GENERAL DIRECTORATE OF
DEVELOPMENT AGENCIES

İZMİR
DEVELOPMENT
AGENCY

GREEN TRANSFORMATION AND BLUE OPPORTUNITIES PERSPECTIVE FOR İZMİR

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İzmir Kalkınma Ajansı
Megapol Çarşı Kule, Halkapınar Mahallesi,
1203/11. Sk. No: 5-7, Kat: 19
35170 Konak/İzmir
Tel : 0232 489 81 81
Faks : 0232 489 85 05
E-posta: info@izka.org.tr

Prepared by

Emine Bilgen EYMİRLİ

Sinem ÖZDEMİR DURMUŞLAR

Ekrem AYALP

General Coordination and Redaction

Sena GÜRSOY

Graphic Design
Orçun ANDIÇ
Hasan Can Çakır

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ABBREVIATIONS

EU : European Union
BASBAŞ : Western Anatolia Free Zone
BSGM : General Directorate of Fisheries and Aquaculture
CIP : Cleaning in Place
CO_2 : Carbon Dioxide
DLH : General Directorate of Railways, Ports and Airports Construction
DSİ : State Water Affairs
ESBAŞ : Agean Free Zone
FAO : Food and Agriculture Organization
EIS : Entrepreneurship Information System
SEPP : Solar Energy Power Plant
GDP : Gross Domestic Product
HPLV : High Pressure Low Volume
İBB : İzmir Metropolitan Municipality
UAV : Unmanned Aerial Vehicle
İSUB : İzmir Union of Aquaculture Farmers and Producers
İTOM : İzmir Provincial Directorate of Agriculture and Forestry
İZBAN : İzmir Suburban Railway System
İZKA : İzmir Development Agency
İZSU : İzmir Water and Sewerage Administration
KLC : Kemalpaşa Logistics Center
KMB : Küçük Menderes Basin
LDT : Light Displacement Tonnage
RBMP : River Basin Management Plan
OIZ : Organized Industrial Zone
PAGEV : Turkish Plastics Industrialists Research, Development and Education Foundation
WEPP : Wind Energy Power Plant
TAGEM : General Directorate of Agricultural Research and Policies
TBMM : Grand National Assembly of Turkey
TCDD : Republic of Turkey State Railways
TOE : Ton of Oil Equivalent
TEPGE : Directorate of Agricultural Economy and Policy Development Institute
TEU : Twenty-Foot Equivalent Unit
TurkSTAT : Turkish Statistical Institution
TWEA : Turkish Wind Energy Association
GW : Ground Water
BOT : Build Operate Transfer
SW : Surface Water
ZMO : Chamber of Agricultural Engineers

PRESENTATION

In recent years as the striking impacts of climate change were begun to be observed clearly, our world has been combating epidemic diseases, vanishing ecosystems, natural disasters and resource scarcity. The present economic structure based on excessive resource use, shaped by rapid technological development, uncontrolled population growth and changing consumer behavior, constitutes a threat on a global scale. In order to cope with these developments that threaten the current economic and social welfare of humanity, the transition to a low-carbon economic system has become one of the most important items in the agenda of the world at the global level.

As an approach where natural resources are protected and the economy develops on environmental technologies, green growth is adopted in our day as a new and competitive growth model towards coping with both economic and environmental challenges. Many countries place the goal of transition to green growth at the core of their national development strategies, design policies for green transformation, carry out programs and establish legal regulations. Considering the striking examples where regional green transformation efforts have led to national policies in recent years, it is considered that a green growth transition strategy to be implemented at the regional level will present guidance in terms of national policies.

With its natural resources that have reached the limit of its capacity to renew itself, its sensitive ecosystems that need protection, and its rapidly growing polluting industry, İzmir has a strategic position in terms of starting regional green transformation initiatives. Our Agency, aiming to make effective and efficient use of the existing resources of İzmir, sees green growth and blue growth as important tools for both combating climate change and eliminating environmental threats and ensuring the continuity of economic development.

The Green Transformation and Blue Opportunities Perspective, prepared for İzmir, aims to demonstrate the magnitude of the existing risks and how they can be mitigated with the transition to green and blue growth, the economic, environmental and social benefits that will occur with various intervention scenarios, how the opportunities will be created around sustainable technologies and industries, and the gains offered by such opportunities. The perspective study utilizes a unique methodology, which covers the entire area subject to the transformation in İzmir, narrows the focus area for intervention through qualitative and quantitative evaluations from the macro level to the sub-sectors through strategic choices, keeps in mind as opportunities in the lower level evaluations the elements that were abandoned during such strategic choices at the macro level, and prioritizes the needs of the local under the framework of blue transformation strategies.

The Green Transformation and Blue Opportunities Perspective for İzmir, with its unique methodology and outcomes, goes beyond the limits of a classic strategy document, enabling decision makers to evaluate the potentials and opportunities for İzmir's green transformation and blue opportunities, identifying the situation at the origin point and determining the transformation process. It acts as guidelines that offer new horizons to the regional actors regarding the process. By use of such feature, it will be a guide for the policies and activities to be developed for İzmir by the stakeholders in the region, especially our Agency. We would like to thank the experts of the Agency, academicians and regional actors who contributed to the work prepared in a long process through intense efforts, and hope that this study will contribute to the quality growth of İzmir.

Dr. Mehmet YAVUZ

Secretary General
İzmir Development Agency

Bergama, Aşağıkırıklar Köyü

EXECUTIVE SUMMARY

Green Transformation and Blue Opportunities Perspective has been prepared to guide the development of İzmir in line with green and blue growth approaches and to support such transition. Based on the green and blue growth approach as a new regional development paradigm, it is aimed to initiate the transformation in the region by creating an impact in the short term with clear and applicable targets determined in line with the needs of the local, and to create the necessary regional capacity, will and coordination for this approach to gain a long and permanent character. In this context, the perspective study aims to reveal the magnitude of the existing problems and risks, how they can be reduced, which priority areas should be focused, the economic, environmental and social benefits that will occur with various intervention scenarios to be determined, how opportunities will be created around sustainable technologies and industries, and the gains offered by these opportunities.

In the present period, the agenda and developments on climate change, sustainable and inclusive development, strengthening resilience at the international level, as well as national policies and engagements provide an important basis and impetus for a transformation based on the green and blue growth approach.

Considering the striking examples where regional green transformation efforts lead to national policies, a green and blue transformation initiative that will start at the regional level has the potential to act as a guide in terms of national policies. In respect to its natural resources reaching the limit of their capacity for renewal, sensitive ecosystems that need to be protected, a rapidly growing polluting industry, the existence of significant agricultural activities and marine areas awaiting evaluation based on a sustainable understanding, İzmir employs an advantageous and strategic position in terms of, commencing the regional green and blue transformation initiative with its existing social and institutional capacities.

