossil fuels combustion CO_2 emissions—by over 7 percent in 2030 on top of the emission reductions in the NDC scenario (Figure 3). As a result, when NDC and combined CE scenarios are implemented simultaneously, CO_2 emissions from fossil fuels combustion decline by almost 28 percent with respect to no-mitigation baseline in 2030 or by 15 percent relative to 2020 levels. In this regard, one might consider CE policies as complementary to climate-specific policies, when achieving pr-defined mitigation targets, thus providing a broader range of potential climate policy options.

Figure 3. Economy-wide CO_2 emissions from NDC implementation and CE measures



Source: Original analysis.

Rather than single measures, supporting the transition will require policy packages

CE policies allow to substantially reduce material demand over time but a combination of various policy measures is needed to effectively support the CE transition. A combination of CE policies can reduce production-based material use by over 14 percent in 2030 compared to the baseline (under the combined scenario, see Figure 4)—an additional 10 percentage points reduction on top of the climate mitigation scenario. Similar reductions are observed for GDP material intensity. Several important policy insights arise from the analysis.

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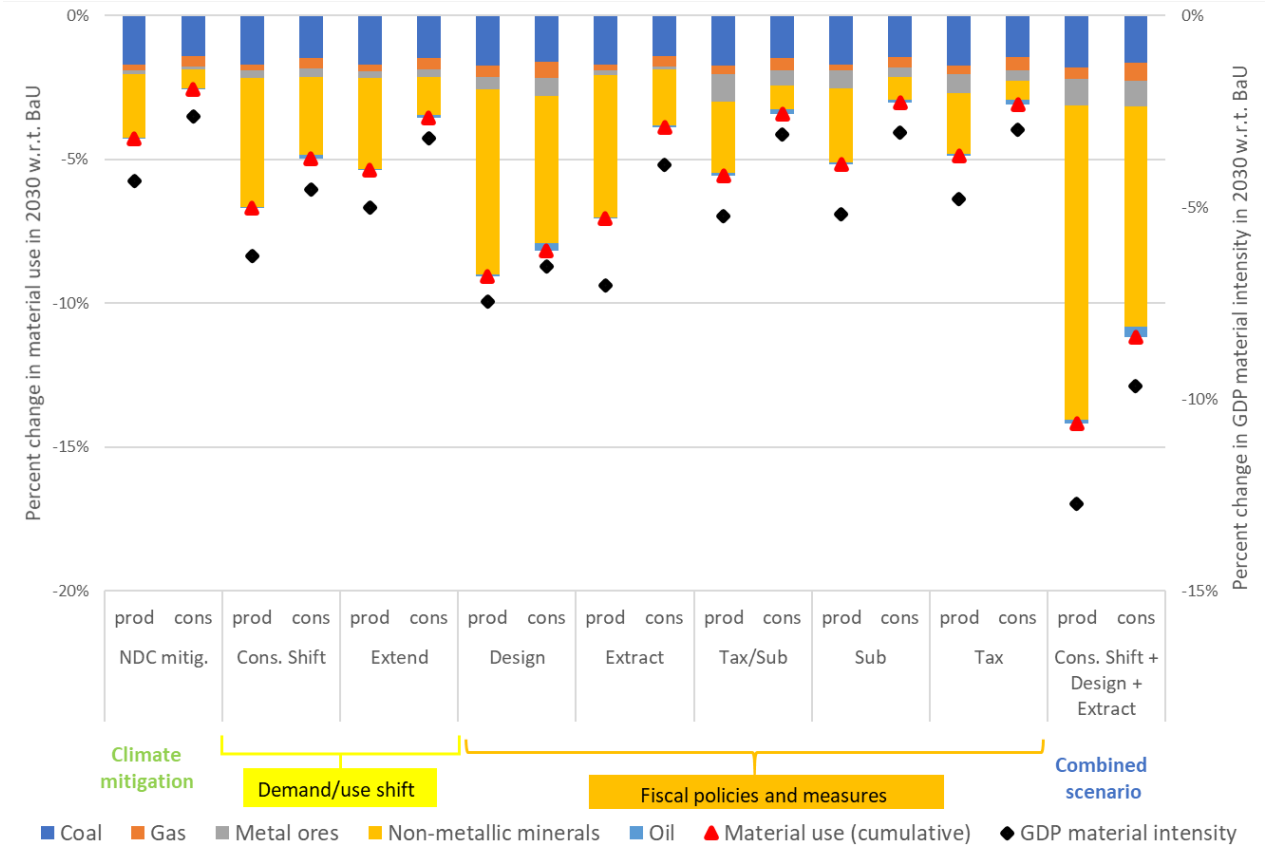
Figure 4. Impact of different policies on material use (right axis) and GDP material intensity (left axis) (2030 with respect to baseline, percent)



Source: Original elaboration.
Notes: The 'prod' and 'cons' labels correspond to production- and consumption-based material accounting methods (quantities). Percent changes are reported relative to the total material use under baseline in 2030.

Combining demand-side and supply-side policies allows for the achievement of more ambitious CE targets. Demand-side measures, such as design change or product lifetime extension, allow reducing overall material demand but have limited impact on the structure of the production processes. In other words, consumers purchase fewer cars but car manufacturers still rely on the primary metals and plastic in the production process. Supply-side measures (for example, extraction tax, production subsidy), on the other hand, are more efficient in changing the composition of technologies, that is, incentivize car manufacturers to rely more on the recycled metals and plastic, thus substituting virgin material inputs. When these two sets of measures are combined, they complement each other—reducing overall material demand and shifting production patterns toward recycled inputs. Results also suggest that the extraction tax, while operating on a much more substantial base (the weight share of non-metallic minerals in the overall material production in Türkiye is around 90 percent, while the share of metal ores is only 2 percent), tends to lead to a more significant reduction in the overall material use compared to subsidies and/or taxes imposed on the primary/secondary production activities. Another observation is that demand-side measures are more efficient in reducing the use of non-metallic minerals, while supply-side measures lead to a more substantial reduction in the use of metal ores by promoting a shift toward recycling activities.

Achieving absolute decoupling is complicated by a substantial share of non-metallic minerals in Türkiye's material use patterns (85–90 percent of total material use). Non-metallic minerals are primarily used in the production of construction materials (gravel, cement, bricks, and so on), which are hard or not economically feasible to recycle. In addition, non-metallic minerals have a long lifecycle with an inflow of raw materials in a specific year substantially higher than the outflow. At the same time, CE policies have a more substantial impact on commodities with higher recycling possibilities, such as plastics and metals, increasing the share of secondary production in 2030 by up to 18 percentage points (in the case of steel) compared to the baseline case – assuming the necessary scrap collection and processing capabilities introduced by modeled policies.

