European Green Deal and Circular Economy Working Group Report

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Green Transformation of Turkish Industry

TSKB

Table of Contents

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Introduction - European Green Deal

While the economic and social effects of the risks stemming from climate change are starting to be seen clearly, the regulations taken towards decarbonization come to the fore. In this axis, in our report, we aim to examine the effects of the EU Green Consensus and the circular economy concept in Turkey.

Foreseeing that climate change will permeate all policies of the EU including industrial and commercial policies in the upcoming years, on the way to the European Union's goal of becoming a climate neutral continent by 2050, the European Green Deal (EGD) was published on December 11, 2019.

EGD is defined as a roadmap that will render the EU economy (production and consumption patterns) more modern, resource efficient and competitive. Although EGD covers all sectors, it will affect and change resource-intensive sectors (energy, water and raw materials) the most.

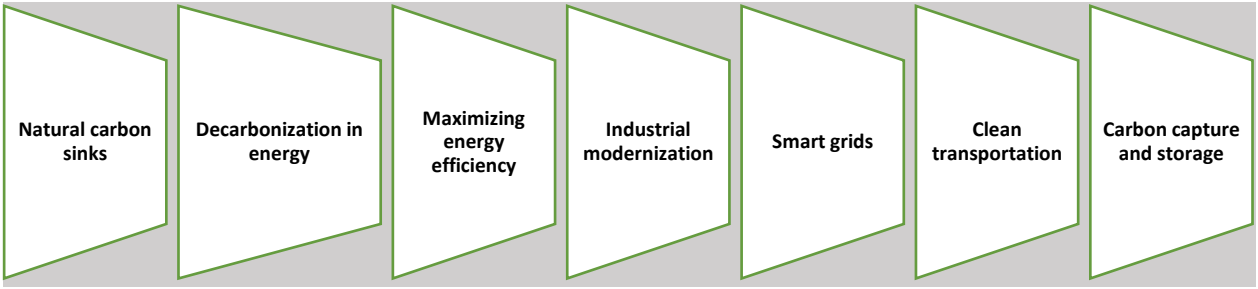
"Fit For 55 Package", a kind of action plan and roadmap for reducing Greenhouse Gas Emissions by 55%, was published on July 14, 2021. The package encompasses the reforms expected to be launched under the EU Emissions Trading System ("ETS") as well as resolutions and guidelines regulating non-ETS sectors such as agriculture, energy efficiency, renewable energy, land use, emission standards and taxation of energy. Among these regulations, the **Carbon Border Adjustment Mechanism** (CBAM) has is critical for Turkish industrialists. The European Commission aims to use CBAM to prevent carbon leakage, reduce greenhouse gas emissions from third countries, develop green policy practices and provide resources for green transformation in the EU.

Adopted by the European Parliament on February 10, 2021, the **Circular Economy Action Plan** is one of the most important building blocks in the EU's transformation program. In addition to the Circular Economy Action Plan, many new-revised laws/regulations, strategies and action plans concerning different sectors have been or are being prepared within the scope of EGD.

Figure 1: EGD's Main Policy Areas

The EU aims to make investments in the following areas in order to achieve the climate neutrality it plans to achieve by 2050.

Figure 2: Key Investment Areas for the EU to Become a Climate-Neutral Continent



These planned investments are expected to contribute in areas such as combating the climate change and adaptation to the climate change, protecting and developing biodiversity, improving environmental quality, using resources efficiently and maintaining competitiveness, and creating new employment in EU countries.

Carbon Border Adjustment Mechanism

EGD invites the continent to boost its climate motivation and invites other countries to join efforts to combat the climate crisis and increase their own contributions. The intention of transforming the economic model within EGD and the association of this transformation with gaining competitiveness give clues that future regulations as well as firms' and countries' search for competitiveness will be shaped in line with the green agenda. In addition, CBAM is considered as an important new tool in reshaping the competitiveness of countries in foreign trade. Efforts to change the competitive landscape, redefine the components of international competition, and add the cost of using natural capital to production costs through emissions pricing also serve as a set of industrial policies. Ultimately, search for of a green deal (on both sides of the Atlantic) can be viewed not only as a rehabilitation effort for polluting industrial activities, but also as a means of generating employment gains through industrial policies[1]. EGD aims not only to improve the conditions under which firms invest, but also to influence expectations about where future growth opportunities may lie and stimulate demand.

The EU has recently made significant gains in emissions reduction with the help of the Emissions Trading System (ETS). However, it is estimated that the European Commission's determination of more ambitious climate targets with EGD may increase the risk of carbon leakage by increasing carbon prices. In order to limit this risk, CBAM draws attention as one of the key elements of EGD. CBAM aims to ensure that products imported by the EU face a financial liability based on their carbon footprints, so that the prices of imported goods reflect the carbon content of the products more accurately. Thus, it aims to mitigate carbon leakage risks in the form of both investment and trade diversion.

Pointing out that CBAM can reduce global emissions by 0.1%, the United Nations Conference on Trade and Development (UNCTAD) emphasizes that the EU should take into account the impacts of the mechanism of combating the climate change on global trade. As a matter of fact, UNCTAD notes that with CBAM, the

[1] Aiginger, K., & Rodrik, D. (2020). *Rebirth of Industrial Policy and an Agenda for the Twenty-First Century. Journal of Industry, Competition and Trade.*

flow of global trade may change in favor of countries with higher carbon efficiency and against developing countries.

The regulation in question recommends the implementation of CBAM in the areas of **iron and steel, cement, aluminum, fertilizer and electricity, which pose the highest risk of carbon leakage.** The impact analysis study carried out by the Commission lists the 3 countries that will be most affected by the trade within the scope of CBAM as Russia, Ukraine and Turkey. According to the regulation proposal, CBAM will be implemented as a transition period without any financial obligations during the 2023-2025 period. Throughout this period, importers will report quarterly on the direct and indirect emissions of their imports. While the direct emissions within the production process (Scope 1) are initially assessed within the scope of CBAM, it is stated that indirect emissions can also be included in the scope according to the assessment to be made at the end of the transition period and thus it may be harmonized with the approach in the EU-ETS. Following the transition phase, the financial burden of CBAM will be reflected starting from 2026. The financial burden will be indexed to the carbon price prevailing within the EU-ETS. With the beginning of the reflection of the financial burden, the process of exiting the EU-ETS free allowances offered to the sectors within the scope of CBAM will also begin. The gradual exit from free allocation will continue until 2035 and will be coordinated with the gradual introduction of CBAM. Thus, it is understood that efforts are made to ensure compliance with the World Trade Organization (WTO) by avoiding a framework where both regulations will offer double protection to EU producers. On the other hand, there are comments that there are many objectionable legal issues before the WTO with regard to the details of the regulation. While the regulation proposal states that a significant portion of the revenues from CBAM will be transferred to the EU budget, there is no clear provision on how much of it will be listed in the budget, whether or not the revenue listed in the budget will be spent for the purpose of combating the climate change, or what the remainder will be.

The climate regulations announced in general, and CBAM in particular, have characteristics that will require a long-term diplomatic effort by both EU and non-EU stakeholders. For this reason, its political acceptability before the stakeholders is important. In this respect, it will be useful to follow the following topics in the upcoming period in order to understand how the regulation proposals can evolve.

- Since there is no exception for least developed countries in the regulation, it will not be surprising that its compliance with the principle of “Joint But Differentiated Responsibility” is questioned.
- Reactions of the developing countries, especially the BASIC group (Brazil, South Africa, India, China), to the regulation will be followed.
- While the distant approach of the USA to the CBAM regulation is still fresh in our memories (US Special Presidential Envoy for Climate John Kerry considered it as a “last resort”), the EU's Climate Club call draws attention. It will be followed whether or not Canada and Japan, which are working on carbon border tax design, will respond to this call in the first place.
- Political acceptability seems to be an important step not only in the international arena but also within the EU. Some sectoral organizations covered by CBAM announced that CBAM and free allocations should be in effect simultaneously, otherwise they would not prefer CBAM. In addition, with the expansion of the scope of the EU-ETS, the fight against the climate crisis will take a form

directly increasing the living costs of households, which will bring about discussions regarding climate justice.

Circular Economy Action Plan

Resource efficiency is the basis of the circular economy. The **Circular Economy Action Plan** evaluates a product throughout its life cycle, aiming to support product design and circular economy processes, strengthen sustainable consumption and keep the resources used within the EU economy for the longest period of time possible. It aims to focus on resource-intensive sectors (such as electronics, informatics, batteries-vehicles, packaging, plastics, textiles, construction-buildings, food, water and nutrients) with a greater potential for circularity.

In this sense, among the many strategies devised within the scope of EGD, it is observed that the circular economy has also taken its place at the top of the agenda and has become one of the main elements of EGD. The European Commission published its first circular economy action plan in 2015 with ambitious targets for recycling, packaging waste and landfills to promote transition to a circular economy[2]. In March 2020, the European Commission adopted the new Circular Economy Action Plan, which sets targets for a 70% recycling rate for all packaging waste by 2030 and 65% for all municipal waste by 2035[3]. The said plan is expected to play a critical role in achieving the EU's goal of being climate neutral by 2050. The EU has targets to set stricter recycling regulations and binding targets for material use and consumption by 2030, and to achieve transition to a fully circular economy by 2050. In this context, the EU has recently established an organization called the Global Alliance on Circular Economy and Resource Efficiency (GACERE), bringing together the representatives of the public, private sector, CSOs and international organizations to develop solutions and proposals regarding transition to circular economy[4]. As can be seen, EGD clearly underlines that, in order for an economic structure to be sustainable, it should be reshaped in line with the circular economy approach.

EU also aims to increase the competitiveness of the region and create new employment areas by promoting and supporting circular economy processes. Projections show that the circular economy offers an alternative that can generate economic returns of up to USD 4.5 trillion by 2030[5]. In addition, the Circularity Gap Report 2021 highlights that the circular economy has the potential to reduce global greenhouse gas emissions by 39% and raw material use by 28%[6].