In the perspective study, the economic, environmental and social gains that will occur at the macro and sectoral level in the next ten-year period with the impact of the transformation and the opportunities in İzmir have been calculated.

Macro gains represent the potential gains to be achieved through green transformation, covering all sectors throughout İzmir. According to the calculations made over three transformation scenarios; it seems feasible to achieve net economic gains of at least **$20.9 billion** in the fields of waste, water and energy during the upcoming ten years. This corresponds to **48%** of the gross domestic income of İzmir as of the year 2020. For the same period, it is predicted that the net economic gain to be provided in the optimistic scenario may reach a level of **$35.1 billion, 73%** of the gross domestic income. The sum of the investment cost for the transformation that will provide the aforementioned gain, considering the management cost, for the ten-year period is expected to be **$3.2 billion** in the optimistic scenario. These calculations made on general assumptions are important in terms of showing the potential economic gains of investments and activities to be realized in the region in the context of green transformation.

Sectoral gains that will occur in result of the transformations and opportunities are revealed at the end of a detailed analysis and evaluation process. In this direction, the prominent sectors in the three transformation/opportunity areas, primarily waste, water and energy, and the locations where they show concentration were determined. A total of 13 sectors and/or development scenarios determined as a result of the analysis studies were studied under three main headings: **Green Transformation in Industry, Green Transformation in Agriculture** and **Blue Opportunities**. Specific to these study subjects, priority interventions that will contribute to the achievement of 33 strategic goals determined for green and blue transformation, and the benefits and costs that will arise if these interventions are realized have been revealed.

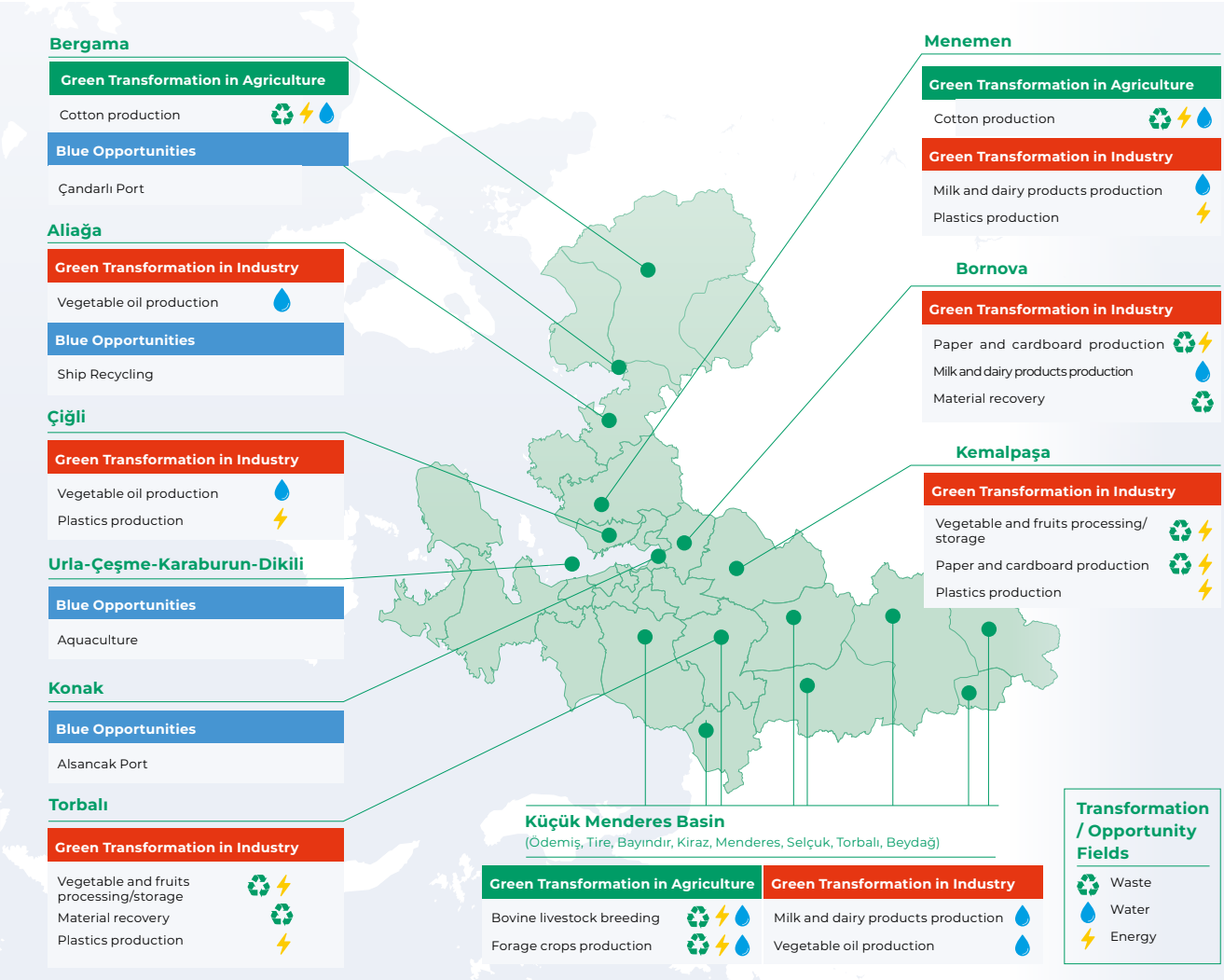
The total economic gain to be achieved in the next ten years with the green transformation of the İzmir industry throughout these interventions in priority sectors is estimated to be $725 million in the best scenario. It is observed to be possible to reduce 1.6 million tons of waste, save 54 million m^3 of water and 1.8 billion kWh of energy, with the implementation of transformation interventions. Green transformation interventions in the industry, requiring a total investment cost of 338 million dollars, will be able to prevent 4.6 million tons of CO_2 equivalent greenhouse gas emissions. Considering that the economic life of the investments proposed within the scope of the interventions is 15 years on average, the economic gain is 1 billion dollars; the amount of waste and CO_2 equivalent greenhouse gas emissions of which generation will be prevented before they occur is 2.4 and 6.9

million tons, respectively; and it is further estimated that the water and energy to be conserved will reach 81 million m³ and 2.7 billion kWh.