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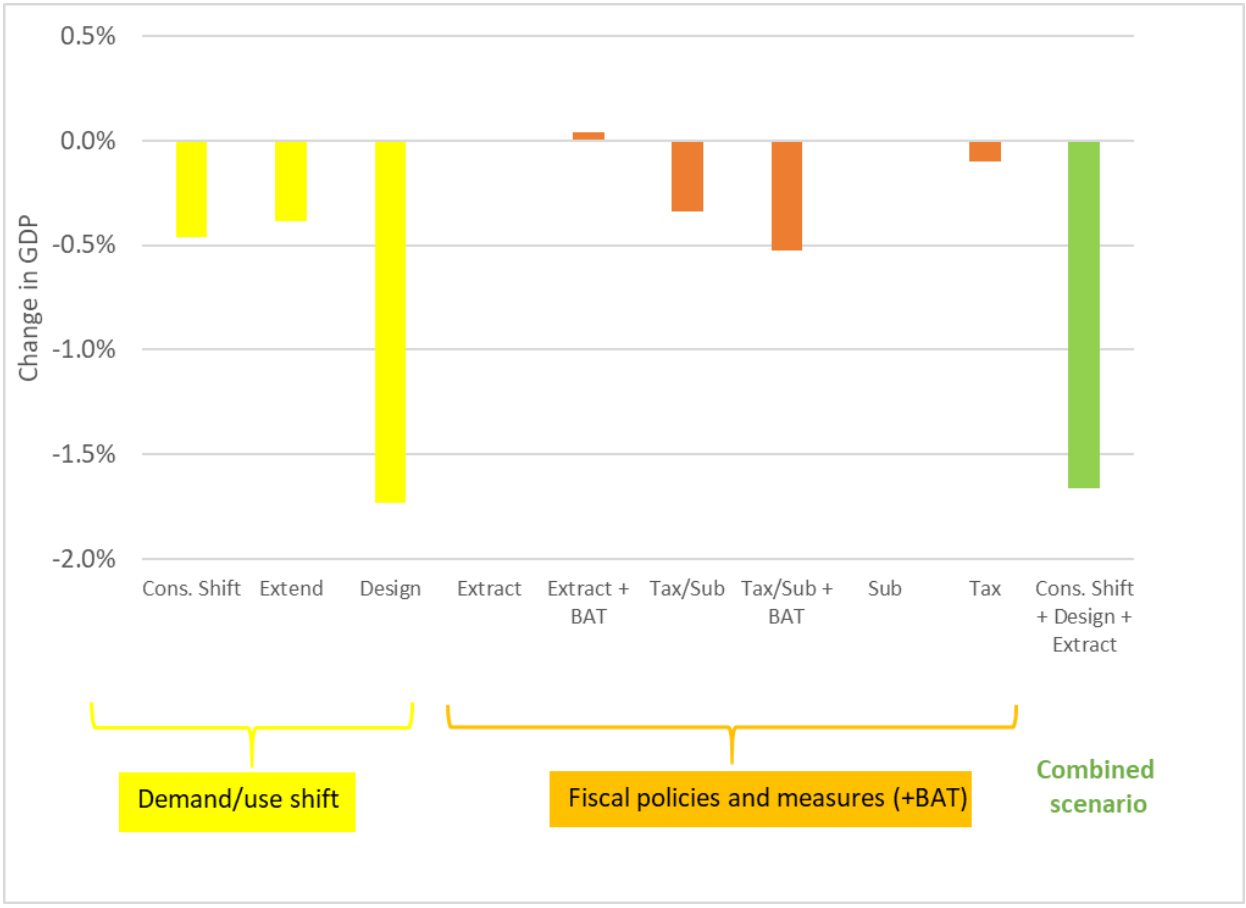
The economic dividend of supporting the transition can be reaped by addressing Türkiye's existing skills gap

The reduction in the EU demand for materials induced by EU CE policies is likely to hurt Türkiye's exports.[19] In line with scenario assumptions, CE measures are implemented simultaneously by the EU and Türkiye. The resulting reduction in the demand for material-intensive goods in the EU results in declining imports of this type of commodities by the EU, including those from Türkiye. Since the EU is a major destination for Türkiye's exporters, this also has a substantial impact on the overall decline in the country's exports and a reduction in the manufactured goods share in the total exports. On the imports side, findings suggest that manufactured goods as well as metals and chemicals are those that experience the most substantial declines in terms of Türkiye's imports from the EU. These findings point to the need for Türkiye to implement ambitious CE policies to retain its future export competitiveness (see Chapter 3).

Figure 5. Change in real GDP across scenarios with respect to baseline, percent



Source: Original elaboration.

The costs of implementing CE policies are relatively moderate (in most cases, within 0.5–1.7 percent of real GDP in 2030 compared to the baseline) and do not include co-benefits of achieving CE objectives. In the combined scenario, real GDP decreases by about 1.6 percent (Figure 5). While this may seem substantial, it is important to note that this figure does not consider multiple co-benefits. For example, reductions in CO_2 are often accompanied with reductions of other air pollutants (for example, SO_2, NO_x, $PM_{2.5}$, and so on). This results in lower mortality rates and can reduce the overall costs of mitigation. Similarly, material extraction is putting major pressure on ecosystems. Reducing material extraction can improve the ecosystem services and provide valuable economic benefits. Finally, additional incentives to apply secondary production technologies and recycling activities could stimulate endogenous technological improvements, thus reducing CE transition costs and strengthening positive spillover effects.

[19] Trade-related results reported in this section correspond to monetary units (value terms).

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While overall macroeconomic costs are expected to be moderate, an increasing skill wage gap might be a concern. A skill wage gap is defined as the ratio between the wages of skilled and unskilled workers. The results suggest that in the case of demand-focused measures, low-skilled workers are affected more adversely than the high-skilled labor force. For instance, changing the design of the products requires additional research and development (R&D) and engineering service inputs but fewer inputs of lower-valued goods, such as raw materials, thus benefiting high-skilled workers. In this regard, targeted policy measures might be needed to mitigate the regressive distributional outcomes of the CE transition and support labor force reskilling.

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2. Positioning Turkish Industry in Circular Global Value Chains

In the context of the EU-Türkiye Customs Union, the CE transition is not only a matter of environmental stewardship but also of strategic alignment with the EU's tightening environmental policies in the context of the Green Deal. As the EU advances toward more sustainable practices, Türkiye, with its deep economic and trade ties to the region, finds itself at a crucial juncture. Embracing CE principles can position Türkiye as a key player in this evolving green landscape, enabling greater economic growth alongside sustainability. The general motivation for Türkiye's transition to a CE is therefore twofold: it addresses the evolving regulatory environment of its principal trade partner, the EU, and it aligns with Türkiye's own environmental and sustainability objectives, exemplified by its ambitious Zero Waste Initiative.

The EU's progression toward stricter environmental standards presents Türkiye with both challenges and opportunities. Adapting offers a chance not just for compliance but for innovation and a more significant role in sustainable global markets. Like all emerging countries, Türkiye faces the choice between continuing to pursue the linear development strategy initiated in past decades or seizing new growth opportunities through the CE transformation. The former, characterized by high resource consumption and waste, poses significant challenges in terms of energy and resource efficiency. Transitioning to a CE offers a pathway to address these challenges. It promises enhanced job resilience and a transformative economic impact by fostering growth in green sectors. This shift allows Türkiye to leverage its strengths while mitigating environmental issues.

The EU's regulatory evolution toward sustainability and circularity, given Türkiye's economic integration with the EU, acts as a powerful catalyst for Türkiye's transformation. Noncompliance with these regulations poses significant risks, including reduced market access and competitiveness, while adaptation could boost Türkiye's economic robustness and secure its EU market position. Proactively engaging with these regulatory changes is crucial for Türkiye's economic prosperity and continued development progress.

This chapter examines the transition of Turkish firms to align with CE principles, highlighting both immediate needs and the longer-term opportunities from engaging in a transition agenda. The chapter stresses that the changing landscape toward CE in the EU offers a significant strategic opportunity for Türkiye to strengthen its position in global markets and build resilience against economic shocks.

Adoption of CE practices in Turkish industry

Nearly one-fifth of Turkish firms have already adopted resource-efficient production technologies, including waste minimization, recycling, or waste management practices.[20] Notably, firms in the garments and textiles sectors have been much more successful in introducing waste and recycling management than their counterparts in fabricated metal products and machinery sectors (Figure 6). While more than 40 percent of firms in the Turkish garments and textiles sectors adopted circularity practices, a proportion substantially higher than the one posted by Europe and Central Asian peers, Turkish firms need to increase the circularity practices in the fabricated metal products and the machinery and equipment sectors, especially in comparison to their peers in Hungary, Poland, and Romania. In line with international evidence, in Türkiye, there was a higher number of larger firms as well as firms selling on the international markets (that is, direct exporters) adopting resource-efficient solutions.

[20] World Bank Enterprise Survey (WBES 2019).