Turkey's Green Deal Action Plan

The Presidential Circular on the **Green Deal Action Plan**, which is a roadmap aiming to support green transformation in all policy areas, was published on July 16, 2021. It was also announced that a Green Deal Working Group was formed to monitor the implementation of the action plan prepared by the Ministry of

[2] European Commission. (2015). *The first circular economy action plan.*
[3] European Commission. (2020). *A new Circular Economy Action Plan.*
[4] European Commission. (2021). *https://ec.europa.eu/environment/topics/waste-and-recycling_en. Waste and recycling.*
[5] World Economic Forum. (2021). *The circular economy can help save the planet – if we start innovating now.* *https://www.weforum.org/agenda/2021/02/the-circulars-acceleratorcircular-economy-zero-waste/*
[6] Circle-Economy.com. (2021). *The Circular Gap Report. The Platform for Accelerating the Circular Economy (PACE).*

Trade and to ensure due coordination. Established under the leadership of the relevant deputy minister of the Ministry of Trade, the working group will be composed of the Deputy President of Strategy and Budget and the deputy ministers of Labor and Social Security, Environment and Urbanization, Foreign Affairs, Energy and Natural Resources, Treasury and Finance, National Education, Industry and Technology, Agriculture and Forestry, Transport and Infrastructure.

Drawn up in order to contribute to Turkey's **transition to a sustainable and resource-efficient economy**, and to adapt to the comprehensive changes envisaged by EGD, in a way that will preserve and further the integration offered within the scope of Turkey-EU Customs Union, the Green Deal Action Plan consists of 32 objectives and 81 actions under 9 steps listed below.

- Carbon border adjustment regulations,
- A green and circular economy,
- Green finance,
- Clean, economic and secure energy supply,
- Sustainable agriculture,
- Sustainable smart transportation,
- Combating the climate change,
- Diplomacy and
- European Green Deal information and awareness-raising activities

The Green Deal Action Plan highlights that continuing to increase the use of **renewable energy** and low-carbon energy resources in Turkey and **improving energy efficiency** are of great importance for the reduction of greenhouse gas emissions. It also covers an action on the preparation of an impact analysis (2021 - 3rd Quarter) and roadmap (2021 - 4th Quarter) regarding CBAM. Roadmap or activities regarding priority manufacturing industry sectors that may be subject to CBAM will be identified, their impacts on energy-intensive sectors will be modeled based on scenarios and analyzed on sectoral basis and the actions that must be taken will be evaluated under the coordination of the Ministry of Industry and Technology and the Ministry of Environment and Urbanization. **A green and circular economy** is one of the most important sub-headings of the Action Plan. It states that it is of great importance to draw up a "National Circular Economy Action Plan" in line with the policies to be implemented within the scope of the "Circular Economy Action Plan" published by the EU on March 11, 2020, and to identify the steps to be taken to conduct circular economy studies at national level.

It is stated that legislative studies will be carried out to identify cleaner production practices (best available techniques) for sectors and a national action plan and implementation schedule will be prepared for the implementation of EU Integrated Pollution Prevention and Control (IPPC) legislation. It is understood that **water and raw material efficiency** studies will gain momentum in the textiles and leather sector as well as other sectors in the future.

Published in September 2021, the Medium Term Program covering 2022-2024 underlines the need for and importance of green transformation.

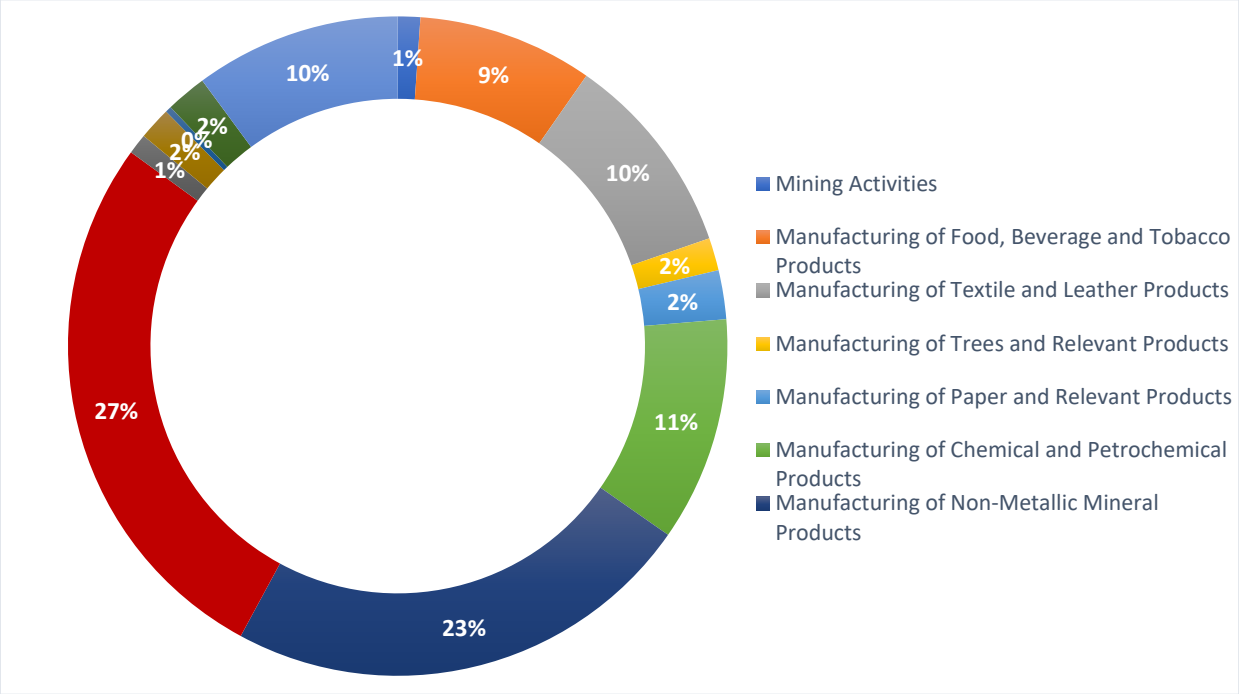
Green Transformation of the Turkish Industry

Energy Efficiency in the Green Transformation of Industry

Transition to a low-carbon energy system aims to increase the share of renewables in power generation while it also aims to reduce the share of energy generated out of fossil fuel, reduce losses in transmission and distribution grids and use electricity efficiently on the consumption side.

The industrial sector accounts for approximately 25.3% of Turkey's final energy consumption[7]. A sectoral analysis (Figure 3) shows that the manufacturing sectors with the highest energy consumption in Turkey are the basic metal (27%) and the manufacturing of non-metallic mineral products (23%) including the cement sector. The sectors following them are the chemistry, textiles and paper products manufacturing sectors.

Figure 3: Sectoral Energy Consumption in Turkey (2019)



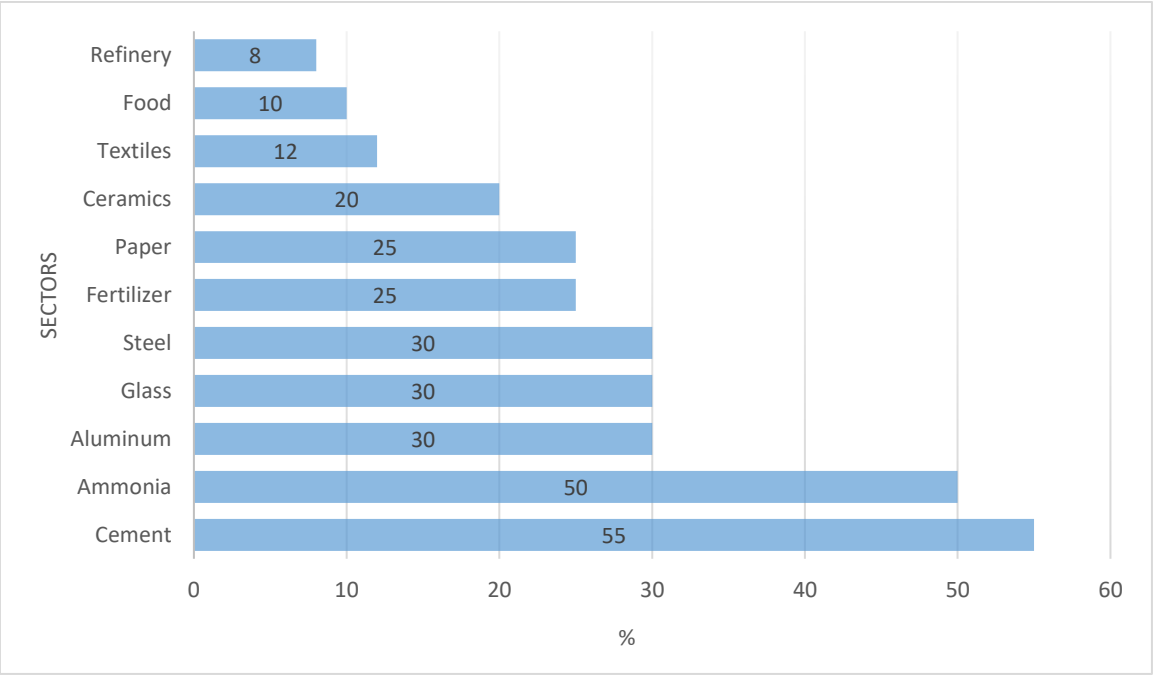
Source: Ministry of Energy and Natural Resources of the Republic of Turkey[8]

An analysis of the ratios of energy costs to total production costs in Turkey shows that cement (55%), ammonia (50%), aluminum, glass and steel (30%) sectors are at the top (Figure 4).

Figure 4: Ratio of Energy Costs to Total Production Cost in Different Sectors (%)

[7] For more information, please visit https://cevreselgostergeler.csb.gov.tr/sektorlere-gore-toplam-enerji-tuketimi-i-85800.