In the sectoral evaluations under the title of Green Transformation in Agriculture, recommendations were developed for the effective management and consumption of water, the development of alternative water sources, the planning of agricultural production activities according to the regional conditions and economic gains, the sustainable management of animal wastes, and the transition to high technology in production. In this direction, it is estimated that the total economic gain to be achieved in the next ten years with the interventions for İzmir's green transformation in agriculture will be $7.9 billion in the best scenario. As a result of the implementation of transformation interventions with a total investment cost of $907 million, it is observed to be possible to restore 12.7 million tons of animal waste to the economy and to protect 626 billion m³ of water. With the transformation, 341 million kWh of energy conservation will be achieved in agricultural energy consumption, and 1.3 billion kWh of biogas energy will be produced. With the green transformation interventions in agriculture, 2.9 million tons of CO_2 equivalent greenhouse gas emissions can be prevented. If the proposed investments can be used effectively in an average of 15 years, the amount of animal waste that can be recycled to the economy will reach 19 million tons, the amount of water that can be protected will reach 939 billion m³, energy savings will reach 511.5 million kWh, and the biogas energy to be produced will reach approximately 2 billion kWh. There is a potential to reach 4.4 million tons of CO_2 equivalent greenhouse gas emissions to be prevented before they occur.

It is pointed out that the development of green labor and skills and the realization of domestic-green technology and innovation development are critical and integral to ensuring green transformation in both agriculture and industry.

Under the main heading of Blue Opportunities, two scenarios were studied in the context of the port services sector and the goal of developing regional logistics infrastructure. In the first scenario, the North



Aegean Port, of which construction activities are still underway, was restructured for the export of wind energy equipment, and in the second scenario, for the revitalization of the Alsancak Port. The development scenario of the completion of the superstructure investment of the Kemalpaşa Logistics Center and the establishment of the railway connection between them was examined, including the relevant benefit and cost analysis. In the event the development scenario focusing on the North Aegean Port is realized, it is possible to gain around $3.2 billion against a cost of $247 million over a ten-year period; and in the case of investments and interventions under the second scenario, it is seen that a return of $1.5 billion may be achieved against a cost of $500 million. As a result of the examinations and evaluations made in respect to the ship recycling sector, measures to reduce the environmental risks created by the sector's activities were given priority. These measures are also associated with the improvement of occupational health and safety. Meeting the needs of coastal logistics facilities and structures in the aquaculture and fishing sector, another mature sector in İzmir, conducting relevant R&D activities for alternative feed use, breeding new species and supporting blue biotechnology studies have been identified as priority intervention areas.

With the perspective study, an approach that goes from macro level evaluations to project and action design level has been adopted, and the problem of where to focus in order to achieve the desired goals has been attempted to be resolved by considering the current constraints and opportunity areas. When such process and the methodology applied are also considered as a prioritization practice, it will be possible to determine what the main components of the strategic path to be followed in a multidimensional, multi-layered and multi-actor transformation problematic are, to reveal the basis, possibilities and opportunities, the status of regional institutional capacity and composition, and to analyze the intervention plans, while also providing a learning and approach development experience that includes cost-benefit assessments that will contribute to decision-making processes. In this context, the headings of activities that could be carried out for the implementation of the intervention framework set forth in the study may be listed as follows;

- Strategic investment projects (common infrastructures, pilot applications etc.)
- Knowledge generation (analysis, planning, study, feasibility)
- Carrying out preparatory work for loan and financing opportunities
- Developing cooperation models between public, private sector and civil society (governance of transformation)
- Establishment of measurement and progress monitoring mechanism
- On the other hand, the general framework of the new working agendas that will facilitate the realization of the intervention perspective, increase its impact and expand the scope of the transformation needs to be put forward. One of the main objectives of the study is to program further and in-depth studies to support the development of our region on the basis of green and blue growth approach. The topics that should be considered in the integrity of research, analysis, planning and implementation and that can also be considered as an agenda to strengthen the foundations of transformation and expand its scope together with the regional actors are as follows;
- Development of green financing mechanisms
- Developing green jobs and ensuring harmonization
- Identifying green and blue technologies to be prioritized and programming their development
- Management of ecosystem services - development of green and blue infrastructure
- Developing sustainable mobility
- Developing sustainable food systems
- Conservation and development of biodiversity
- Harmonization and mainstreaming:
  i. Developing proposals for regulations, standards, legislative arrangements
  ii. Developing recommendations for monitoring and inspection -punishment and reward- mechanisms
- Studies to be conducted for social, cultural and behavioral transformation (public, private, civil society-stakeholder governance)

Within the framework of this general approach, İzmir Development Agency situates itself in a position that supports to the production of knowledge, contributes financially to the realization of strategic investments within the framework of opportunities, undertakes the role of facilitator for the regional actors to benefit from other credit and fund opportunities, and designs and performs the governance of this multi-actor process.

CHAPTER 1.

Introduction

1.1. Transition to Green Growth and Blue Opportunities

The destruction of the natural environment and resources, the deterioration of ecosystems and their inability to provide services in result of the current global economic system constitute a significant threat to the future and welfare of humanity. It is accepted at the global level that the current economic growth model, based on increasing resource use with high negative impacts on the natural environment, is not sustainable in the long term, and that a transition to a new economic system is necessary for the continuity of economic and social development.

In order to minimize the pressures on the environment, it is necessary to use resources efficiently and to take measures to protect nature. In the green and blue growth approach, efficient resource use and management is considered as the main objective of economic policy. Since the critical limit for natural resources determines the threshold of production and consumption activities, the transition process to green and blue growth should be considered as starting a transformation that aims to change production and consumption structures by directing existing economic investments to green economic activities and clean technologies.

For an effective and inclusive green transformation, it is necessary to ensure the sustainability of the marine environment and biodiversity by considering the seas and oceans as critical natural resources. At this point, blue growth, which comes to the fore as the protection of sea and coastal areas for future generations as well as activating its potential for employment and growth, is to be seen as a complementary component of the transition to green growth.

The green transformation process, harmonized on the existing sustainable development initiatives in many countries, includes the realization of structural changes related to the transition to a green economy on the one hand, and the development of cleaner growth sources such as green industries and green technologies on the other. The transition to green growth requires radical transformations of technologies, relevant markets and institutions, and the development of new and innovative skills in all segments of society. Considering the constraints and opportunities that arise in the current economic order, the transformation should be started by focusing on specific areas. Towards the purpose of determination of these areas, it is necessary to prioritize the expectations for effectiveness and a high chance of success. In order to meet these expectations, the spatial scale of the transformation, institutional and social capacity, labor and skills, the state of natural resources, the development of the urban infrastructure, the present technology level, the qualities of economic activities, and the industrial structure will prove to be decisive.