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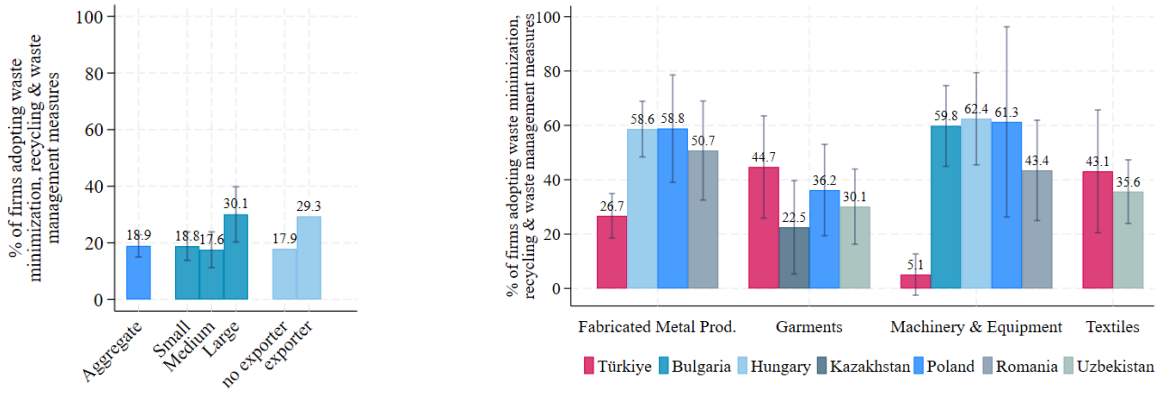
Figure 6. Adoption of CE practices



Source: Original analysis.
Note: These figures shows the percentage of firms that adopted CE practices such as waste minimization, recycling, or waste management in the three years preceding the latest WBES. The left panel depicts adoption rates in the aggregate Turkish economy, broken down by establishment size and export status. The right panel illustrates adoption rates in the four CE priority sectors with representative coverage and adds sectoral averages of surveyed Europe and Central Asian economies with the same industry stratum. Whenever inference is possible, 95 percent confidence intervals are included.

Nearly 35 percent of surveyed firms have taken action on energy efficiency improvements, with such initiatives being more common in larger companies. Companies in the textiles sector show significant energy efficiency activities, outpacing some regional competitors. In contrast, Turkish firms need to increase energy efficiency in the machinery and equipment sector, especially in comparison to their peers in Bulgaria, Hungary, and Poland. Among non-adopters, there is a noted lack of financial resources and prioritization for these initiatives, especially among smaller and domestic-oriented firms.

Turkish industry has significant scope for improving its resource productivity and carbon footprint. Türkiye's overall resource productivity ranges in the bottom half in Europe, with approximately 1.8 units of purchasing power adjusted GDP generated out of every kilogram of domestic material consumption.[21] This compares to an EU average of 2.3 purchasing power standards per kilogram.

Two possible CE futures for Türkiye

The shift to a CE can be achieved through varying approaches, each with distinct implications for Turkish firms. We categorize such different approaches as light and ambitious 'CE transition futures' (Figure 7). The light transition aims at a more efficient use of materials and an increase in reuse and recycling through measures that are already in progress or can be implemented in the immediate future. The ambitious transition envisions enhanced environmental standards and a comprehensive redesign of products, business models, and financing. The light approach is a conservative strategy, while the ambitious transition in many respects represents a higher-risk, higher-returns strategy that can help Turkish firms to shift toward producing and exporting higher value-added goods and services. The approach is ambitious in that it involves transitioning from a primarily one-way flow of goods to a dynamic two-way exchange. However, although the shift introduces uncertainty, it offers opportunities for significant advancement without necessarily incurring high costs.

[21] Domestic material consumption is computed as domestic material inputs, that is, the sum of domestic extraction plus physical imports minus physical exports.

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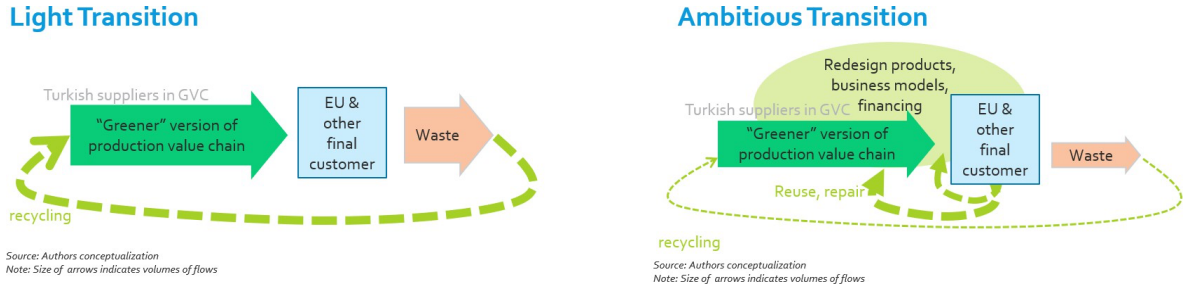
Figure 7. Two CE transition scenarios for Türkiye



Source: Original elaboration.

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Factors enabling CE readiness

In the global move toward circular economies, strategic positioning and competitiveness hinge on several key factors, each playing a pivotal role in enabling a successful transition. At the core of the CE is the need for effective traceability and robust digital monitoring systems. These systems are crucial for ensuring carbon and material efficiency in key sectors, tracking resource flows, identifying inefficiencies, and minimizing waste. Access to and use of recycled inputs is another fundamental aspect of a successful transition. The demand for recycled inputs under a weak CE scenario tends to increase, presenting countries in transition with two strategic options: securing foreign recycled materials or developing a domestic recycling industry. Hence, fostering growth in domestic recycling rates and securing adequate access to imported recycled materials are important and complementary enablers. As economies progress from 'light' to full circularity, the focus expands from merely ensuring access to recycled inputs to maintaining products in the usage cycle for longer periods, thereby reducing reliance on both new materials and recycled ones.

Ultimately, the transition requires innovation. Technological upgrades, advancing the innovation frontier, and upskilling the workforce are therefore fundamental ingredients as well. Seamlessly transitioning to the CE necessitates significant technological advancements across all sectors of the economy. As circular technologies and practices become more prevalent in the domestic economy, the cost of adoption per unit of output decreases more rapidly. Technological upgrades include at least three key strategies, that is, swiftly deploying technologies that conserve resources, upgrading machinery, and investing heavily in workforce upskilling to reduce the material footprint of production. Agility in adopting and adapting to the new technologies is therefore crucial for implementing CE practices, whether in 'light' scenarios or more comprehensive ones.

However, transitioning effectively goes beyond mere technological upgrades; it requires a strong push toward innovation and R&D. It is about rethinking business models, products, and processes to fully integrate circular principles. Innovation in the value chain is key, demanding a proactive stance in crafting new, sustainable business strategies. The goal is to create new products from prototypes or new patents and to make commercially viable technical solutions which may be still at the experimentation stage. Those firms and countries who lead in such frontier efforts can secure a first-mover advantage once the innovation becomes economically viable.

Clearly supporting such transformations requires new skills and competencies across the entire society. It also requires carefully designed, adaptable financing frameworks. These frameworks must cater to the diverse needs of various firms and industries, facilitating their shift toward more asset-light, circular business models. Such financial support structures should be inclusive, accommodating the evolving challenges of different market players during this structural transition. A comprehensive financing strategy that leverages the different sources of financing is suggested. Financing can originate from many different sources: own capital; intra-GVC (global value chain) financing; private financial investors, such as institutional investors and private equity; and public subsidies and finances. These differ from one another in time horizon, investment size class, criteria for financing, and domestic versus international considerations.

Finally, demand and supply dynamics also matter. The broader context of consumer preferences and market demands significantly steers the transition's pace and direction. Aligning national sustainability trends with global movements and responding to the changing demands within key partner

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markets can accelerate the adoption of CE practices. Domestically, fostering a shift in material consumption patterns can act as a powerful catalyst, bolstering the local private sector's capacity for circular initiatives.

The way forward under a 'light' CE transition

A one-size-fits-all reform is not going to be helpful. The relationship between costs and transformation efforts is not straightforward, primarily due to the diverse nature of industries and sectors within the Turkish economy. This diversity means that while some sectors and firms can rapidly transition, supported by necessary reforms, others may only undergo incremental changes due to external decision-making factors. This necessitates a focus on adaptive transformation in such sectors and firms. Meanwhile, other sectors and firms should have higher aspirations, since they can catalyze transformation, achieve leadership roles in the relevant CE GVCs, and enhance competitiveness through innovation-led growth.

In the very short term, and with the 'light' approach in mind, three improvements are paramount.