[8] https://enerji.gov.tr/eigm-raporlari



Source: Ministry of Energy and Natural Resources of the Republic of Turkey, Enerji Gazetesi

When considered within the framework of maintaining competitiveness in terms of EGD and similar regulations that can be put into force in developed countries, energy efficiency and the reduction of energy consumption per unit product (and therefore greenhouse gas emissions) in sectors such as cement, iron and steel, chemistry and textiles, where energy consumption and intensity are high, is an advantageous option by considering short payback periods in such investments.

According to the study "Financing the Energy Transformation in Turkey"[9] published by SHURA, at least USD 10 billion was invested in energy efficiency improvements between 2002 and 2018. The report states that the energy efficiency investments made during the said period were made by large industrial enterprises in sectors with high energy consumption, mainly in the iron and steel, cement, glass, ceramics and refinery products sectors. However, it is stated that energy efficiency practices in small and medium-sized industrial establishments are relatively limited. It is important to expand energy efficiency practices in these enterprises as well.

According to the same study, an analysis of the period between 2002 and 2018 shows that investments were made in the cement sector for waste heat recovery, fuel efficiency, and fuel use from waste. In the iron and steel industry, investments were made intensively for the recovery of waste heat and gases, as well as for electricity and fuel efficiency. In the textiles sector, resource efficiency investments, which also provide energy efficiency, were at the forefront.

National Targets and Investment Needs in the Field of Energy Efficiency

Activities intended for the measures required for energy efficiency were initiated especially during 2000s. The "Energy Efficiency Law" No. 5627, which entered into force in 2007, aims to alleviate the burden of energy costs on the economy and improve efficiency in the use of energy to protect the environment. Published in 2012, the "**Energy Efficiency Strategy Paper**" sets energy efficiency objectives for 2023.

[9] You can visit https://www.shura.org.tr/turkiyede_enerji_donusumunun_finansmani/ to access the report in question.

In line with emerging needs and in order to improve the 2012 strategy further, the "**National Energy Efficiency Action Plan (NEEAP)**" was prepared in 2017, taking into account the best practices across the globe and entered into force in January 2018. Covering 55 actions to be implemented between 2017 and 2023 under the categories of buildings and services, energy, transport, industry and technology, agriculture and horizontal matters, the NEEAP aims to reduce primary energy consumption by 14% by 2023 (savings of 23.9 million tons of oil equivalent (MTOE)). An investment of **USD 10.9 billion** is envisaged for achieving such savings. According to the NEEAP 2017-2020 Progress Report[10], **a total of USD 4.8 billion** was invested in energy efficiency during the said period and 3.2 MTOE of savings was achieved.

The "**Eleventh Development Plan**" published in July 2019 aims to ensure uninterrupted, high-quality, sustainable, reliable and affordable energy supply. Objectives regarding energy efficiency within the Eleventh Development Plan are given below:

1. Rehabilitation of the publicly-operated power plants will be completed.

2. Development Agency subsidies will be restructured and priority will be given to issues such as institutionalization, innovation management, customer relationship management, corporate resource planning, e-trade, digital transformation, foreign trade, and lean manufacturing, clean production, energy efficiency, and industrial symbiosis.

3. Energy efficiency will be improved in the manufacturing industry.

a. Subsidy mechanism will be established for the replacement of inefficient electric motors used in industry with efficient ones.

b. It is ensured that cogeneration systems will be expanded in large industrial plants using heat.

c. To promote and disseminate exemplary energy efficiency practices, energy efficiency projects will be supported by competitions and it is ensured that legislation and technical infrastructure will be established concerned with implementation.

d. Heat market legislation will be established to expand energy-efficient district heating and cooling systems throughout the country and to enable heat trade.

e. Projects with high savings potential will be supported by improving efficiency-boosting project implementation processes.

f. Support will be provided for OIZs, to prepare and present Productivity Action Plans by completing their Energy Management Unit and ISO 50001 Energy Management System establishment.

4. Domestic production in the sector will be improved through activities aiming at promoting energy efficiency in the electrical equipment and domestic appliances sector.

a. The replacement of energy-inefficient motors used in industrial plants with more efficient motors will be supported.

b. Awareness will be raised on efficiency improvement potential by applying energy labels on the electrical motors used in industrial plants.

5. With regard to technical textiles, which is one of the key areas in the transformation of high value-added structure in the textile-clothing and leather industry, companies will be supported to select optimum technology, comply with the environmental protection legislation, energy efficiency and waste re-use activities and cooperate with other stakeholders in the value chain (in particular machinery, fiber and technical end-use manufacturers).

6. Measures to reduce carbon emissions will be developed through additional measures such as energy efficiency gains and increasing forest assets.

7. For expanding the buildings that are more efficient and produce their own energy, energy efficiency in existing buildings will be promoted through support systems.

[10] For more information, please visit https://enerji.gov.tr/evced-enerji-verimliliği-uevep.

8. "Green Port" practices will be supported to boost energy efficiency in port operations, minimize environmental impacts and ensure sustainability.

9. Quality, safeness, accessibility, energy efficiency and disaster resilience standards will be developed in housing production and will be taken into consideration at every level.

Practices to Boost Energy Efficiency in the Sectors To Be Most Affected by EGD

CBAM included in the proposal of the European Commission of July 2021 will be implemented in phases and in a way to cover direct greenhouse gas emissions (Scope 1), and the **cement, iron and steel, aluminum and fertilizer** sectors within the manufacturing industry will be affected by the regulation in the first stage. Other energy-intensive sectors that could be affected by the extension of CBAM are the chemistry, textiles and paper sectors. With the expansion of the scope, indirect greenhouse gas emissions (Scope 2) will also be covered.

The actual extent of the impact of CBAM in Turkey and other countries will depend on the carbon intensity of products and the level of carbon tax currently applied/to be applied in the countries.

Cement Industry

Information About the Sector:

Total Number of Employees in the Sector (2020)	11,201
Total Quantity/Amount of Exports to the EU (2020)	1.1 million tons / USD 153.3 million
Share of EU in Total Exports (Quantity/Amount) (2020)	7% / 13%
Contribution to GDP (2019)	TL 4 billion (USD 700 million)

When compared to the cement plants in EU countries (Table 1), it is seen that the average greenhouse gas emission intensity values of the plants in our country are higher than the averages of both Scope 1 and Scope 1 and 2 emissions for clinker, portland cement and white cement products. Current data shows that CBAM will impose additional costs on cement manufacturers operating in our country and exporting to the EU market. For this reason, it is important for the sector to make investments so as to reduce the emission intensity. In particular, it is critical for the sector to make improvements regarding the clinker firing process, where approximately 80% of the total energy used in cement production is consumed. Emissions in clinker production account for approximately 65% of the total process emissions in cement production.

Table 1: Comparison of Emission Intensities in the Cement Industry in Turkey and EU Countries (Source: The European Roundtable on Climate Change and Sustainable Transition - ERCST [11])

		CO_2 intensity - tCO_2/ton of product	
		Scope 1 emissions	**Scope 1 and 2 emissions**
Clinker	**EU27**	**0.813**	**0.835**

[11] Detailed information is available at https://ercst.org/.

	Turkey	**0.843**	**0.875**
Portland cement	**EU27**	**0.630**	**0.664**
	Turkey	**0.731**	**0.783**
White cement	**EU27**	**1.073**	**1.121**
	Turkey	**1.001**	**1.077**

According to the Green Industry Guide published by the Aegean Region Chamber of Industry (EBSO), the EU aims to reduce the greenhouse gas emission intensity by 32% to achieve a cement value of 530 kg CO_2/ton in 2050 when compared to the greenhouse gas emission intensity of 2015 with regard to the cement manufactured through conventional methods (thermal efficiency, alternative fuels, clinker-efficient cements, transport efficiency, renewable electricity, the electrification of transport systems and the use of new binding materials). It is planned that an additional 80% reduction can be achieved by using innovative technologies (carbon capture, storage and utilization technologies), thus reaching 156 kg CO2/ton cement greenhouse gas intensity by 2050[12].

EBSO's Green Industry Guide states that new types of cement clinkers (such as SAC, FAZ, X-Clinker) are developed in which the quantity of limestone in the product formulation is reduced in order to reduce the greenhouse gas emission intensity, and that greenhouse gas emission reductions of 20%-30% can be achieved. It should be noted that these products can only be used in certain applications as they have different properties.

Table 2 covers practices that boost energy efficiency in the sector.

Table 2: Energy Efficiency Practices in the Cement Sector (Source: EU BAT Reference Document)

A. Measures Regarding General Facilities	
Process Control Systems	Energy Management Systems and Instrumentation
Lighting	Energy efficiency and the use of lighting controls in lighting
Electricity	Use of energy-efficient motors, fans and variable speed drives (VSD)
B. Process-Specific Measures	

[12] You can visit http://ebso.org.tr/e-kitap/YesilSanayiRehberi.html to access the guide.

Clinker production	Transition from wet production to dry production process[13] Dry kilns with multistage preheater and precalciner Use of efficient chiller technology Improvement and optimization of process control Cogeneration plants - Waste heat recovery plants[14] [15] Reducing the clinker content in cement and producing a new type of clinker with less limestone content Use of alternative fuels[16] (for example, biomass and hydrogen in the clinker production process) (Preheating and homogenization system investments may be required for the use of biomass as an alternative fuel)
Raw materials	Replacing traditional mills with high-efficiency vertical roller mills and horomills Using high-efficiency separators and classifiers Automation of raw material mixing control Closed loop system for ball mills Improvement of the grinding environment in ball mills
Furnaces	Optimizing combustion efficiency in furnaces Reducing furnace shell heat losses and cold air leaks

[13] Almost all of the facilities established in the sector in Turkey have a dry-type process with high energy efficiency.
[14] While the potential of the sector is 15-30% in electricity generation from waste heat, the level of realization is around 5% in Turkey. Depending on the technology used and the moisture of the raw material, electrical energy between 3.0 and 6.0 MW can be obtained from a clinker production line with an average clinker production of 3,200 tons/day.
[15] The investment cost in cogeneration plants with high installed capacity varies between EUR 0.8 and 1.2 million/MW.
[16] The European Cement Association (CEMBUREAU) aims to use alternative fuels by 60% by 2030 and biomass accounts for 30% of this target.