1.2. Present Trends in İzmir

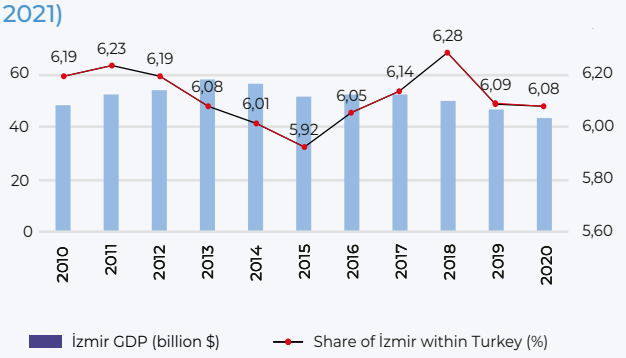
With its multidimensional and multi-sectoral economic structure, İzmir has an important potential in terms of industry, agriculture, tourism and service main sectors. Having a GDP per capita above the country average, İzmir constitutes an average of 6.12% of Turkey's total GDP (Figure 1).

Realizing 9.3% of our country's industrial production, İzmir is an important industrial and commercial base with its employment and the added value created. The industrial sector in İzmir is growing rapidly with 13 organized industrial zones, most of which are mixed structure, with a total area of 4,345 hectares, as well as its technology development zones and free zones including the Aegean Free Zone, the second largest free zone in the country. The industrial sector, which is concentrated in the center and in the districts close to the center, has a significant place in the industrial sector of the country in terms of both the number of local businesses and the number of people employed. Mainly metal goods, food products, clothing, furniture, leather, motor vehicles, chemicals, plastics, machinery and equipment manufacturing, wood products, paper products and tobacco production come to the fore.

İzmir, an ancient port city, is an important trade hub with a foreign trade volume reaching 25.7 billion dollars as of 2021. In terms of foreign trade balance, the foreign trade deficit, going on for many years, has turned into foreign trade surplus since 2017, and with the foreign trade surplus of $2.8 billion reached in 2021, the ratio of exports to imports has reached 135.3%

İzmir is one of the provinces with the highest population density in our country, 40% of its population is under the age of thirty and the province enjoys a dynamic and qualified labor with its strong university infrastructure and young population. The province, where the share of university graduates in employment is 30%, exhibits a more positive image compared to the country in general in terms of inequality in income distribution.

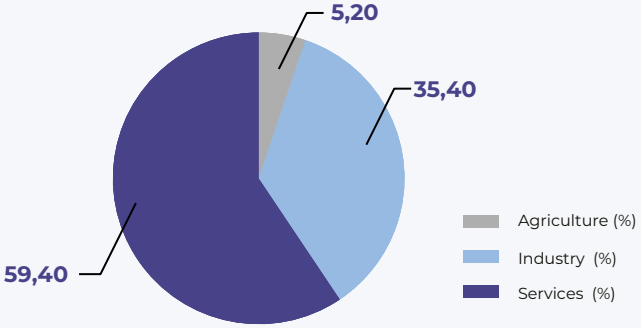
FIGURE 1. Change of İzmir GDP by years (TurkSTAT, 2021)



Source: TurkSTAT, 2021

The gross domestic product (GDP) of İzmir in 2020 occurs to be $43.6 billion, indicating a decrease by approximately 9.5%, following a fluctuating course in the last 10 years. The GDP per capita in the province in 2020 was observed to be $9,945, indicating a level 15.6% above Turkey's average. In respect to the distribution of GDP in the province by main sectors, the highest share belongs to the services sector, followed by the industry and agriculture sectors, respectively. Compared to 2010 data, the share of the industry sector in İzmir's GDP is observed to have increased by 4.33%, while the shares of the services sector and agriculture sector decreased by 2.8% and 1.55%, respectively.

FIGURE 2. The share of sectors in İzmir GDP according to 2020 data (TurkSTAT, 2021)



Source: TurkSTAT, 2021

Located at the intersection of the Gediz, Küçük Menderes and Büyük Menderes basins, İzmir is an important agricultural production and livestock center. Fertile agricultural areas constitute 40% of the province's land area. The boundaries of urban and industrial settlements press on sensitive ecosystems such as many coastal areas, wetlands, and wildlife protection areas, some of which have international protection status, and create significant pressures in these areas.

According to DSİ data, the annual water potential of İzmir is 4,508 hm^3. İzmir is one of the water-poor regions of our country, with an annual usable water potential of 639 m^3 per person. According to the sectors, agriculture takes the first place in water use with 70%, industrial water use is 20% and urban water use is 10%.

Water scarcity proves to be a major problem for İzmir, and its effects are expected to increase in the coming period due to population growth, unconscious and large amount of water use in sectors such as agriculture and industry, and polluting sources. With the impact of climate change, it is predicted that access to water resources will become limited in the coming periods. This situation poses a threat to the continuity of the current agricultural and industrial activities of the province

İzmir possesses the highest installed power of electricity with a value of 5,355 MW constituting 5.7% of the country's total. In addition to its high solar and wind energy potential, the province has important agriculture and livestock production to meet the raw material needs of the biomass sector, and has a high geothermal energy potential thanks to its geological structure. In terms of clean energy resources, 292 MW of a total of 7,325 MW SEPPs installed throughout the country and 1,874 MW of a total of 10,585 MW WEPPs are located in İzmir.

Including the emissions from industry, aviation and energy production in İzmir, the average emissions per person in 2018 occurs to be 5.08 tons. The largest share in greenhouse gas emissions belongs to the industry sector with a ratio of 31.4%, followed by transportation with a rate of 23%, residences with a rate of 14.3% and agricultural activities with a rate of 8.2% (İBB, 2021).

İzmir is also observed to be one of the provinces in Turkey that produces the most waste, producing one-fourth of all hazardous waste produced in the country by itself. Despite the recovery potential of the waste types produced, the waste recycling rate remains at the very low level of 10%.

Population in İzmir

According to the data of 2021, the total population of İzmir is 4,425,789, and the population density is 368 people per square kilometer. The population density of İzmir, which constitutes 5.22% of Turkey's population, is observed to be above the country average. 69.7% of the total population consists of the 15-64 age group who are in working age. The young population, which constitutes 12.9% of the total population, is below the national average and tends to decrease. Considering the distribution of the working age population by gender, it is seen that the rate of women is 50.30%, while the rate of men is 49.70%.

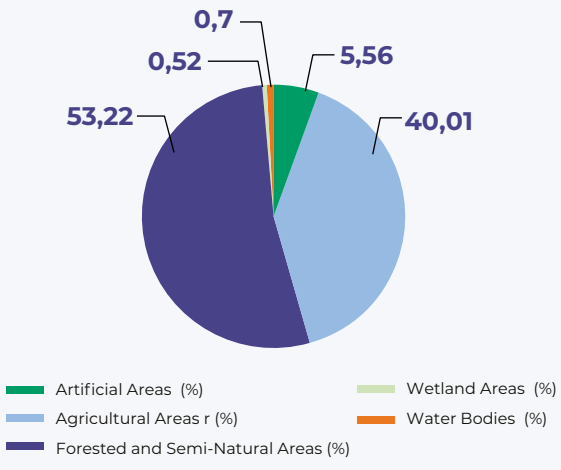
Labor Market and Employment in İzmir

The unemployment rate in the province is observed to be 14.7%, while the labor force participation rate is 52.1%. In respect to the distribution of employment by main sectors, it is seen that 58.06% are employed in the services sector, 32.94% in the industrial sector, and 8.94% in the agriculture sector. 32.68% of total employment consists of university graduates.