- ***First,* accelerating the adoption of mature technology and critical tools is essential for resource-efficient production.** For example, there is an urgent need for firms to access recycled inputs and monitor production through digital tracing infrastructure.
- ***Second,* the problem of insufficient scale and high fixed costs to invest in the transition, particularly for smaller firms and lower-tier suppliers in GVCs, needs to be addressed.** This includes targeted financing options to address the initial investment hurdles faced by businesses; shared infrastructure, such as wastewater treatment facilities and environmental monitoring systems, to support sustainable practices; and other shared resources such as green transformation centers and one-stop shops for information and implementation of new regulation.
- ***Third,* institutional and coordination enhancements are needed to help address the coordination shortfalls and promote innovation, observed in the preparation of this analysis.** There are two dimensions to this, one about the relations with the EU and one concerning domestic platforms for intergovernmental and public-private coordination and partnership. Specifically, Türkiye should strengthen ties with EU entities and ensure regulatory alignment while also advocating for regulations that consider the unique needs of Turkish companies. In particular, the Government of Türkiye should operate a balancing act between maintaining an open dialogue with the EU counterparts to meet evolving regulatory requirements and carefully timing the transition to EU standards, to optimize the trade-off between costs and market opportunities. In addition, it should foster collaboration among public stakeholders in Türkiye (Ministries of Trade, Environment, Urbanization and Climate Change, Industry and Technology) and with private sector entities, to unify the national approach toward sustainability and CE transitions.

The way forward under an 'ambitious' CE transition

In the envisioned 'ambitious' scenario, this analysis aims to position Turkish firms at the forefront of new and emerging industries, creating a fertile ground for sustained growth, innovation, and the advancement of the CE. The focus is on bolstering R&D activities, pioneering innovative business models and processes, and nurturing green skills. Our findings reveal a direct link between a firm's scale, its reliance on import and export activities, and its R&D investment. Yet, in comparison to their peers in Europe and Central Asia, Turkish companies tend to lag in R&D spending. The shift toward a CE emerges as a possible avenue for bridging this gap. The Turkish private sector exhibits remarkable resilience and adaptability, and it is poised to capitalize on its integration into European initiatives, connections with global GVCs, and exposure to the most innovative practices. This positions Türkiye favorably to embrace fully the CE, provided there is sufficient and long-lasting governmental backing.

The field research undertaken for this analysis highlights the dynamic strides local entrepreneurs are making in adopting existing sustainable innovation solutions. Examples include polyester recycling and the implementation of waterless dyeing techniques for synthetic fibers.

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These efforts have been further propelled by Türkiye's involvement in EU initiatives, such as Horizon Europe projects focusing on textile and plastic recycling. These successes illustrate the potential of Turkish businesses to lead in eco-friendly business practices and technological breakthroughs, even in ambitious transitions to a CE. For instance, global innovation in areas like cotton recycling and waterless dyeing of non-synthetic textiles could benefit from Turkish ingenuity, contingent upon a supportive long-term policy strategy.

Beyond the immediate priorities outlined above, a successful and robust transition into global CE industries requires three longer-term actions. *First,* Türkiye's government should invest in green skills and in raising awareness about the CE among firms, workforce, educational institutions, and the general public. *Second,* it should foster an innovative ecosystem that supports R&D, new business models, and environmental sustainability through tailored finance, subsidies, incentives, and cross-border collaborations. *Finally,* to catalyze sufficient private investment there is the need for the government to signal to the private sector long-term commitment and policy coherence in promoting this agenda. The government has already demonstrated its commitment to the green agenda by the Green Deal Action Plan and upcoming National Circular Economy Action Plan. Nonetheless, the government should also communicate its commitment to support broader global initiatives promoting green markets and sustainable investment vehicles. This can be achieved through fostering a national vision for sustainable and inclusive development and a mindset shift: rather than an imperative, the CE transformation should be viewed as an opportunity to upgrade Turkish firms' position into GVCs, enhance export competitiveness, and build resilience against economic shocks through the adoption of sustainable practices**.**

The analysis highlights the importance of a deliberate, strategic, and articulated approach toward transitioning Turkish firms to a CE, blending immediate actionable steps with a forward-looking long-term strategy. By moving forward with flexibility and vision, Türkiye can use its distinct advantages to not only respond to the changing global economy but also to lead in sustainable innovation and resilience, establishing a model for others in the worldwide move toward a more circular and thriving future.

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3. Prioritizing Industries for Building a Competitive Circular Economy in Türkiye

In a CE, strong connections between industries are essential. These connections ensure the efficient flow of materials, information, and resources, facilitating innovation, reducing waste, and optimizing resource use throughout the value chain. When these connections are weak or missing, the flow of resources and information is disrupted, hindering the distribution and sale of circular products. This disruption reduces the overall value generated by supply chains, leading to inefficiencies in using economic resources and preventing capital from being fully productive in a sustainable economy. However, the potential benefits of a CE for Türkiye are immense, including reduced environmental impact, increased resource efficiency, and enhanced economic resilience.

For policy makers, fostering strong links between industries is not just crucial but also a powerful tool in transitioning to a sustainable CE. In a CE, industries and markets are interconnected in complex ways that facilitate the continuous cycling of resources. This creates a closed-loop system where waste is minimized, and resources are reused and recycled. However, a successful CE also requires openness to new market relationships and connectivity, driving innovation and creating new business opportunities and investments. Effective policies must focus on both strengthening existing connections and making new ones to develop strong, competitive CE markets that are sustainable and continuously evolving. By doing so, markets can support each other, creating a self-reinforcing system where economic activities feed back into the chain, enhancing sustainability and economic resilience. Policy makers, with their unique position, can play a pivotal role in this process.

For Türkiye, stronger links between industries provides unique opportunities for growth and development. Currently, the connections between high-potential circular industries (such as chemicals, manufacture of basic metals, plastics, and non-metal minerals) and key industries that rely on them (such as computers, electronics, food products, machinery and equipment, motor vehicles, and textiles) are weak. Additionally, the connections between these key industries and their supporting sectors (such as business services, transportation and storage, and wholesale and retail) are also weak. Weak connectivity means that industries struggle to efficiently share resources and information, leading to higher costs and reduced competitiveness. However, by addressing these challenges, Türkiye can not only strengthen its economy but also lead the way in sustainable practices. Strengthening these connections involves improving collaboration between industries, investing in infrastructure that supports efficient resource flow, and implementing policies that incentivize sustainable practices. This, in turn, would attract further CE investments and enable more productive use of capital in a sustainable economy.

The analysis identifies gaps in the links of industries in six value chains by deploying network analytics and a market distortion assessment. The network analysis presented in this chapter provides policy makers with a data-driven decision tool to prioritize the development of links between core and closely related CE sectors, identifying gaps by comparison with networks in countries with higher level of implementation of CE policies. The analysis is structured into three main components: (a) core sectors: value chains prioritized by the EU which include sustainable design, reuse, remanufacturing, recycling, and repair and maintenance, among others; (b) supporting sectors: those closely related to key product value chains; and (c) ancillary sectors: connected as second tier to the supporting sectors.

The analysis focuses on six priority value chains identified by TÜBİTAK[22] for technology improvements associated with Türkiye's green transition ambitions and adaptation to the European Green Deal: iron and steel, aluminum, cement, plastics, fertilizers, and chemicals. For these core sectors, the analysis identifies 80 industries (see Annex 1) and 75 supporting and ancillary industries (see Annex 2) connected through their value chains that shall potentially strengthen the business opportunities and market challenges affecting the CE transition.

[22] Türkiye's Scientific and Technological Research Council.

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Key characteristics of circular networks

Spillover effects from a circular industry are more strongly transmitted to other industries that are nearby (collocated) across local markets. Many economic transactions occur within local economies, especially for non-tradable goods. Consequently, a shock to one industry can have a significant impact on other collocated industries compared to less connected ones. For example, a shock to the textile industry, such as a sudden decrease in demand, could negatively affect the agriculture industry in a specific local market by reducing the need for raw materials like cotton. This, in turn, could lead to lower production levels, job losses, and reduced economic activity within the local market.

The analysis of the domestic economy network identifies opportunities for fostering circularity within local markets. Local circular industries play a crucial role in transitioning to a CE as they engage in economic transactions involving both tradable and non-tradable circular products. To fully harness the potential of these industries and strengthen local markets, it is vital to enhance demand and supply for circular products by integrating them into GVCs. Strategies should account for the proximity of industries and the business environment. By examining upstream and downstream connections between firms and industries, a comprehensive strategy can be developed to promote circularity and maximize the economic benefits of circular practices, guiding policy makers and business leaders in making well-informed decisions.