Iron and Steel Industry

Information About the Sector:

Total Number of Employees (2019)	103,932
Total Quantity/Amount of Exports to the EU (2020)	4.6 million tons / USD 2.7 billion
Share of EU in Total Exports (Quantity/Amount) (2020)	28% / 31%
Contribution to GDP (2019)	TL 24.3 billion / USD 4.3 billion

The iron and steel industry, which provides input to various strategically-important industries, needs change and transformation within the scope of combating climate change. According to the data of the World Steel Association, the CO_2 emission in global crude steel production in 2019 is approximately 1.83 tons per 1 ton of crude steel, and the iron and steel industry accounts for approximately 7-9% of the CO_2 emissions resulting from the global use of fossil fuels[17].

According to the data of TURKSTAT, 41% of Turkey's exports in 2020 on value basis are exports to the EU while about 8% of exports to the EU are the exports of iron and steel and the goods made of iron and steel. In 2020, the EU's share in Turkey's exports of iron and steel and the goods made of iron and steel is around 31%. Accordingly, the report "New Climate Regime from the Perspective of Economic Indicators"[18] published by TUSIAD (Turkish Industry and Business Association) in 2020 estimates that the carbon cost calculated to occur in the exports of the Turkish iron and steel industry to the EU will be EUR 198 million (when calculated over EUR 50/ton CO_2).

Production via Electric Arc Furnace (EAF) is quite common (70%) in our country when compared to production via blast furnaces using coke and coal with high energy efficiency and low greenhouse gas emissions (Basic Oxygen Furnace; BOF) (30%). Therefore, when compared to the averages of iron and steel plants in EU countries (Table 3), it is seen that the average greenhouse gas emission intensity values of the plants in our country are lower than the averages of both Scope 1 and Scope 1 and 2 emissions. For this reason, it would be sounder to evaluate the impacts of CBAM on each respective firm.

[17] For more information, please visit https://www.worldsteel.org/en/dam/jcr:7ec64bc1-c51c-439b-84b8-94496686b8c6/Position_paper_climate_2020_vfinal.pdf and https://www.worldsteel.org/steel-by-topic/sustainability/sustainability-indicators.html.

[18] For the relevant TUSIAD report, please visit https://tusiad.org/tr/yayinlar/raporlar/item/10633-ekonomik-gostergeler-merceginden-yeni-i-klim-rejimi-raporu.

Table 3: Comparison of Emission Intensities in Turkey and EU Countries in the Iron and Steel Industry (ERCST)

	CO_2 intensity - tCO_2/ton of raw steel	
	Scope 1 emissions	**Scope 1 and 2 emissions**
EU27	**0.71**	**1.09**
Turkey	**0.40**	**0.85**

It is considered that, together with CBAM, there may be a need to reduce energy consumption and, accordingly, the quantity of CO_2 emitted per product, especially in iron and steel production plants engaging in integrated production with blast furnaces in Turkey. In this context, energy efficiency studies can be performed with regard to:

- Blast furnaces,
- Coking plants,
- Annealing furnaces,
- Boilers, pumps and compressed air systems (compressors).

Recently, it has been observed that many steel manufacturers have started to establish pilot plants and cooperate to test different methods, especially hydrogen-based steel production, in order to reduce carbon emissions in the steel industry. In this respect, the concept of "Green Steel" is among the concepts that have been heard frequently recently[19].

In the next 10 years, the EU steel industry is expected to increase investments and use of carbon capture, storage and utilization technologies, which are currently mostly used as pilot practices. However, it is expected that the use of hydrogen-based steel in processes and the production of hydrogen-based steel will increase with the development of technologies, the decrease in hydrogen production costs and the gradual rise of carbon prices in the EU by 2050 (For example, increased hydrogen injection in the blast furnace at BOF plants and the replacement of fossil fuels with hydrogen at EAF plants using direct reduced iron and hydrogen).

Table 4 covers practices to boost energy efficiency in the iron and steel industry.

Table 4: Energy Efficiency Practices in the Iron and Steel Sector (Source: EU BAT Reference Document)

A. Measures Regarding General Facilities	
Compressed air	System improvements and optimization systems

[19] For information on steel production via green hydrogen without using fossil fuels, please visit https://www.ssab.com/fossil-free-steel.

Electricity	Rehabilitation of power distribution systems, the use of high-efficiency motors with VSD and soft starters for all pumps, fans, lifting and transport systems
Process Control Systems	Energy Management Systems, instrumentation and energy monitoring and targeting systems
Lighting	Energy efficiency and the use of lighting controls in lighting
B. Process-Specific Measures	
Coking	Use of dry coke extinguishing systems Coal moisture control Coke furnace gas compressors with variable speed drive Automation and process control system Emission Optimized Sintering New-generation coke production technology
Sintering and Pelletizing	Waste heat recovery in sinter plants Improved material recharge Optimized sinter pellet ratio
Iron Production	Peak gas pressure recovery turbines Improved hot air furnace process control Improved blast furnace process control Natural gas injection Blast furnace with peak gas recycling Improving blast furnace gas recovery Pulverized coal injection Heat recovery from hot air stoves
Steel Production	Waste heat and gas recovery in basic oxygen furnaces Scrap preheating Bottom mixing/gas injection Installation of Direct Current Arc Furnaces

	Twin Shell DC Arc Furnace Foamy slag practices Use of oxy-fuel burner Improving the process control
Rounding and Finishing	Process control in hot production line Improving the insulation of reheating furnaces Regenerative burners for reheating furnaces Installation of energy efficient drive in hot production line Hot charging Reduction of losses in the annealing line (cold rounding) Automatic tracking and aiming system (cold rounding)

Aluminum Industry

Information About the Sector:

Total Number of Employees (2019)	36,473
Total Quantity/Amount of Exports to the EU (2020)	467 thousand tons / USD 1.5 billion
Share of EU in Total Exports (Quantity/Amount) (2020)	52.2% / 51.6%
Contribution to GDP (2019)	TL 6.4 billion / USD 1.1 billion

The aluminum sector provides inputs to the Turkish industry as finished and intermediate goods and is a sector that has continuity for the economy. Playing a supportive role in terms of the continuity of production, the aluminum sector provides input to the leading sectors for Turkey, especially defense, automotive and construction. Unprocessed aluminum is the basic raw material input used in the manufacturing of finished and semi-finished aluminum products. According to the "Aluminum 2020 Report in the World and in Turkey" of the Turkish Aluminum Industrialists Association, primary aluminum production in the world was 65.3 million tons in 2020 with a growth rate of 5.2%. The demand for production through recycling reached 33 million tons with a growth rate of 6.2%[20].

Aluminum is cyclical by its nature and suitable for multiple recycling. Aluminum can be recycled repeatedly without losing its original properties (lightness, conductivity, formability, durability, permeability). Besides, as stated in the studies of the European Aluminum Association, aluminum recycling requires only 5% of

[20] Turkish Aluminum Industrialists Association. http://talsad.org.tr/wp-content/uploads/2021/06/TALSAD_Aluminyum_Sektor_Raporu_2020_Ozet_compressed.pdf

the energy required to produce primary aluminum, resulting in significant CO_2 savings[21]. Estimates for aluminum show that the demand will reach 240 million tons by 2050. It is expected that at least 50% of this strong demand rise will be met by recycling and energy efficiency-oriented recycling activities in the aluminum sector will be accelerated.

It is seen that entry into the market through scrap and recycling has increased in Turkey in recent years, and recycling has started to play a more important role in our country. It is expected that the steps taken to be carbon neutral within the scope of EGD, especially in the EU, which accounts for more than 50% of the Turkish aluminum export market, will also accelerate the recycling activities in the Turkish aluminum sector.

When the primary aluminum production plants in our country are compared to the plants in EU countries (Table 5), it is seen that the average values of Scope 1 and Scope 1 and 2 greenhouse gas emission intensity are considerably higher than EU averages. In this respect, current data shows that CBAM will impose additional costs on aluminum manufacturers operating in our country and planning to export to the EU market. For this reason, it is important for the plants producing primary aluminum to make investments to reduce their emission intensity.

Table 5: Comparison of Emission Intensities in Turkey and EU Countries in the Aluminum Industry (ERCST)

	CO_2 intensity - tCO_2/ton of primary aluminum	
	Scope 1 emissions	**Scope 1 and 2 emissions**
EU27	**1.5**	**5.95**
Turkey	**2.1**	**9.12**

It is stated that the sector has an energy efficiency potential up to 50%. Installing a new boiler and cogeneration system is among the large-scale energy efficiency investments (with a payback period of more than 3 years). The table below covers the practices to boost energy efficiency in the aluminum industry.

Table 6: Energy Efficiency Practices in the Aluminum Sector (Source: Sectoral BAT Reference Documents)

A. Measures Regarding General Facilities	
Compressed Air	System improvements and optimization, including leak detection
Electricity	Rehabilitation of power distribution systems Use of high efficiency motors with variable speed drive and soft starter for all pumps, fans and transport systems

[21] Environmental Profile Report. https://www.european-aluminium.eu/media/2052/european-aluminium-environmental-profile-report-2018-executive-summary.pdf

Process Control Systems	Energy Management Systems, instrumentation and tracking and targeting systems
Lighting	Energy efficiency and the use of lighting controls in lighting
B. Process-Specific Measures	
Mining - Ore Grinding	Use of high efficiency motors and variable speed drives
Metalworking	Installation of regenerative or recuperative burners into furnaces to recover heat from flue gases Use of regenerative afterburner
Metalworking - Furnaces	Reducing furnace shell heat losses by insulating, thereby minimizing losses from gaskets and openings Optimizing furnace operations through programming and control of combustion Use of oxy-fuel in the combustion process Circulating fluidized bed calciners Enrichment of combustion air with oxygen
Metalworking (Primary and Secondary production)	Inert anode technology Increasing the recycling of scrap material

Fertilizer Industry

Information About the Sector:

Total Number of Firms in the Sector (2018)	1.284
Total Quantity/Amount of Exports to the EU (2020)	110.6 thousand tons / USD 93.5 million
Share of EU in Total Exports (Quantity/Amount) (2020)	16% / 25%
Contribution to GDP (2019)	TL 2.3 billion (USD 399 million)

The main raw materials used in fertilizer production are natural gas, ammonia, phosphate and sulfur rock. 53%-58% of the total cost in fertilizer production originates from raw materials. Industry players follow various strategies such as backward integration, joint ventures and long-term agreements to minimize the risks associated with the supply of raw materials. 35% of the fertilizer consumed in Turkey consists of urea fertilizer. Average annual domestic urea consumption is approximately 2.5 million tons.