Land Use in İzmir

In terms of land use status, forest and semi-natural areas cover 633,094.69 hectares, agricultural areas cover 475,894.62 hectares, while the remaining area consists of artificial zones, wetlands and water bodies.

FIGURE 3. Land use status of İzmir in 2018 (TOB, 2022)



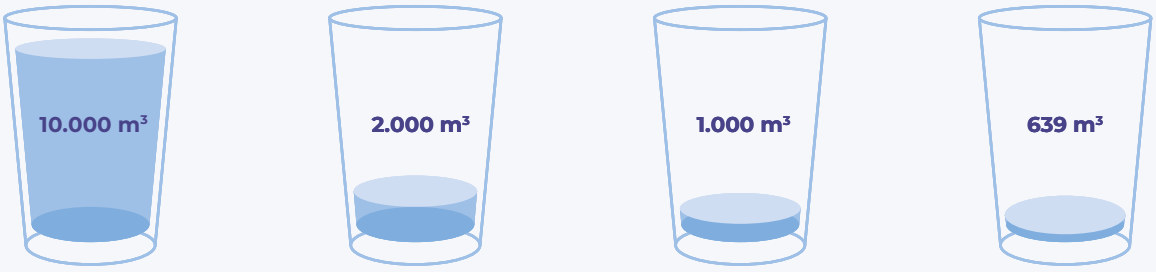
Source: TOB, 2022

Water Potential and Water Consumption in İzmir

According to DSİ data, the annual water potential of İzmir is 4,508 hm³. İzmir occurs to be one of the water-poor regions of our country with an annual usable water potential of 639 m³ per person. According to the sectors, agriculture takes the first place in water use with 70%, while industrial water use rate is observed to be 20% and urban water use rate is observed to be 10%.

Groundwater and surface water resources used in agricultural production in İzmir are used through irrigation facilities built by DSİ or wells drilled by farmers. Operation, maintenance and management services of these facilities are carried out by DSİ or authorized institutions such as cooperatives and irrigation unions. Currently, 19 irrigation organizations, including 3 irrigation unions, 6 municipalities and 10 irrigation cooperatives, operate in surface water source (SW) irrigation in İzmir, and 60 cooperatives operate in ground water source (GW) irrigation. These establishments determine a fixed water price according to the plant type or per hectare and do not set pricing based on the amount of water. Most of the GW irrigations comprise of public irrigation. In this context, no fee is paid for the water supplied from the wells drilled by the farmers, the cost of electricity consumed for the pump constitutes the basic expense of irrigation. Especially in the Küçük Menderes Basin, which is facing the threat of absolute water scarcity, the largest share in the use of ground water resources, with a rate of 75.42%, belongs to the water drawings made from privately owned wells.

Water scarcity proves to be a major problem for İzmir, and its effects are expected to increase in the coming period due to population growth, unconscious and large amount of water use in sectors such as agriculture and industry, and polluting sources. With the impact of climate change, it is predicted that access to water resources will become limited in the coming periods. This situation poses a threat to the continuity of the current agricultural and industrial activities of the province.

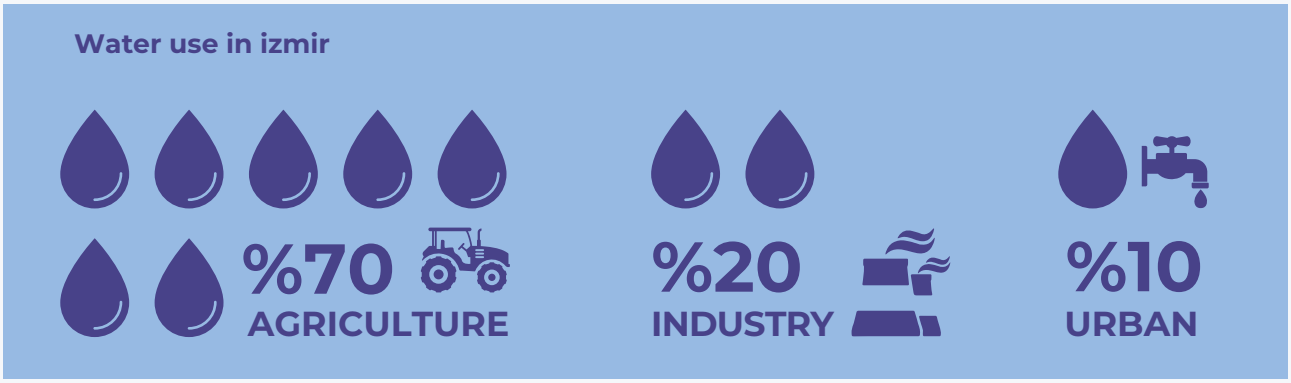


Water Richness:
The amount of usable water per person per year is more than 10,000 m3

Water Scarcity:
The amount of usable water per person per year is less than 2,000 m3

Water Poverty:
The amount of usable water per person per year is less than 1,000 m3

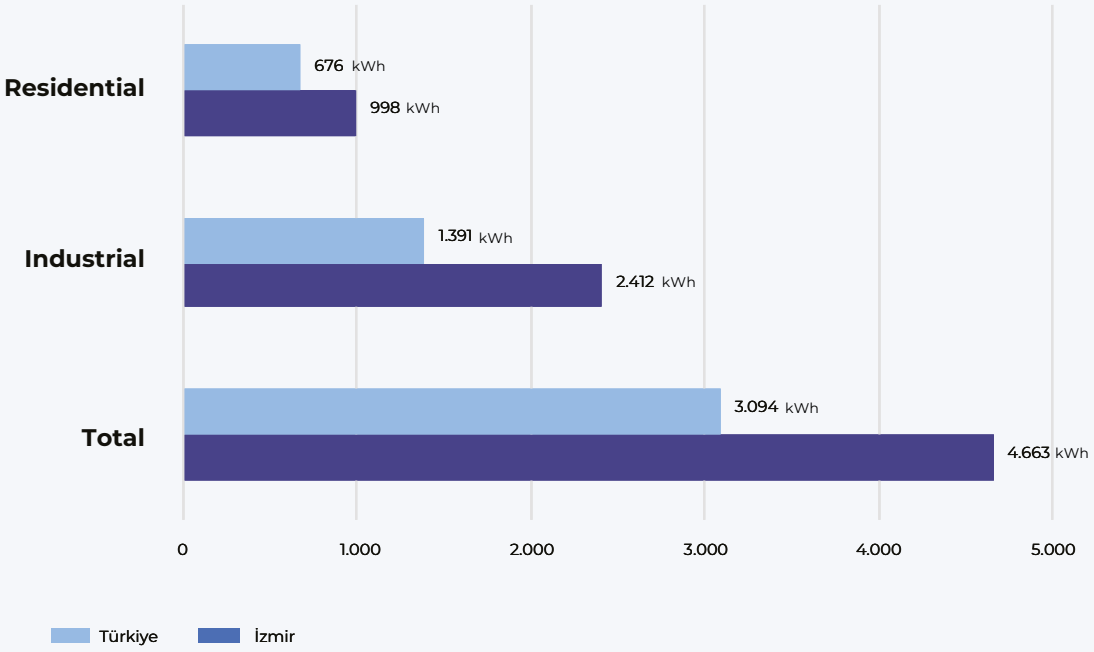
İzmir is a
water-poor region with an annual usable water potential of 639 m³ per person.