Integrating circular products into GVCs provides opportunities. By embracing a CE model, industries can tap into significant economic opportunities in prioritized value chains. This activity highlights the importance of understanding the domestic economy network to facilitate integration into GVCs. To achieve this integration, industries must build solid partnerships and adopt a system view that encompasses all participants in a supply chain and connected supply chains. The successful integration of circular products into GVCs can promote economic diversity and resilience, contributing to the global transition toward a CE, addressing pressing environmental challenges, and fostering sustainable development.

Understanding industry interdependence and circular value chains is essential. Comprehending the connections and relationships between industries and firms in circular product value chains is crucial for evaluating the economic impact of implementing CE practices and promoting circularity among businesses. Strategic industries hold potential as central players in establishing circular value chains, serving as suppliers and consumers of circular products.

Collaboration and partnerships between firms and industries are vital for driving the transition to a CE. This cooperation can involve sharing resources, knowledge, and best practices and jointly developing new circular products. Such collaborations can create new business opportunities, reduce costs, and enhance local economic resilience. By leveraging the strengths of different industries, the local economy can benefit from positive spillover effects, where the success of one industry can have a positive impact on the performance of others, ultimately leading to a more sustainable, resilient, and economically viable future.

Policies for a competitive CE transition in targeted sectors

Boosting competition in key industries is essential. To speed up Türkiye's transition to a CE, increasing competition within industries connected to targeted value chains is important. By focusing on successful industries (with high regional concentration) and making them even stronger, Türkiye can continue making progress in potential circular industries related to TÜBİTAK's priorities. Meanwhile, supporting and encouraging lower-performing industries (with lower regional concentration) to improve their business environment will allow them to contribute more effectively to the growth of the prioritized value chains.

Strengthening the primary and manufacturing industries related to TÜBİTAK's prioritized value chains and fostering collaboration and development within the tertiary sector is essential for the CE transition. This can be achieved more efficiently using finite resources like forests, soil, water, air, metals, and minerals. For example, in the textile industry, the government can incentivize using sustainable materials, such as organic cotton or biodegradable fibers, and promote recycling and upcycling of textile waste to reduce reliance on fossil fuels for synthetic fiber production. Furthermore, the government plays a significant role in promoting the efficient use of finite resources by creating policy frameworks, regulations, and incentives that drive businesses and consumers toward adopting circular

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practices. For instance, governments can implement taxes or levies on the extraction of raw materials and provide tax breaks or subsidies for businesses that adopt circular practices, such as recycling or using renewable energy sources. Establishing partnerships and adopting a systems approach that includes all supply chain participants is vital for transitioning to a CE. Environmental industries, including renewable energy production, recycling, repair, maintenance, renting, and leasing, play a crucial role in this transition. They involve a wide range of products, services, technologies, and processes that serve various economic sectors.

The tertiary sector is particularly relevant for nurturing domestic supply chains and ensuring the smooth functioning of local economies. Service activities like consulting, design, engineering, computer services, and repair and maintenance for delivering and maintaining environmental goods, machinery, and equipment are considered of particular importance. Trade restrictions on services can have a negative impact on environmental service provisions due to their anti-competitive nature, which hinders the entry of new competitors. Efforts to eliminate barriers to trade in environmentally related services could substantially affect sector-wide productivity, skills, and earnings. Service liberalization, on the other hand, can be a source of economic performance gains, enhancing manufacturing productivity and coordination within and between firms. However, countries may miss opportunities for links within the services sector, remaining confined to providing natural resources for domestic and international production networks.

Firms operating in supporting industries in sectors such as other business sector services, transportation and storage, human health and social work, construction, and others need to enhance their competitiveness to facilitate and expedite the transition to a CE. By enhancing their competitiveness and adopting innovative solutions, these firms can contribute to a more sustainable future, reduce environmental impact, and ultimately drive growth in a CE. To foster the transition to a CE, firms in the transportation and storage sector can focus on optimizing their logistics networks and integrating eco-friendly transport solutions. This may involve utilizing electric vehicles, improving route planning to reduce fuel consumption, or investing in efficient warehousing and inventory management systems. In the construction sector, companies can promote green building practices, use sustainable materials, and implement waste-reducing methods during the construction process. These efforts can significantly decrease the environmental footprint of these industries and support the broader transition to a CE. In human health and social work, industries can also contribute to the CE by implementing innovative patient care and resource management approaches. This might include adopting telemedicine technologies to reduce transportation-related emissions, utilizing digital platforms for data sharing and collaboration, and incorporating sustainable practices to provide health services. By enhancing their competitiveness in these sectors, firms can not only improve the overall efficiency of their operations but also encourage sustainable development and contribute to the realization of a CE.

Next steps

The efforts toward circularity in Türkiye should be geared toward three main objectives aligned with the prioritized value chains.

***First,* it is vital to enhance the competitiveness of core industries related to TÜBİTAK's priorities, especially those lagging their European OECD counterparts.** Strengthening these industries will help build a solid foundation for the CE in Türkiye. According to Figure 8, 31 percent of industries fall into this category.

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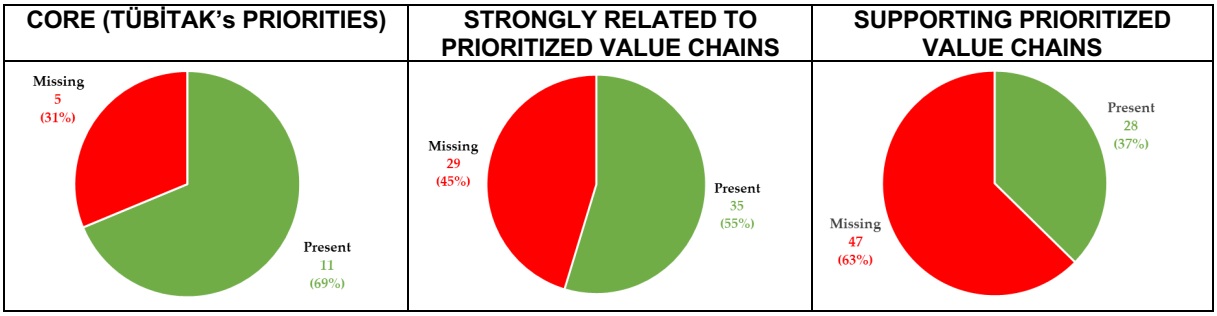
Figure 8. Core, strongly related, and supporting industries with the most extensive connections to other industries



Source: Original analysis.

***Second,* fostering the growth of upstream industries linked to the targeted value chains is essential.** These industries provide crucial inputs for the CE, and their development will help ensure a consistent supply of resources. Equally important is the support to downstream industries, which allows for the benefits of the CE to be spread across sectors, spurring growth and creating more opportunities for firms. Figure 8 indicates that 45 percent of industries are either upstream or downstream in the value chains.

***Third,* there is a need to promote investments in key industries that support circularity.** These industries play a pivotal role in ensuring the efficient functioning of the CE, and their development will help accelerate the transition to a CE in Türkiye; 63 percent of industries fall under this category.

In Türkiye, the regulations to foster circularity are focused on waste management and recycling. This chapter shows that there are gaps in the value chains that can be addressed with policies to incentivize more upstream interventions. Building upon the eco-design directive of the EU under discussion, Türkiye could adopt measures to support industries developing products that can facilitate the recovery of critical materials for the Turkish industry and/or to reduce the impact on landfills and waste generated by the domestic market.