Benchmark studies on greenhouse gas emission intensities for fertilizer production plants in our country are not available. Therefore, no comparison with EU averages is possible.

Table 7 presents exemplary energy efficiency practices in the chemistry industry, including the fertilizer industry.

Table 7: Energy Efficiency Practices in the Chemicals Sector(Source: Sectoral BAT Reference Documents)

A. Measures Regarding General Facilities	
Compressed Air	System improvements and optimization, including leak detection
Cogeneration	Cogeneration with the use of flue gas
Electricity	Rehabilitation of power distribution systems Use of high efficiency motors with VSD and soft starter for all pumps, fans and blowers and transport systems; improving steam traps
Process Control Systems	Energy Management Systems; Instrumentation and M&T systems; process integration and compression technology; integrated process control and maintenance techniques
Lighting	Energy efficiency and the use of lighting controls in lighting
B. Process-Specific Measures	
Processing – Boilers and Furnaces	Integrated process control and maintenance techniques Flue gas monitoring

	Advanced heating and process control Cogeneration Use of high efficiency burners Preventive maintenance Heat recovery from exhaust gas

Best Practices to Boost Energy Efficiency in Other Energy Intensive Sectors

The tables below cover some practices to boost energy efficiency in the textiles and paper and paper production sectors that are not yet covered by CBAM.

Table 8: Best Available Technologies in the Textiles Industry (Source: the Ministry of Energy and Natural Resources of the Republic of Turkey)

Process-Specific Measures	
Spinning Process	Use of energy-efficient blower fans and overhead traveling cleaners (OHTCs)
Weaving Process	Taking measures for energy efficiency in weaving plans
Wet Processing	Using counterflow currents for washing Achieving energy savings in continuous washing machines
Dyeing and Printing	Achieving thermal insulation in high temperature/high pressure (HT/HP) dyeing machines Achieving heat recovery from hot rinsing water

Table 9: Best Available Technologies in the Paper and Paper Production Industry (Source: the Ministry of Energy and Natural Resources of the Republic of Turkey)

Process-Specific Measures	
Raw Material Preparation	Replacing pneumatic conveyors with belt conveyors
Chemical Pulp Production	Using a continuous cooking boiler and control system
Bleaching	Replacing conventional vacuum pressure units with washing presses
Paper Production	Waste heat recovery without paper drying Use of energy-efficient vacuum systems

Replacement of motor systems and energy efficiency practices in process heating and cooling systems can be applied throughout the entire manufacturing industry. They are effective in reducing the energy consumption of plants and, accordingly, their greenhouse gas emissions.

Motor Systems

Motor systems, which are used in many different equipment such as fans, compressors and pumps, are the largest electricity consumption item in the industrial sector. Four efficiency classes have been set as IE1 (most inefficient), IE2, IE3 and IE4 (most efficient). As stated by SHURA, IE1 and IE2 class motors are generally used in industrial facilities in Turkey. Use of IE3 and IE4 class motors is an important energy efficiency enhancing factor in the industry. In addition, the use of motors and systems (such as fans, pumps, compressors) used in processes with variable load together with variable speed drives regulates the operating frequencies of the systems, ensuring the efficient use of energy and saving a significant amount of electricity.

Process Heating and Cooling (with Cogeneration and Trigeneration)

Heating and cooling systems used in production and storage processes in industrial facilities have a significant share in electricity consumption. The heating process is mostly carried out by the heat generated by the combustion of fossil fuels in boilers and furnaces, or by the steam produced out of this process. However, there are also processes in which electricity is used in process heating. Cooling processes performed entirely by electricity.

Prevention of heat loss, the use of high-efficiency devices to meet the heating and cooling needs, and the correct management of heating and cooling loads lead to significant electricity savings.

Cogeneration systems can be used for industrial facilities with low process temperatures and can partially meet both the electricity and heat needs of the facility. Distributed electricity generated by the

cogeneration system reduces the demand in the grid, thus reducing grid losses. By using cogeneration systems with absorption chillers, the efficiency of cogeneration systems can be further increased (trigeneration plants).

It can be used in cogeneration plants, petrochemical complexes, chemical plants, textile dyeing plants, paper and cellulose processing plants, food production plants and fertilizer plants.

Investment Potential in Energy Efficiency

According to the Final Report[22] which is supported by the Ministry of Industry and Technology of the Republic of Turkey and conducted by TÜBİTAK MAM of the Project for Identifying the Resource Efficiency Potential in the Industry, the total amount of energy efficiency investments that should be made for realistic scenarios and ideal scenarios in 5 main resource-intensive sectors are presented in the chart below (Figure5). Iron and steel and aluminum sectors, which will be affected by CBAM, are included in the basic metal industry in the charts below. On the other hand, the manufacturing of chemicals and chemical products sector includes the fertilizer sector, which is another sector that will be affected by CBAM.

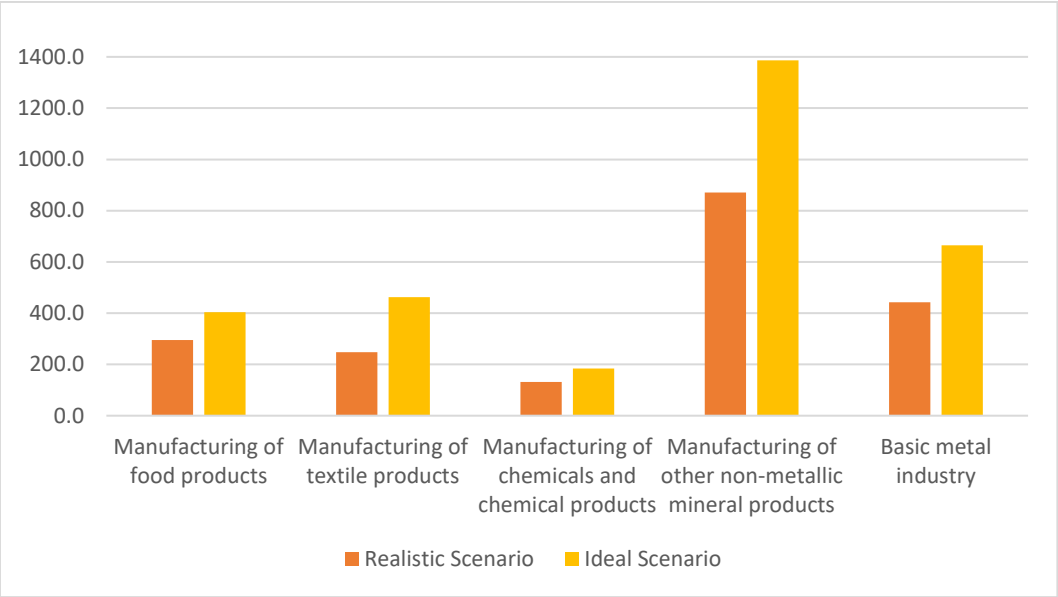
It is seen that the manufacturing of other non-metallic mineral products sector needs the highest investment (EUR 871 million in the realistic scenario and EUR 1.4 billion in the ideal scenario). In the basic metal industry, there is an investment potential between EUR 442 million and EUR 665 million in the field of energy efficiency. **There is an energy efficiency investment potential between EUR 2.8 billion (realistic scenario) and EUR 4.3 billion (ideal scenario) in total in the Turkish manufacturing sector.**

The payback period of 59% of the investments in the basic metal industry and 53% of the investments in the manufacturing of chemicals and chemical products sector is longer than 1 year. Most of the energy efficiency investments (61%-77%) that can be made in other sectors have a payback period of less than 1 year. This shows that energy efficiency is a very important tool in reducing the energy and greenhouse gas emission intensity of industrial facilities.

Figure5: Energy Efficiency Investment Potential in Sectors (EUR million[23])

[22] Report may be accessed through the link; https://www.temizuretimmerkezi.org/imagesbuyuk/6727d-Sonuc-Raporu.pdf ziyaret edilebilir.

[23] In this study, the investment potentials given for energy, water and raw material efficiency were calculated based on the Euro/TL parity in September 2017, the publication date of the Project for Determining the Resource Efficiency Potential in Industry - Final Report.



According to the "Financing the Energy Transformation in Turkey" report prepared by SHURA Energy Transformation Center, there is an investment potential of **EUR 336 million** in the **cement sector** under the manufacturing of other non-metallic mineral products and **EUR 527 million** in the **iron and steel sector** under the basic metal industry. According to the SHURA scenario, the sum of the energy efficiency (motor replacement, lighting and process heating and cooling) investments to be made in the sectors other than the investments in the cement and iron and steel sectors is around **EUR 3.8 billion** and the majority of these investments are expected to be made in chemistry, textiles and food plants with high energy intensity.

Regarding waste heat recovery investments in cement plants;

Delivering a speech during the Mineral Panels in Industry- Cement Sector meeting organized by Istanbul Mineral Exporters' Association (IMIB) in May 2021, CEO of Türkçimento[24] (Turkish Cement Manufacturers' Association) Volkan Bozay stated that blended cement would gain even more importance in transition to the low-carbon production model. It was also emphasized that a total of USD 2 billion USD has been invested in energy generation from waste heat during the last decade. In addition, it was pointed out that there were currently 32 million tons of waste in Turkey and approximately 20% of this quantity could be used as fuel, thus reducing the current account deficit by USD 365 million.