Electricity Consumption in İzmir

Of the 20.4 million MWh electrical energy consumed in İzmir in 2019, 51.8% was used in industry, 21.3% in residences, 20.2% in businesses and 1.9% in agriculture. Electricity consumption per capita (4,663 kWh) is observed to be above the national average (3,094 kWh).

FIGURE 4. Electricity consumption values per capita for İzmir and Turkey in 2019-kWh (TurkSTAT, 2020)



Source: TurkSTAT, 2020

Electricity usage in izmir

%51,8 INDUSTRY

%21,3 RESIDENTIAL

%20,2 BUSINESS

%1,9 AGRICULTURE

1.3. Motivation Necessary for the Transformation

In the current period, the agenda and developments on climate change, sustainable and inclusive development, strengthening resilience, and national policies and engagements provide an important basis and impetus for a transformation based on the green and blue growth approach.

The Paris Agreement, which forms the framework of the climate change regime, entered into force in 2016 in result of fulfilling the condition that at least 55 parties, which account for 55% of global greenhouse gas emissions, ratify the agreement. In our country, the Proposal for Approval of the Paris Agreement was accepted in the General Assembly of the Grand National Assembly of Turkey and became effective after being published in the Official Gazette with date 7 October 2021 and no. 31621. The Paris Agreement aims to strengthen global socioeconomic resilience against the threat of climate change in the post-2020 period.

With the European Green Consensus announced towards the end of 2019, the European Union has set its goal of being the first climate-neutral continent in 2050. The Union has also announced that it will adopt a new growth strategy that requires the transformation of its industry and that it will reshape all its policies in the axis of climate change. The growth strategy of the Union within the scope of the defined goals is structured around a total of 7 policy areas: clean energy, sustainable industry, building and renovation, farm to fork, elimination of pollution, sustainable mobility and biodiversity. The policies to combat the climate crisis, organized within the framework of the Green Deal, not only bind the European Union and the European continent countries, but also bind all other countries that have commercial and economic relations with these countries.

The European Green Deal includes creating standards, labeling systems, taxes and non-tariff barriers for efficient use of resources and reduction of waste emissions, especially for export products. Through this system to be implemented with the aim of effectively pricing carbon in the entire economy, it will become mandatory for the polluting sectors that consume resources and energy in the coming period to meet the determined standards, otherwise, there may be losses in foreign trade revenues.

Turkey, in connection with foreign trade, carefully monitors the policy changes aimed to be implemented by the European Union and the effects of the Customs Union relations. As a matter of fact, the Ministry of Commerce published the Green Reconciliation Action Plan in 2021 as a roadmap for evaluating the effects of international developments on industry, agriculture, energy and transportation policies and for ensuring harmonization.

Considering the striking examples where regional green transformation efforts have led to national policies in recent years, it is considered that a green growth transition strategy to be implemented at the regional level in our country will provide guidance in terms of national policies. With its natural resources that have reached the limit of its capacity to renew itself, sensitive ecosystems that need to be protected, a rapidly growing polluting industry and marine areas waiting to be evaluated with a sustainable understanding, İzmir has a strategic and advantageous location in terms of initializing the regional green and blue transformation initiative with its current social and institutional capacity, opportunities in the field of renewable energy.

The transition to green growth is generally managed under public ownership, with national-scale programs. The transition to green growth programs implemented on a regional scale aim to initiate the transformation by creating an impact in the short term with clear and applicable targets determined in line with the needs of the local, and to create the necessary regional capacity and coordination for a long and lasting transformation.

In the transition to green and blue growth, it is necessary to focus on certain areas, that is, to determine a strategic path by prioritizing, taking into account the constraints and opportunities that arise in the current economic order. In the determination of these areas, factors such as institutional and social

capacity at the relevant socio-spatial scale, labor and skills, state of natural resources, development of urban infrastructure, current technology level, qualifications of economic activities, and industrial structure occur to be determinative.

It takes a long time to see the gains from the investments made for green and blue transformation and the improvement effects on natural resources at national or regional scale. However, it is expected that the incremental action programs implemented to achieve these long-term goals will provide incremental improvements that can be followed in a short time. From this perspective, it is necessary to focus on strategically determined intervention areas where improvements can be achieved in the short term, and to identify the points where change will be most effective, taking into account the required investment sizes and capacities. In addition, it is likewise important to ensure that the priority determination study to be carried out at the regional level for İzmir is compatible with national priorities.

Karaburun, Alman Koyu

1.4. Scope and Method of the Perspective Study

The "Green Transformation and Blue Opportunities Perspective in İzmir" study carried out by our agency in line with its mission of "To generate information based on Green and Blue Growth approaches and to develop pioneering, original and exemplary projects for İzmir" is the product of a long research, analysis and synthesis process.

The studies carried out in respect to these processes form the basis of the perspective document and include different approaches, analyses, evaluations and calculations. All the stages, approaches and methods, technical evaluations and findings carried out within the scope of the study are reported separately under the name of "Background Documents". The first among the total three of background documents is titled as 'Approach, Method and Macro Dimension', the second as 'Sectoral and Spatial Prioritization', and the third as 'Potential Achievements'. "Green Transformation and Blue Opportunities Perspective for İzmir", prepared for publication based on the studies carried out in the background, is a synthesis and policy document.

The scope of the perspective study, designed for a period of ten years, will contribute to the achievement of the targets determined within the scope of the study in order to determine the sectors where the prominent problems and opportunities in the three priority areas, waste, water and energy, are interconnected, and the locations where such show concentration, and to ensure green and blue transformation in these focuses thus determined to reveal the priority interventions and the benefits and costs that will arise if these interventions take place.