For the targeted sectors in Türkiye, the aim of the policy makers should be to foster the creation of domestic markets, by generating demand-supply dynamics through regulations and incentives:

1. **Steel/aluminum.** Scrap metal can be contaminated by alloys or other materials. Introducing regulation to design products with limited use of alloys, conceived to facilitate disassembling or separation of the metal parts. A circular regulation could establish the maximum content of alloys, their specification to ease the separation of the main elements in the recovery process.
2. **Cement.** There are very few examples of pre-fabrication or modular design to facilitate the recovery of the materials at the end of life of a building. Demolition should be replaced by disassembling. Potential circular regulation should incentivize modular design, with the introduction of a building material registry as repository of recoverable materials from buildings. The minimum content of recovered material from the disassembling of old buildings for the new ones could offer the opportunity to establish a circular loop for this industry.
3. **Plastics.** Plastic recovery shows low rating in Türkiye due to contamination of plastic waste. Improving circularity requires introducing regulation to establish minimum content of recycled plastics, reducing content of additives, and reducing multilayer products in the design of the products.
4. **Chemicals.** Additives could limit the recovery of materials at the end of life of products. Introducing regulations to shift the fabrication of products by limiting the use of additives that could affect the reuse/recovery of products and materials should contribute facilitating circularity in the value chains that use additives.
5. **Fertilizers.** Chemical and mineral fertilizers consume resources, particularly phosphorus. Regulation to promote smart agriculture, supporting the use of alternative bio-based fertilizers, and enable the development of a sustainable value chain for phosphorus. The regulation should

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cover three sources for the creation of a circular loop for phosphorus: manure, wastewater, and solid waste.

Going forward, it is recommended that Turkish policy makers initiate pilot regulations within vital sectors that have strong interrelations and supporting specific industries. The utilization of network analysis should also be broadened to bolster monitoring, reporting, and verification (MRV) objectives. Such a strategic approach will streamline policy implementation and ensure alignment with Sustainable Development Goals, thereby reinforcing Türkiye's trajectory toward a more competitive CE.

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Conclusions

Türkiye's CE transition will have economic, trade, and industrial policy implications. The significant opportunities arising from the CE transition will not materialize automatically. For Türkiye to leverage its comparative advantages and retain competitiveness in a changing global economy, policy and investments will need to focus on overcoming existing barriers—such as the existing skill gaps limiting CE investments—and mitigating potentially negative impacts of the transition.

A combination of various policy measures is needed to support the CE transition. A mix of demand-side and supply-side policies will be needed to achieve CE targets. Demand-side measures will be more efficient in reducing the use of non-metallic minerals, while supply-side measures are better suited for increasing recycling of metal ores. Achieving absolute decoupling of resource use from economic growth will be complicated by the high share of non-metallic minerals in Türkiye's resource use patterns. Still, reducing resource use through CE policies intervention will deliver important benefits in terms of climate mitigation, helping Türkiye achieve its NDC objectives.

A strategic approach to the CE transition needs to differentiate between immediate short-term priorities and the longer-term perspective. In the short term, Türkiye needs to speed up the adoption of mature technologies for resource-efficient production, overcome investment hurdles, and improve coordination with the EU and between Turkish stakeholders. In the longer term, Türkiye will need to increase investments in green skills and in raising awareness about the CE, incentivize R&D and new business models, and signal long-term commitment to the CE transition—also in view of catalyzing sufficient private investment, particularly in key industries that support circularity.

Going forward, finalizing and implementing the forthcoming CE Strategy and Action Plan for Türkiye will be essential for the CE transition to unfold in Türkiye. In alignment with the EU's CE Action Plan, Türkiye's new CE Strategy and Action Plan will need to ensure a vast program of regulatory, fiscal, and investment measures. Realistic long-term targets, implemented through concrete short-, medium-, and longer-term actions are essential, also in view of providing investment security for private sector finance. In this respect, a clear MRV system on CE indicators will help ensure the credibility of the CE Strategy and Action Plan.

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ANNEX 1: Industries Related to TÜBİTAK's Priority Products and Strongly Related to Them—Industries with Potential for Circularity

N	NAICS4	Industry Description	Economic Sector	Category	In Türkiye (with LQ > 1)[23]
1	2123	Nonmetallic Mineral Mining and Quarrying	Mining and quarrying of non-energy producing products	TÜBİTAK priority	YES
2	3219	Other Wood Product Manufacturing	Wood and of products of wood and cork (except furniture)	TÜBİTAK priority	NO
3	3251	Basic Chemical Manufacturing	Chemicals and pharmaceutical products	TÜBİTAK priority	NO
4	3252	Resin, Synthetic Rubber, and Artificial and Synthetic Fibers and Filaments Manufacturing	Chemicals and pharmaceutical products	TÜBİTAK priority	YES
5	3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	Chemicals and pharmaceutical products	TÜBİTAK priority	NO
6	3254	Pharmaceutical and Medicine Manufacturing	Chemicals and pharmaceutical products	TÜBİTAK priority	NO
7	3259	Other Chemical Product and Preparation Manufacturing	Chemicals and pharmaceutical products	TÜBİTAK priority	YES
8	3261	Plastics Product Manufacturing	Rubber and plastics products	TÜBİTAK priority	YES
9	3271	Clay Product and Refractory Manufacturing	Other non-metallic mineral products	TÜBİTAK priority	YES
10	3273	Cement and Concrete Product Manufacturing	Other non-metallic mineral products	TÜBİTAK priority	YES
11	3311	Iron and Steel Mills and Ferroalloy Manufacturing	Manufacture of basic metals	TÜBİTAK priority	YES
12	3312	Steel Product Manufacturing from Purchased Steel	Manufacture of basic metals	TÜBİTAK priority	YES
13	3313	Alumina and Aluminum Production and Processing	Manufacture of basic metals	TÜBİTAK priority	YES
14	3322	Cutlery and Handtool Manufacturing	Fabricated metal products, except machinery and equipment	TÜBİTAK priority	NO
15	3323	Architectural and Structural Metals Manufacturing	Fabricated metal products, except machinery and equipment	TÜBİTAK priority	YES

[23] LQ = Location Quotient. The LQ measures the concentration of a specific industry in a location compared to the overall concentration of that industry in a larger area, such as a country. A higher LQ (greater than 1) means a specific industry is more concentrated in a location, which suggests that related industries tend to group in certain regions. For example, if the textile industry has an LQ of 1.5 in a particular region, it is more concentrated in that region than in others. By identifying key industries in the network, efforts can be focused on making them more sustainable and efficient, which will have a positive ripple effect across connected industries. Overall, the benefits of using network analysis include improved decision-making, better understanding of industry connections, and the ability to identify opportunities for sustainable growth.

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N	NAICS4	Industry Description	Economic Sector	Category	In Türkiye (with LQ > 1)[23]
16	3329	Other Fabricated Metal Product Manufacturing	Fabricated metal products, except machinery and equipment	TÜBİTAK priority	YES
1	1111	Oilseed and Grain Farming	Agriculture, forestry and fishing	Highly related	NO
2	1112	Vegetable and Melon Farming	Agriculture, forestry and fishing	Highly related	NO
3	1113	Fruit and Tree Nut Farming	Agriculture, forestry and fishing	Highly related	YES
4	1114	Greenhouse, Nursery, and Floriculture Production	Agriculture, forestry and fishing	Highly related	NO
5	1119	Other Crop Farming	Agriculture, forestry and fishing	Highly related	NO
6	1121	Cattle Ranching and Farming	Agriculture, forestry and fishing	Highly related	NO
7	1122	Hog and Pig Farming	Agriculture, forestry and fishing	Highly related	NO
8	1123	Poultry and Egg Production	Agriculture, forestry and fishing	Highly related	NO
9	1129	Other Animal Production	Agriculture, forestry and fishing	Highly related	NO
10	1133	Logging	Agriculture, forestry and fishing	Highly related	NO
11	2211	Electric Power Generation, Transmission and Distribution	Electricity, gas, water supply, sewerage, waste and remediation services	Highly related	YES
12	3111	Animal Food Manufacturing	Food products, beverages and tobacco	Highly related	NO
13	3112	Grain and Oilseed Milling	Food products, beverages and tobacco	Highly related	YES
14	3113	Sugar and Confectionery Product Manufacturing	Food products, beverages and tobacco	Highly related	YES
15	3114	Fruit and Vegetable Preserving and Specialty Food Manufacturing	Food products, beverages and tobacco	Highly related	YES
16	3115	Dairy Product Manufacturing	Food products, beverages and tobacco	Highly related	YES
17	3118	Bakeries and Tortilla Manufacturing	Food products, beverages and tobacco	Highly related	YES
18	3119	Other Food Manufacturing	Food products, beverages and tobacco	Highly related	YES
19	3121	Beverage Manufacturing	Food products, beverages and tobacco	Highly related	YES
20	3122	Tobacco Manufacturing	Food products, beverages and tobacco	Highly related	NO
21	3131	Fiber, Yarn, and Thread Mills	Textiles, wearing apparel, leather and related products	Highly related	YES
22	3132	Fabric Mills	Textiles, wearing apparel, leather and related products	Highly related	YES