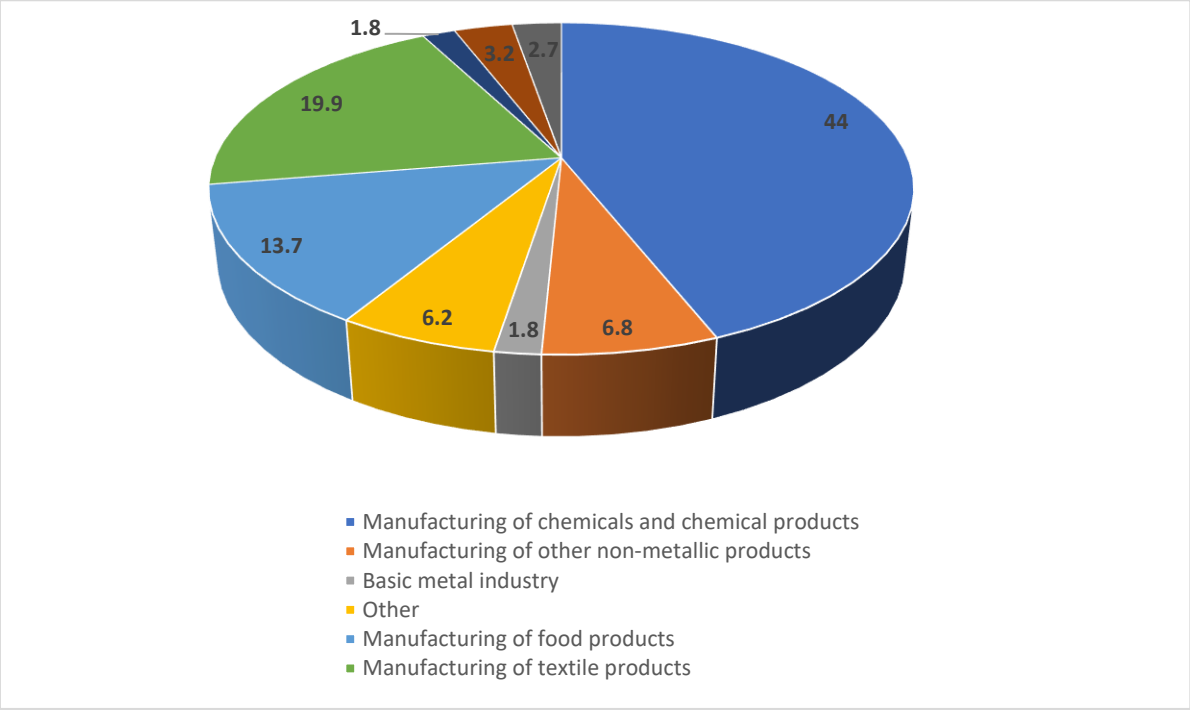
[24] *Türkçimento (formerly Turkish Cement Manufacturers' Association, TCMA) is a civil society organization established in 1957 as an association. It represents a total of 65 plants in Turkey, 50 of which are integrated and 15 are grinding plants. Being a member of the European Cement Association since 1972 as the international representative of the Turkish cement industry, Türkçimento also engage in many activities from research and development services to training, international cooperation, certification, sectoral data compilation, cooperation with universities, civil society organizations and other relevant institutions.*

Water Efficiency in the Green Transformation of Industry

The agricultural sector is the largest water consumer sector in Turkey, accounting for 73% of water consumption. Current water use ratio of the industry in Turkey is around 13%[25] and it is predicted to go up to 20% by 2030. The pressure triggered by climate change on ground and surface water resources requires much more efficient use of water in industrial sectors with high water dependency. It is important to implement practices based on water efficiency, especially in sectors with intensive water consumption such as the manufacturing of food products, textiles, the manufacturing of non-metallic mineral products, the basic metal industry and the manufacturing of chemicals. We consider that the outputs of the "Industrial Water Use Efficiency by NACE Codes" Project organized between 2021 and 2023 under the leadership of the Ministry of Agriculture and Forestry of the Republic of Turkey will be an important guidance document and action plan regarding the efficient use of water in industry.

As can be seen from the chart (Figure 6) below, the largest share of water consumption in industrial sectors in Turkey belongs to the manufacturing of chemicals and chemical products at 44%. This sector is followed by the manufacturing of textile products and the manufacturing of food products at 19.9% and 13.7%, respectively.

Figure 6: Sectoral Breakdown of Water Consumption (%)



Source: Assoc. Prof. Gökşen Çapar and Prof. Ülkü Yetiş, TURKSTAT

Utilization of high technology in water-intensive sectors and the dissemination of Best Available Techniques (BAT) practices to reduce water consumption are considered as an important need. It is

[25] Calculated together with water use in the energy sector (thermal power plants). Water consumption of manufacturing industry, organized industrial zones and mining enterprises is around 4%.

considered that the dissemination of BAT practices along with wastewater recovery will make a significant contribution to the sector in terms of water efficiency[26].

According to the Final Reportof the Project for Identifying the Resource Efficiency Potential in the Industry supported by the Ministry of Industry and Technology of the Republic of Turkey and TUBITAK MAM (Marmara Research Center), the industry holds a water savings potential of 17% to 29%. It was determined that approximately 57% of the total water saving potential could be obtained from studies requiring investment.

Water efficiency investments that can be made in the industrial sector in general;

- Using technologies that will enable transition from wet industrial processes to dry industrial processes,
- Use of water in a closed loop setting,
- Reducing water leaks,
- Waste water treatment and process recovery plants,
- Reuse of washing water,
- Installing a rainwater collection and utilization system,
- High pressure and low volume nozzles and low water consumption sprays (process equipment consuming less water),
- Steam and ultrasonic cleaning instead of hot water washing,
- Automatic water opening and closing systems,
- Flow, quality and level measurement systems and
- Installation of a water monitoring and management system.

An analysis of water efficiency by sectors shows that high quantities of waste water are generated in parallel with intensive water consumption in plants operating in the **manufacturing of chemicals and chemical products sector**, including the fertilizer sub-sector. However, the high levels of chemicals mixed with water due to production processes cause a rise in the chemical loads carried by the wastewater. It is possible to reduce the quantity of waste water by 50-60% via various efficiency measures to be taken regarding production processes.

An analysis of the **textiles sector** shows that 70-80% of water use results from finishing and dyeing processes, and water is consumed in auxiliary processes such as steam generation, plant cleaning and water softening. In order to achieve water efficiency in the textiles sector, the following actions are recommended:

- Monitoring and controlling water consumption on the basis of all processes,
- Separation and characterization of wastewater flows and the evaluation of water/material recovery and reutilization facilities,
- Reuse of alkaline-containing wastewater in other pre-treatments for mercerization processes,
- Ensuring the reuse of finishing wastewater where possible,

[26] http://suyonetimi.ankara.edu.tr/wp-content/uploads/sites/88/2018/10/Anahtar-Dergisi-Sanayide-Su-Verimlili%C4%9Finin-%C3%9Clkelenen-Durumu.pdf

- Recovery of sizing chemicals from desizing wastewater by membrane filtration,
- Increasing washing efficiency and using counter-current washing and
- Using water flow control devices and automatic shut-off valves in continuously operating machinery.

In order to achieve water efficiency in the **food sector**, the following actions are recommended:

- Detailed monitoring of water use on the basis of processes,
- Routine monitoring of ground and process water quality,
- Optimization of the water softening system,
- Preventing unnoticed losses (Preventing losses by maintaining pipes and pumps),
- Evaluation of facilities for the recovery/reuse of process wastewater of appropriate quality,
- Utilization of some cooling water used in the enterprise as prewash water and
- Preventing environmental pollution by reusing the filling liquid in manufacturing canned food and pickle.

It is seen that water is consumed in dry processes under **cement production** only for cooling the mill atmosphere and cooling the kiln gases during grinding processes. The studies carried out within the scope of the Project for Identifying the Resource Efficiency Potential in the Industry show that there is no consumption other than evaporation losses due to the use of closed systems, although water is needed for bearing cooling in the facilities. In order to achieve water saving in the sector, it is recommended to convert all cooling water systems from open circuit to closed circuit, to use treated tap water for cleaning and garden irrigation, and to recover 100% of the cooling water of waste heat recovery facilities.

It is observed that closed and open water systems are used together in enterprises operating in the **iron and steel sector** in Turkey. It is observed that closed water systems are used especially in the steelwork sections of the facilities. The following practices can increase water efficiency in the sector:

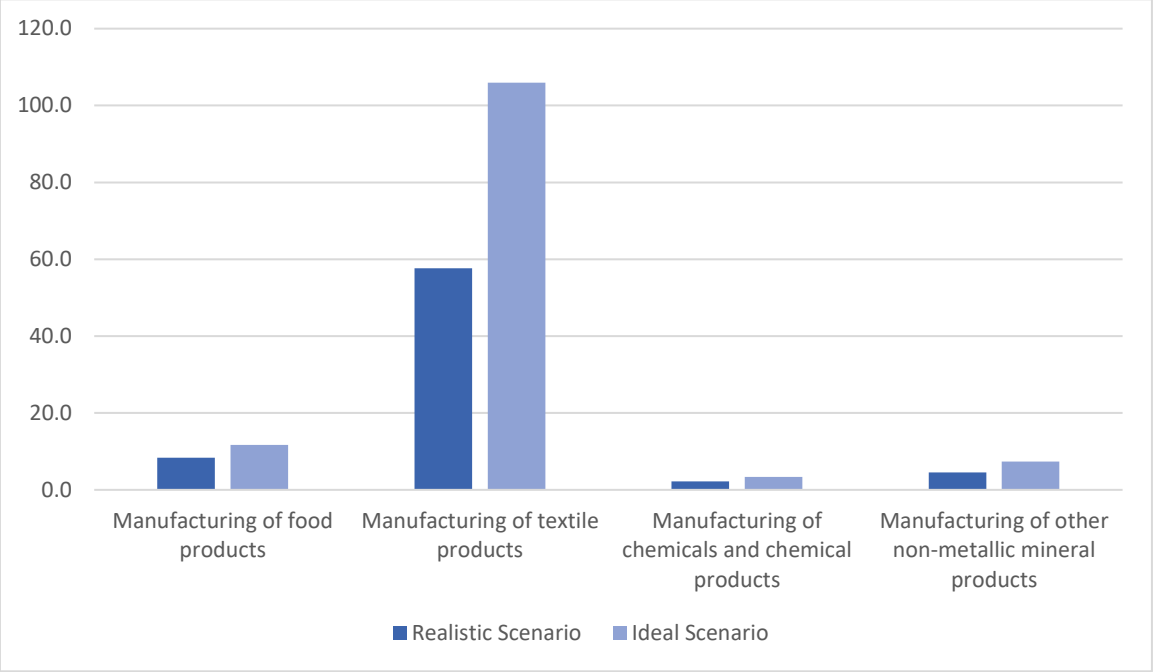
- Using closed circuit water cooling systems as much as possible for the cooling of the furnace, thus minimizing the water consumption resulting from the electric arc furnace (EAF) process,
- Separating and utilizing treated and untreated wastewater and using rainwater as much as possible throughout the process,
- Removal of solids by precipitation, sedimentation and/or filtration; minimizing the discharge of waste water from continuous casting by combining the methods of removing oil from stripping tanks or any other active device and recirculating the cooling water and vacuum-generated water as much as possible, and
- Preventing water losses in cooling towers by using a reverse osmosis system and exchanger.