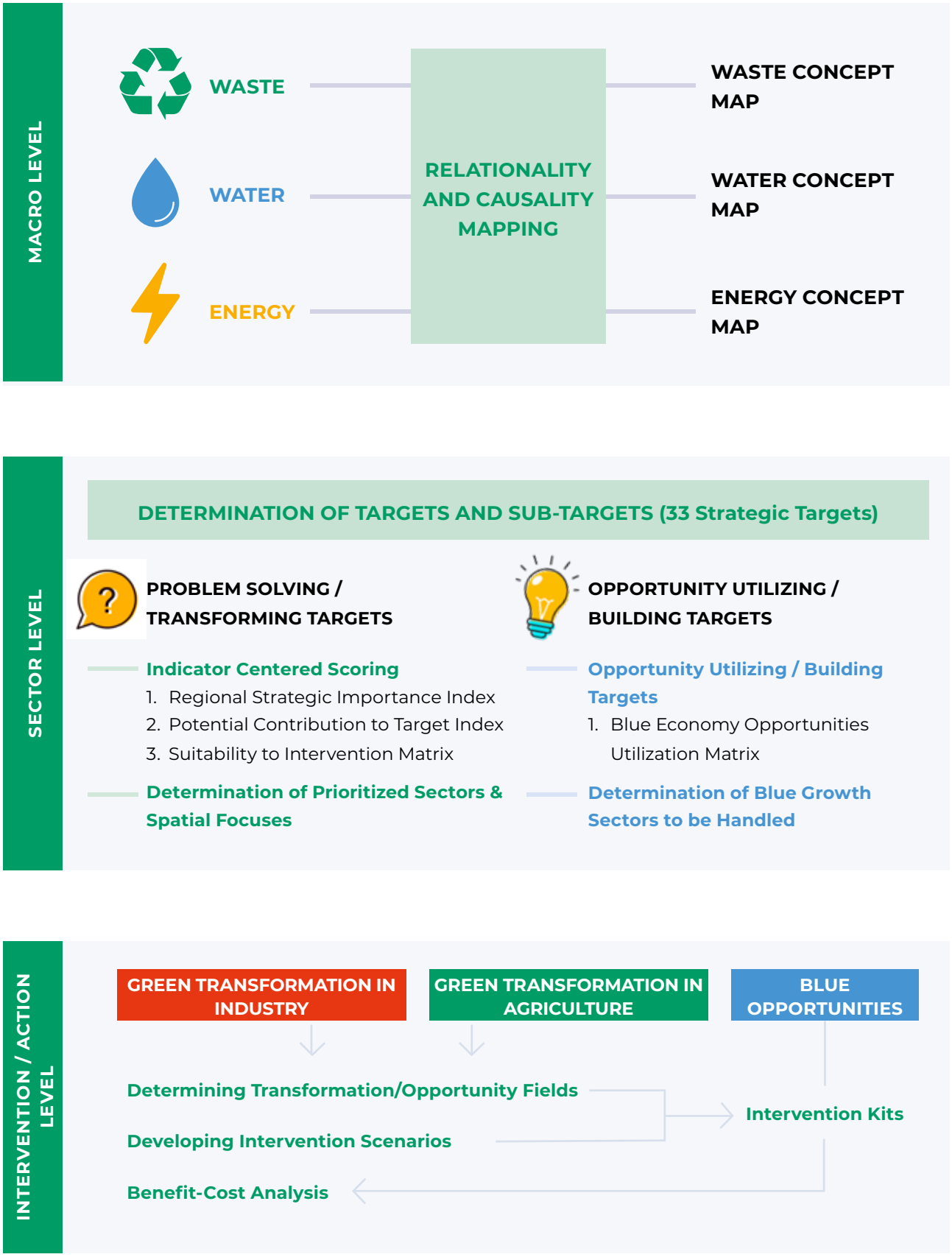
The perspective study deals with the transformation for İzmir as a whole, sets goals, and makes strategic choices from among the potential areas where intervention will be developed, in order to achieve these goals. It has a unique methodology that narrows the focus area for intervention through qualitative and quantitative evaluations from the macro level to the sub-sectors, keeps in mind the elements that were abandoned during the high-level strategic selections as opportunities that can be used in the lower-level evaluations, thus differentiating the weight given to the criteria used for selection according to the reality of the scale in which the evaluation is made, and prioritizing the needs of the local.

The transition to green growth refers to a difference of understanding that points to the transformation of an existing economic structure, the sustainable use and protection of natural resources, and the change of goals, priorities, ways of doing business and technologies. Such comprehensive transformations need to be carried out within the scope of strategic programs. Evaluations were made on the basis of criteria such as the size of the problem or opportunity, the possibility of obtaining quick results, the urgency of the intervention and the existence of established and cumulative capacities that would ensure a high chance of success, while determining the platforms on which the green transformation and blue opportunities perspective in İzmir would be developed.

The study has a three-layer architecture: macro level, sector level and intervention/action level.

In determining the transformation and opportunity areas for İzmir, the problem areas within the current economic structure and the potential healing effect of the transformation in these areas, the existing assets of the region and the potential of the opportunities indicated by their potential to accelerate the desired transformation were evaluated. In addition, the presence of local capacity and skills required for green transformation, the completed and ongoing studies for the transition of the region to green growth (the knowledge in hand and the engagements for the near future) and finally the national policy framework have been guiding in the determination of the areas to focus on. Three inclusive and strategic priority planes, where the impact of the transformation can be seen at a high level, which will create economic opportunities while reducing the environmental impacts, have been determined as “waste, water and energy” for İzmir.

FIGURE 5. The scope of the study, the study stages and the method followed



With the realization of green transformation and blue opportunities of İzmir in these areas, it is expected that new investments with high environmental performance will be realized, clean production practices will become widespread, energy efficiency and use of clean energy will increase, new sectors and new technologies will develop. Revealing the gains to be created by the green transformation and blue opportunities through concrete proposals both at the macro level and in the dimension of action development, which is the last stage of the study, is important in terms of being able to see the potential return of this transformation and opportunity effect to İzmir within a ten-year time projection, and to make basic choices according to this evaluation. In this direction, as a first step, within the scope of macro evaluation, gain and cost calculations were made based on transformation scenarios in the fields of resource efficiency, sustainable waste management and renewable energy.

After revealing the potential gains in the fields of waste, water and energy, the programming phase of realizing these gains at the highest level was commenced, and the main targets and sub-targets were determined by analyzing the causality and relationality in the related fields. Strategic selections were made and these objectives were distilled by considering the context of the study. Finally, accessible and reliable data opportunities were evaluated, specifically for 33 targets, and indicators were determined for targets suitable for measurement on the basis of the economic sectors determined as the analysis unit.