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N	NAICS4	Industry Description	Economic Sector	Category	In Türkiye (with LQ > 1)[23]
23	3133	Textile and Fabric Finishing and Fabric Coating Mills	Textiles, wearing apparel, leather and related products	Highly related	NO
24	3141	Textile Furnishings Mills	Textiles, wearing apparel, leather and related products	Highly related	YES
25	3149	Other Textile Product Mills	Textiles, wearing apparel, leather and related products	Highly related	YES
26	3151	Apparel Knitting Mills	Textiles, wearing apparel, leather and related products	Highly related	YES
27	3161	Leather and Hide Tanning and Finishing	Textiles, wearing apparel, leather and related products	Highly related	NO
28	3162	Footwear Manufacturing	Textiles, wearing apparel, leather and related products	Highly related	NO
29	3211	Sawmills and Wood Preservation	Wood and of products of wood and cork (except furniture)	Highly related	NO
30	3212	Veneer, Plywood, and Engineered Wood Product Manufacturing	Wood and of products of wood and cork (except furniture)	Highly related	YES
31	3221	Pulp, Paper, and Paperboard Mills	Paper products and printing	Highly related	YES
32	3222	Converted Paper Product Manufacturing	Paper products and printing	Highly related	YES
33	3231	Printing and Related Support Activities	Paper products and printing	Highly related	YES
34	3241	Petroleum and Coal Products Manufacturing	Coke and refined petroleum products	Highly related	YES
35	3255	Paint, Coating, and Adhesive Manufacturing	Chemicals and pharmaceutical products	Highly related	YES
36	3256	Soap, Cleaning Compound, and Toilet Preparation Manufacturing	Chemicals and pharmaceutical products	Highly related	NO
37	3262	Rubber Product Manufacturing	Rubber and plastics products	Highly related	YES
38	3272	Glass and Glass Product Manufacturing	Other non-metallic mineral products	Highly related	YES
39	3279	Other Nonmetallic Mineral Product Manufacturing	Other non-metallic mineral products	Highly related	YES
40	3314	Nonferrous Metal (except Aluminum) Production and Processing	Manufacture of basic metals	Highly related	YES
41	3315	Foundries	Manufacture of basic metals	Highly related	YES
42	3331	Agriculture, Construction, and Mining Machinery Manufacturing	Machinery and equipment n.e.c.	Highly related	YES
43	3332	Industrial Machinery Manufacturing	Machinery and equipment n.e.c.	Highly related	YES
44	3333	Commercial and Service Industry Machinery Manufacturing	Machinery and equipment n.e.c.	Highly related	YES
45	3336	Engine, Turbine, and Power Transmission Equipment Manufacturing	Machinery and equipment n.e.c.	Highly related	NO

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N	NAICS4	Industry Description	Economic Sector	Category	In Türkiye (with LQ > 1)[23]
46	3339	Other General Purpose Machinery Manufacturing	Machinery and equipment n.e.c.	Highly related	NO
47	3341	Computer and Peripheral Equipment Manufacturing	Computer, electronic and optical products	Highly related	NO
48	3342	Communications Equipment Manufacturing	Computer, electronic and optical products	Highly related	YES
49	3343	Audio and Video Equipment Manufacturing	Computer, electronic and optical products	Highly related	NO
50	3344	Semiconductor and Other Electronic Component Manufacturing	Computer, electronic and optical products	Highly related	YES
51	3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	Computer, electronic and optical products	Highly related	NO
52	3351	Electric Lighting Equipment Manufacturing	Electrical equipment	Highly related	YES
53	3352	Household Appliance Manufacturing	Electrical equipment	Highly related	YES
54	3359	Other Electrical Equipment and Component Manufacturing	Electrical equipment	Highly related	NO
55	3362	Motor Vehicle Body and Trailer Manufacturing	Motor vehicles, trailers and semi-trailers	Highly related	YES
56	3364	Aerospace Product and Parts Manufacturing	Other transport equipment	Highly related	NO
57	3365	Railroad Rolling Stock Manufacturing	Other transport equipment	Highly related	NO
58	3366	Ship and Boat Building	Other transport equipment	Highly related	YES
59	3369	Other Transportation Equipment Manufacturing	Other transport equipment	Highly related	NO
60	3399	Other Miscellaneous Manufacturing	Other manufacturing; repair and installation of machinery and equipment	Highly related	YES
61	5111	Newspaper, Periodical, Book, and Directory Publishers	Publishing, audiovisual and broadcasting activities	Highly related	NO
62	5121	Motion Picture and Video Industries	Publishing, audiovisual and broadcasting activities	Highly related	NO
63	5122	Sound Recording Industries	Publishing, audiovisual and broadcasting activities	Highly related	NO
64	5413	Architectural, Engineering, and Related Services	Other business sector services	Highly related	NO

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ANNEX 2: Industries (NAICS4) Supporting TÜBİTAK's Priorities and Strongly Related Products

N	NAICS4	Industry Description	Economic Sector	In Türkiye (with LQ > 1)
1	1124	Sheep and Goat Farming	Agriculture, forestry and fishing	NO
2	1132	Forest Nurseries and Gathering of Forest Products	Agriculture, forestry and fishing	NO
3	1153	Support Activities for Forestry	Agriculture, forestry and fishing	NO
4	2213	Water, Sewage and Other Systems	Electricity, gas, water supply, sewerage, waste and remediation services	NO
5	2361	Residential Building Construction	Construction	YES
6	2371	Utility System Construction	Construction	NO
7	2372	Land Subdivision	Construction	NO
8	2373	Highway, Street, and Bridge Construction	Construction	YES
9	2381	Foundation, Structure, and Building Exterior Contractors	Construction	YES
10	2382	Building Equipment Contractors	Construction	YES
11	2383	Building Finishing Contractors	Construction	NO
12	2389	Other Specialty Trade Contractors	Construction	NO
13	3116	Animal Slaughtering and Processing	Food products, beverages and tobacco	NO
14	3117	Seafood Product Preparation and Packaging	Food products, beverages and tobacco	NO
15	3169	Other Leather and Allied Product Manufacturing	Textiles, wearing apparel, leather and related products	YES
16	3274	Lime and Gypsum Product Manufacturing	Other non-metallic mineral products	YES
17	3321	Forging and Stamping	Manufacture of basic metals	YES
18	3324	Boiler, Tank, and Shipping Container Manufacturing	Fabricated metal products, except machinery and equipment	NO
19	3325	Hardware Manufacturing	Fabricated metal products, except machinery and equipment	NO
20	3326	Spring and Wire Product Manufacturing	Fabricated metal products, except machinery and equipment	NO
21	3328	Coating, Engraving, Heat Treating, and Allied Activities	Fabricated metal products, except machinery and equipment	NO