Investment Potential in Water Efficiency

According to the Final Report of the Project for Identifying the Resource Efficiency Potential in the Industry, the total amount of water efficiency investments that should be made for realistic scenarios and ideal scenarios in water-intensive sectors are presented in the chart below (Figure 7). It is seen that the textiles sector needs the highest investment (EUR 57,5 million in the realistic scenario and EUR 106 million in the ideal scenario). The payback period of most of the investments (92%) that should be made in the textiles sector is longer than 1 year. In the food sector, which follows the textiles sector, there is an investment

potential between EUR 8.3 million and EUR 11.7 million. **There is a water efficiency investment need between EUR 135 million (realistic scenario) and EUR 222 million (ideal scenario) in total in the Turkish manufacturing sector.**

Figure 7: Water Efficiency Investment Potential by Sectors (EUR million[30])



Raw Material Efficiency in the Green Transformation of Industry

Raw material efficiency has become a very important issue for the industrial sector in terms of competitiveness with the rise in environmental pollution, the rapid decrease in non-renewable natural resources and the increase in the value of resources. For this reason, in addition to the objectives of boosting efficiency in production in the Member States of the European Union and developed countries, it is seen that policies are being developed and disseminated for the use of processes and products that will both reduce resource consumption and minimize environmental impacts.

In order to use resources efficiently, increase the competitiveness of the Turkish manufacturing industry and reduce environmental impacts, our country also aims to expand clean production activities based on the principle of minimum resource consumption and minimum waste generation throughout production processes.

Below are examples of good practices and/or improvement potentials in terms of raw material efficiency on a sectoral basis within the framework of the studies carried out in the Project for Identifying the Resource Efficiency Potential in the Industry:

In the **cement sector**, priority should be given to the use of waste fuel (alternative fuel) in terms of resource efficiency. In the Turkish cement industry, imported fossil fuels and petcoke (petroleum coke) are used as thermal energy sources. The rate of waste-derived fuel (WDF) use in the sector is around 4%. Despite the rise achieved in recent years, the main reason why the use of waste-derived fuel is low compared to developed countries is considered to be the lack of fixed-cost resources of appropriate quality and sufficient quantity. If appropriate resources are available and managed correctly, the rate of waste-derived fuel use in the cement sector will increase. In plants not designed to use WDF, the maximum rate of waste utilization (incineration) is 5%. There is a need for additional investment for the utilization of waste at higher rates. In order for the cement sector to make such investments or for the investments to be economical, long-term assurance is required in the provision of waste-derived fuel. By ensuring the continuity of waste sources and reducing fluctuations in waste quality, the cement sector will achieve higher rates of waste use.

It is also important for the sector to reduce the clinker ratio in the cement produced to reduce the greenhouse gas emission intensity (it is around 80% on average in Turkey) and to use blast furnace slag, fly ash, trass, limestone, etc., instead of clinker.

Investments on reducing dust, NO_X, SO_2, HCI and HF emissions and metal emissions (bag filter, electro filter and hybrid filter) will contribute to reducing the environmental impacts of the cement industry. It is seen that all plants established after 2009 can achieve the current national limit value. However, many plants require investment in non-selective catalytic reduction technology (NSCR) for EU - BAT compliance (450 mg/Nm_3) in NOx emissions (5 out of 74 furnaces meet the limit value).

According to the study of the Ministry of Environment and Urbanization of the Republic of Turkey, total cost of the Turkish Cement Industry for compliance with the EU - Industrial Emissions Directive was calculated as USD 873 million. The share of energy efficiency investments in the total cost is 30%.

The raw materials used in the **iron and steel industry** differ depending on the production method. In basic oxygen furnace (BOF) based plants, iron ore, scrap metal and hard coal are used together. On the other hand, Electric Arc Furnace (EAF) plants produce based on scrap metal. An analysis of the resource efficiency practices in the iron and steel industry shows that:

- It is important to recover materials that can provide input to the process. Processes such as the recovery of metal in slag, zinc recovery from flue dust and after galvanization significantly affect the raw material saving potential. Zinc is recovered from flue dust the plants established for this purpose,
- In addition, ladle furnace slags are considered to be used as a slag builder instead of lime in steelmaking, since they contain high levels of Calcium Oxide (CaO).
- Improvements in regulation systems can achieve a decrease in electrode consumption per ton of product.
- Both raw material and energy efficiency can be achieved in the sector with the use of quality scrap and scrap screening-separation processes. However, very few of the plants in our country are equipped with a scrap screening system.
- As with cement plants, energy recovery from waste tires is possible.

In the **chemistry industry** (in the plants manufacturing basic chemicals, chemical fertilizers and nitrogen compounds, primary form plastics and synthetic rubber), the consumption of primary and auxiliary raw materials has a significant share in production costs, and therefore, reducing raw material consumption is critical for the sector. This sector generates hazardous, non-hazardous and chemicals sector-specific waste throughout production processes. The rise in efficiency concerning production processes can lead to a reduction of approximately 50% in solid waste quantity.

An analysis of the **fertilizer sector** in terms of circular economy shows that studies regarding the use of green and organic fertilizers in agricultural production are carried out as specified in the document "Fertilizer Sector Policy Document 2018-2022[27] drawn up by the Ministry of Environment and Forestry of the Republic of Turkey. It was emphasized that organomineral fertilizers, which were offered as an alternative to chemical fertilizers in the recent past, were prioritized and the production of these fertilizers was encouraged.

The Green Deal Action Plan published by the Ministry of Trade of the Republic of Turkey underscores the reduction of the use of chemical fertilizers under the heading of sustainable agriculture. It is stated that efforts will be made to develop organic agriculture in Turkey and to carry out this process in a harmonized manner with the European Union.

Consumption of chemicals in the **textiles sector** is quite intense. It is stated that by taking various efficiency measures, approximately 40-60% savings can be achieved in the consumption of existing auxiliary chemicals and 26% in the consumption of dyestuffs. Hazardous, non-hazardous and textile-specific waste

[27] The document is available at https://www.tarimorman.gov.tr/TAGEM/Belgeler/yayin/G%C3%BCbre%20Sekt%C3%B6r%20Politika%20Belgesi%202018-2022.pdf.

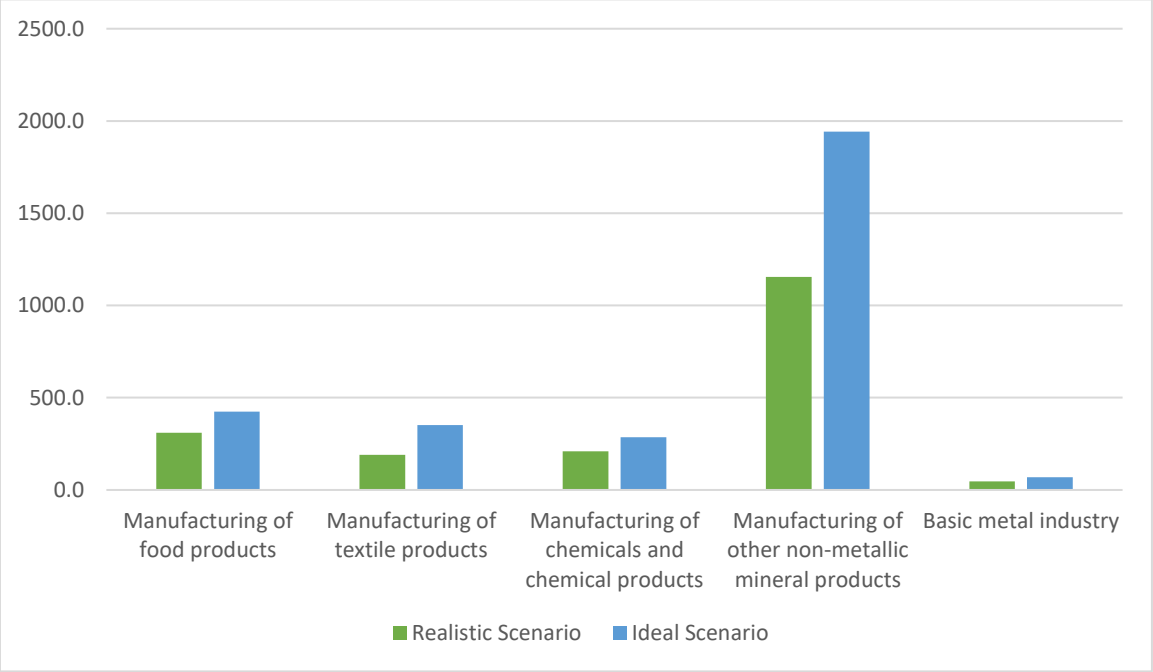
is generated in the production processes within the textiles industry. It is shown that the rise in efficiency concerning production processes can lead to a reduction of approximately 54% in solid waste quantity.