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N	NAICS4	Industry Description	Economic Sector	In Türkiye (with LQ > 1)
22	3334	Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing	Machinery and equipment n.e.c.	YES
23	3335	Metalworking Machinery Manufacturing	Machinery and equipment n.e.c.	YES
24	3353	Electrical Equipment Manufacturing	Electrical equipment	YES
25	3363	Motor Vehicle Parts Manufacturing	Motor vehicles, trailers and semi-trailers	YES
26	3371	Household and Institutional Furniture and Kitchen Cabinet Manufacturing	Other manufacturing; repair and installation of machinery and equipment	NO
27	3372	Office Furniture (including Fixtures) Manufacturing	Other manufacturing; repair and installation of machinery and equipment	YES
28	3379	Other Furniture Related Product Manufacturing	Other manufacturing; repair and installation of machinery and equipment	NO
29	4231	Motor Vehicle and Motor Vehicle Parts and Supplies Merchant Wholesalers	Wholesale and retail trade; repair of motor vehicles	YES
30	4233	Lumber and Other Construction Materials Merchant Wholesalers	Wholesale and retail trade; repair of motor vehicles	YES
31	4235	Metal and Mineral (except Petroleum) Merchant Wholesalers	Wholesale and retail trade; repair of motor vehicles	YES
32	4237	Hardware, and Plumbing and Heating Equipment and Supplies Merchant Wholesalers	Wholesale and retail trade; repair of motor vehicles	YES
33	4238	Machinery, Equipment, and Supplies Merchant Wholesalers	Wholesale and retail trade; repair of motor vehicles	YES
34	4239	Miscellaneous Durable Goods Merchant Wholesalers	Wholesale and retail trade; repair of motor vehicles	YES
35	4244	Grocery and Related Product Merchant Wholesalers	Wholesale and retail trade; repair of motor vehicles	YES
36	4245	Farm Product Raw Material Merchant Wholesalers	Wholesale and retail trade; repair of motor vehicles	NO
37	4246	Chemical and Allied Products Merchant Wholesalers	Wholesale and retail trade; repair of motor vehicles	NO
38	4247	Petroleum and Petroleum Products Merchant Wholesalers	Wholesale and retail trade; repair of motor vehicles	NO
39	4248	Beer, Wine, and Distilled Alcoholic Beverage Merchant Wholesalers	Wholesale and retail trade; repair of motor vehicles	YES
40	4249	Miscellaneous Nondurable Goods Merchant Wholesalers	Wholesale and retail trade; repair of motor vehicles	YES
41	4413	Automotive Parts, Accessories, and Tire Stores	Wholesale and retail trade; repair of motor vehicles	NO
42	4431	Electronics and Appliance Stores	Wholesale and retail trade; repair of motor vehicles	NO
43	4441	Building Material and Supplies Dealers	Wholesale and retail trade; repair of motor vehicles	NO

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N	NAICS4	Industry Description	Economic Sector	In Türkiye (with LQ > 1)
44	4451	Grocery Stores	Wholesale and retail trade; repair of motor vehicles	YES
45	4452	Specialty Food Stores	Wholesale and retail trade; repair of motor vehicles	NO
46	4461	Health and Personal Care Stores	Wholesale and retail trade; repair of motor vehicles	NO
47	4471	Gasoline Stations	Wholesale and retail trade; repair of motor vehicles	YES
48	4483	Jewelry, Luggage, and Leather Goods Stores	Wholesale and retail trade; repair of motor vehicles	NO
49	4831	Deep Sea, Coastal, and Great Lakes Water Transportation	Transportation and storage	NO
50	4841	General Freight Trucking	Transportation and storage	NO
51	4851	Urban Transit Systems	Transportation and storage	NO
52	4883	Support Activities for Water Transportation	Transportation and storage	NO
53	4911	Postal Service	Transportation and storage	NO
54	5182	Data Processing, Hosting, and Related Services	IT and other information services	NO
55	5311	Lessors of Real Estate	Real estate activities	NO
56	5313	Activities Related to Real Estate	Real estate activities	NO
57	5418	Advertising, Public Relations, and Related Services	Other business sector services	YES
58	5619	Other Support Services	Other business sector services	NO
59	5621	Waste Collection	Other business sector services	NO
60	5622	Waste Treatment and Disposal	Other business sector services	NO
61	5629	Remediation and Other Waste Management Services	Other business sector services	NO
62	6213	Offices of Other Health Practitioners	Human health and social work	NO
63	6219	Other Ambulatory Health Care Services	Human health and social work	YES
64	6231	Nursing Care Facilities (Skilled Nursing Facilities)	Human health and social work	NO
65	6233	Continuing Care Retirement Communities and Assisted Living Facilities for the Elderly	Human health and social work	NO
66	6241	Individual and Family Services	Human health and social work	NO

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N	NAICS4	Industry Description	Economic Sector	In Türkiye (with LQ > 1)
67	7111	Performing Arts Companies	Arts, entertainment, recreation and other service activities	NO
68	7112	Spectator Sports	Arts, entertainment, recreation and other service activities	NO
69	7211	Traveler Accommodation	Accomodation and food services	YES
70	7212	RV (Recreational Vehicle) Parks and Recreational Camps	Accomodation and food services	YES
71	7225	Restaurants and Other Eating Places	Accomodation and food services	YES
72	8111	Automotive Repair and Maintenance	Motor vehicles, trailers and semi-trailers	NO
73	8113	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	Other manufacturing; repair and installation of machinery and equipment	NO
74	8114	Personal and Household Goods Repair and Maintenance	Other business sector services	NO
75	8123	Drycleaning and Laundry Services	Human health and social work	NO

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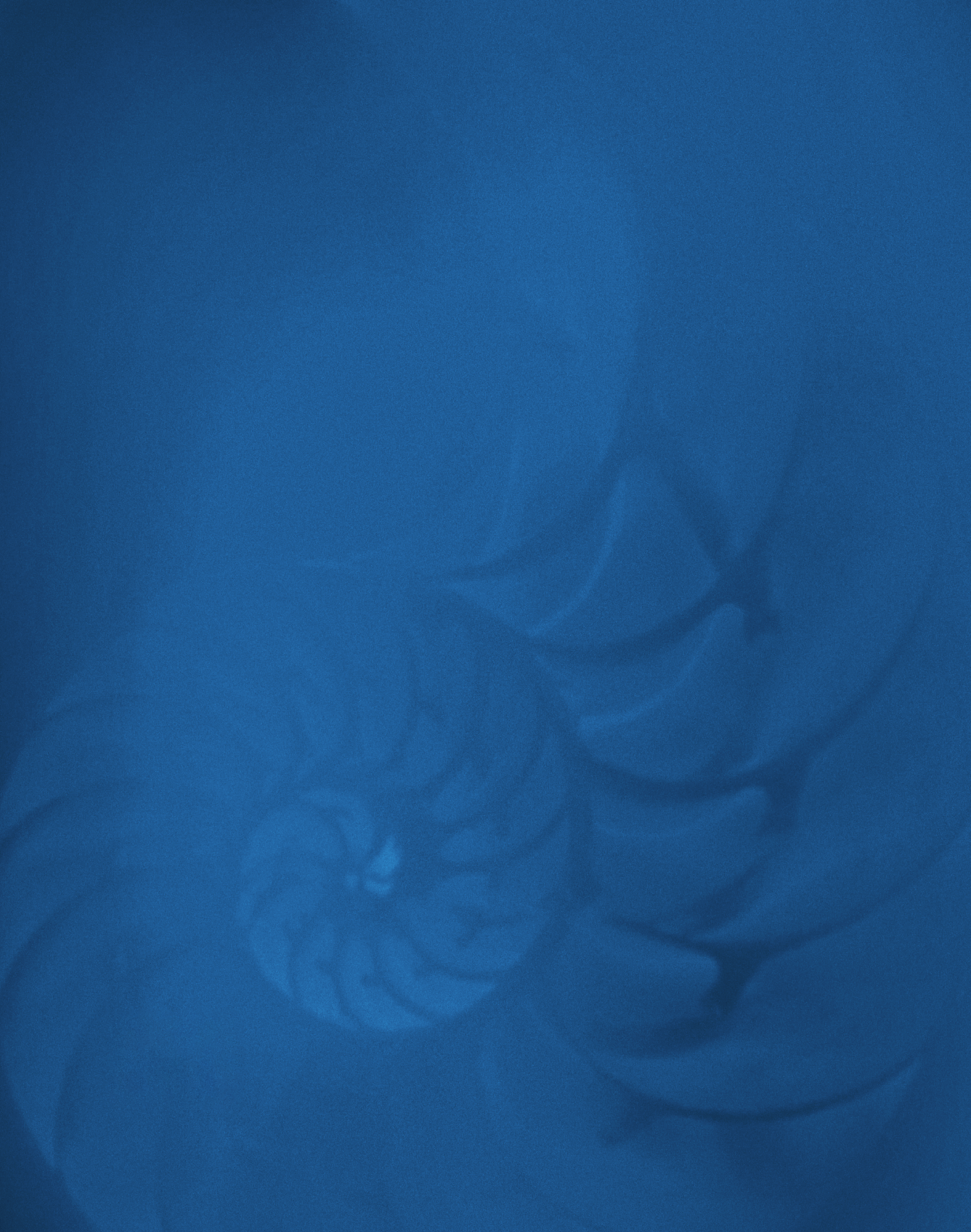

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