With the use of chlorine-free bleaching technologies in the paper industry, it is possible to prevent the discharge of chlorinated organic substances into the water environment. According to the Green Industry Guide published by EBSO, the use of recovered raw materials in the EU paper industry has doubled since 1991. Applications of using biomass (pulverized biomass obtained in Kraft type production facilities) instead of fossil fuels in heat boilers and lime kilns have been gradually increasing in the last 2-3 decades.

Investment Potential in Raw Material Efficiency

According to the Final Report of the Project for Identifying the Resource Efficiency Potential in the Industry, the total amount of raw material efficiency investments that should be made for realistic scenarios and ideal scenarios in 5 main sectors are presented in the chart below (Figure 8). It is seen that the manufacturing of other non-metallic mineral products sector including the cement sector needs the highest investment (EUR 1.1 billion in the realistic scenario and EUR 1.9 billion in the ideal scenario). The payback period of most of the investments (65%) that should be made in this sector is longer than 1 year. There is an investment potential of EUR 310-425 million in the manufacturing of food products, EUR 209-286 million in the manufacturing of chemicals and chemical products, and EUR 190-352 million in the manufacturing of textile products. **There is a raw material efficiency investment need between EUR 4.5 billion (realistic scenario) and EUR 6.3 billion (ideal scenario) in total in the Turkish manufacturing sector.**

Figure 8: Energy Efficiency Investment Potential in Sectors (EUR million[30])



Regarding Waste Derived Fuel (WDF) investments in cement plants;

At the Anadolu Meetings event of Dünya Newspaper held in Mersin in February 2021, Murat Kahya, the CEO of Medcem Cement operating under Eren Holding, stated that alternative fuel conversion on a plant

basis could be achieved at an average cost of USD 10-15 million. In this way, domestic waste supplied from municipalities will be able to be converted into waste-derived fuel at the plant. In this context, it was stated by Murat Kahya that there was a need for temporary import support for waste imports. According to the information TSKB received from sector representatives, the investment expenditure required for WDF transformation in plants that have not yet made any investment is in the range of EUR 10-12 million.

Impacts of the Circular Economy Action Plan on Plastics and Packaging Industries

The final Circular Economy Package[28] published by the EU in 2019 includes the Circular Economy Action Plan and the review of the legislation on waste. While the strategies intended for plastics are created under the Circular Economy Action Plan, the packaging and packaging waste control directive is updated within the scope of the revisions of the legislation on waste[29].

According to PAGEV[30] (Turkish Plastic Industry Foundation), the annual quantity of plastics manufactured in Turkey approaches 10 million tons and a turnover of around EUR 30 billion is achieved. According to official data, over 3.7 million tons of plastic packaging are produced annually in our country[31]. Therefore, it is important to evaluate the potential impacts of the EU Circular Economy Package on the plastics and packaging industries.

Strategies developed within the scope of the EU Circular Economy Action Plan aim to introduce new regulations on many plastic products. It is clearly seen that certain steps have been taken especially for plastic manufacturers to share responsibility for the impacts that will materialize at the end of the life cycle of the products. However, it is seen that serious measures have been taken regarding microplastic waste, which is harmful to sea creatures and human health. With regard to disposable plastics, the resolution issued by the EU Parliament in 2019 aimed to ban the use of disposable plastics (plate, fork, knife, glass, ear stick, straws) starting from July 3, 2021 and direct users towards sustainable alternatives. **As part of its circular economy vision, the EU aims to render all plastic packaging products reusable or cost-effectively recyclable by 2030. By 2030, the EU aims to recycle more than 50% of plastic waste and increase the collection-separation and recycling capacity by 4 times. Similarly, it also aims to increase the demand for recycled plastics by 4 times.**

According to the "Report on Plastic Recycling and Waste Import in Turkey" drawn up by the Chamber of Chemical Engineers of TMMOB (Union of Chambers of Turkish Engineers and Architects), the EU Member States set the target of collecting 90 percent of disposable plastic bottles by 2029, while they also agreed to impose a 25% recycled content regarding these bottles by 2025 and 30% by 2030. In addition, a tax of EUR 0.8 was imposed per kilogram of plastic packaging starting from January 1, 2021 through the resolution of taxation for plastic packaging waste[32].

Within the scope of the activities under the "Zero Waste Project", the "Packaging Waste Control Regulation" was published in the Official Gazette on June 26, 2021 in order to comply with both the

[28] https://ec.europa.eu/environment/topics/circular-economy/first-circular-economy-action-plan_en
[29] https://ambalaj.org.tr/tr/bilgi-merkezi-ab-dongusel-ekonomi-paketi
[30] PAGEV's report is available at https://pagev.org/turkiye-plastik-sektor-izleme-raporu-2020-601b95c394d04.
[31] https://ticaret.gov.tr/data/5b87000813b8761450e18d7b/Ambalaj.pdf
[32] https://www.kmo.org.tr/resimler/ekler/d5e10e038d7b224_ek.pdf

revisions made in the Environmental Law No. 2872 and the establishment of the Turkish Environmental Agency by the Law No. 7261 as well as the developments in practices concerning environmental legislation. In the upcoming period, the creation of new regulations and secondary regulations including the reduction of disposable and multi-layered (problematic) composite packaging may come to the fore in Turkey in parallel with the developments in the EU and various restrictions may be introduced, which may affect the plastic and packaging industries in Turkey. As specified in the study[33] published by TUSIAD on the subject, it will be important to carry out legislative studies in order to set the conditions that will allow the use of recycled plastic in food packaging by ensuring food safety.

Increasing the capacity in the separation and recycling of all packaging waste, especially plastics, and improving the conditions of existing recovery facilities for high-quality recycling will be critical in terms of harmonization with the EU's Circular Economy Action Plan. Improving the capacity of the plastic and packaging industries to use recycled products as a resource plays a key role.

Other Areas Where Turkish Industrialists Can Invest for Green Transformation

In addition to energy, water and raw material efficiency, investments can be made in the following areas, which will reduce energy intensity, increase the level of circularity in production and operations, and make positive contributions to companies against physical and transition risks[34] caused by the climate change:

- Utilizing renewable energy directly in production (especially roof-top and facade SPP applications[35] (there is a total of 3,000 MW of roof-top and facade SPP potential for commercial and industrial buildings) and wastewater treatment and the installation of biogas power plants for the generation of renewable energy (electricity and heat) in industries and enterprises with high organic waste output[36], etc.,
- Renewable heat applications (Geothermal and solar energy),
- Indirect use of green electricity in production (YEK-G[37] or I-REC[38]),
- Electrification in currently-used vehicles,
- Sustainable product and packaging design and R&D (For example, green chemicals and biological-based products),
- Carrying out Life Cycle Assessment studies for products and exploring improvement opportunities,

[33] https://tusiad.org/tr/yayinlar/raporlar/item/10790-avrupa-yesil-mutabakati-dongusel-ekonomi-eylem-plani-turk-is-dunyasina-neler-getirecek

[34] For more detailed information on transition and physical climate risks; https://www.fsb-tcfd.org/recommendations/

[35] For the roof-top and facade SPP investment potential in industrial facilities in Turkey, please visit https://www.shura.org.tr/wp-content/uploads/2020/04/Binalarda_Cat%C4%B1_Ustu_Gunes_Enerjisi-Potansiyeli-.pdf.

[36] More information on the total biogas investment potential in Turkey (EUR 9 billion) is available at https://www.vivis.de/wp-content/uploads/WM9/2019_WM_119-128_Azbar.pdf.

[37] For more information about YEK-G; https://www.epias.com.tr/yek-g-piyasasi/yek-g-sistemi-ve-organize-yek-g-piyasasi-tanitimi/

[38] For more information about I-REC; https://www.irecstandard.org/turkey/#/

- Exploring industrial symbiosis opportunities[39],
- Sustainable raw material supply (For example, the use of PEFC[40] and FSC[41]-certified raw materials in the paper industry),
- Investments in adaptation to climate change,
- Protection and development of biological carbon sinks (forests),
- In particular, green hydrogen investments (it is a fast-growing area and there are practices in the iron and steel industry in some EU countries[42]) in the upcoming period (within 5-10 years)
- The developments in carbon capture, utilization and storage practices especially in the cement, iron and steel and chemicals -petrochemistry sectors should be followed closely.[43][44]

Conclusion and TSKB Roadmap

With the European Green Deal process, which started in December 2019, a great change has started in the EU Green Deal and Circular Economy themes, especially in the industrial sectors. The Border Carbon Regulation, which will come into effect in the coming period, is important for the Turkish industries and for Turkey's export strategy. In this context, as a result of both literature research and interviews with the companies in the portfolio, it comes to the fore that significant investments may be required on European Green Deal and Circular Economy in industrial and public areas. When Turkey is considered in particular, it is of great importance to involve the private sector in adaptation investments, which cannot gain importance only by transferring public resources. Therefore, a series of meetings will continue being held with both public institutions and sectoral representatives, and studies will be carried out to set a target for the dimensions, planning and financing of adaptation investments.

[39] For more information, the document prepared by BEBKA (Bursa Eskişehir Bilecik Development Agency) is available at https://www.bebka.org.tr/admin/datas/ Sayfas/files/EndustriyelSimbiozBrosur_son.pdf
[40] https://www.pefc.org/
[41] https://fsc.org/en
[42] For information on steel production via green hydrogen without using fossil fuels, please visit https://www.ssab.com/fossil-free-steel
[43] Detailed information for exemplary carbon capture and storage practices conducted by Heidelberg Cement and Tata Steel is available at https://www.heidelbergcement.com/en/carbon-capture-and-storage-ccs and https://www.business-standard.com/article/companies/tata-steel-commissions-5-tonne-per-day-carbon-capture-plant-at-jamshedpur-121091400747_1.html
[44] Information on developments in the field of direct CO2 capture from the atmosphere is available at https://www.iea.org/reports/direct-air-capture.