A three-dimensional decision-making method was developed for the sectors that will focus on achieving the targets, which are multi-dimensional, multi-actor and differentiated in terms of quality, determined in respect to the fields of waste, water and energy for green transformation and blue opportunities of İzmir. In the first dimension, the Potential Contribution to the Target Index, measuring the potential contribution of the sectors to the achievement of the relevant target through the determined indicators, was developed, and then the Regional Strategic Importance Index was created by using foreign trade, expertise, dominance, size and value added data for all sectors operating in İzmir. On the basis of each target, sectors with low scores from these two indices were eliminated, and sectors with 'reasonable' and 'high' scores were subjected to a prioritization assessment using the Suitability to Intervention Matrix. Through this matrix, sectors with high potential contribution to the target and strategic importance for the region were scored on the basis of expert opinions on the criteria of model implementation and expansion potential, sectoral multiplier effect, suitability for regional intervention and necessity/motivation for transformation. In the fields of waste, water and energy, the selected sectors were synthesized in terms of green transformation and blue economy opportunities with a three-stage evaluation process specific to each target, and sectoral study areas were determined accordingly.

A different method has been followed in determining the sectors to be prioritized within the scope of the target of “evaluating the blue economy potential” under the water transformation field. Blue growth sectors were analyzed on the basis of employment-based expertise, dominance and size indicators, and those with a 'mature' and 'growing' nature were identified. In addition, 'promising' blue growth sectors were determined in the expert evaluation carried out using innovation, competitiveness, policy compliance, spillover effect and sustainability criteria. Following these evaluations, it was brought to the agenda to determine the sectors to be studied by providing focus, and to define a working framework for examining certain development scenarios for some of them. In such context, the work titles under the heading of 'blue opportunities' have been determined by taking into account the studies carried out by our Agency for the relevant sectors, the regional ownership as of the point reached in these studies, and the capacities regarding the possibility of analyzing the relevant development scenario.

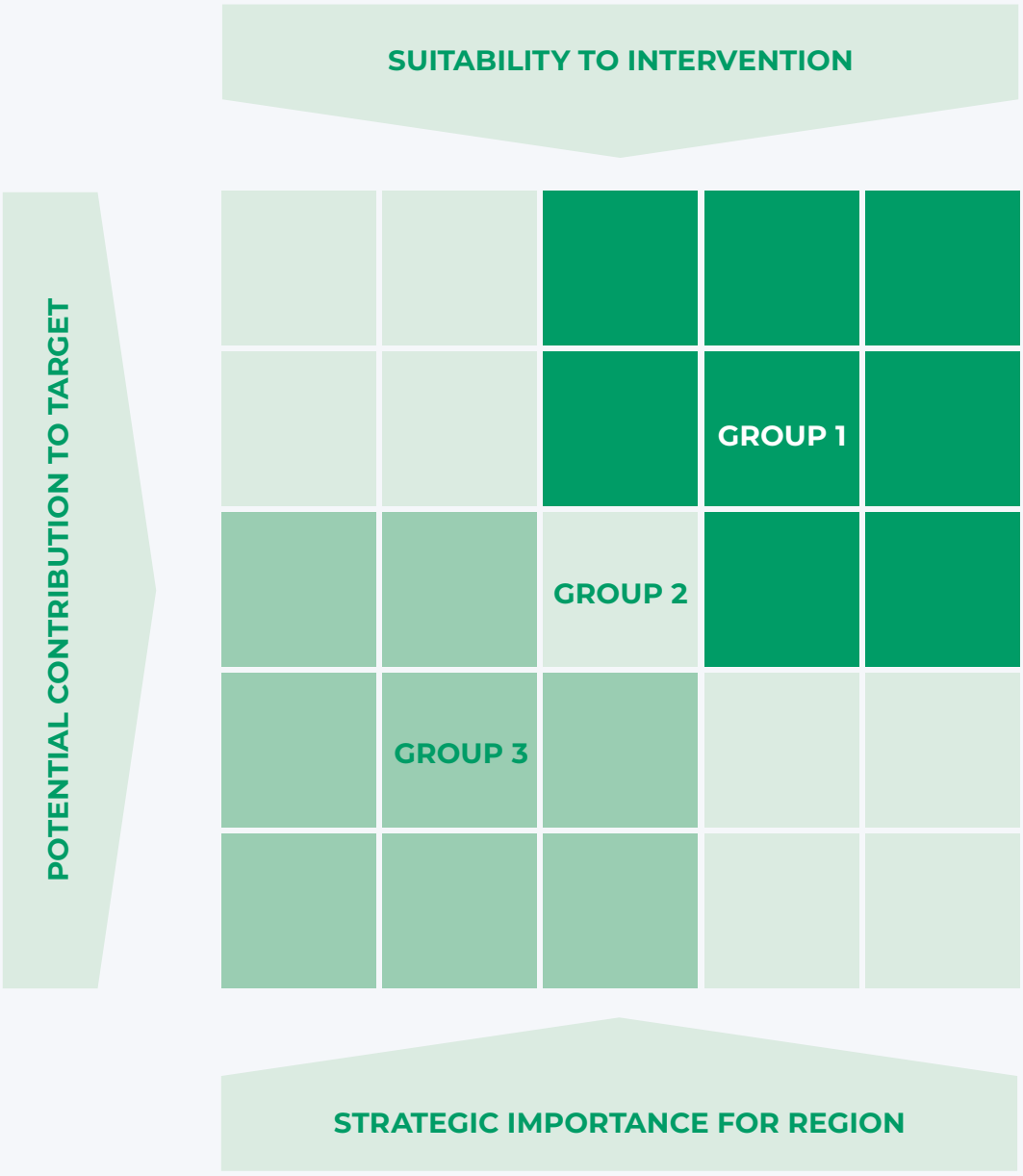
In the next stage, data-based analyzes at a sub-detail level were carried out in the priority sectors, and the sub-sectors that have the potential to make the biggest contribution to the green transformation perspective and the spatial focuses on which they are concentrated were determined. In accordance with these analyzes, the study subjects and scopes to be taken as a basis in the intervention/action dimension of the study were selected, and thus, the 12 study titles were determined. Within the scope of these titles, it is aimed to predict social, environmental and

economic gains and losses by developing intervention scenarios that can contribute the most to the relevant target and by making extended cost-benefit analyzes of these interventions.

The perspective preparation, which started with the methodology design, was carried out with a dynamic approach that fed each other back and forth from the first stage and improved the overall methodology in the light of the experiences and results obtained.

The process has also been designed in a way that encourages and inculcates learning and specialization for our Agency. Working groups formed under the headings of industry, agriculture and blue opportunities and Agency experts were included in the study to carry out the intervention/action dimension, and it was aimed to develop interventions in line with the local realities through stakeholder meetings held for each sector.

FIGURE 6. Three dimensional decision making method



CHAPTER 2.

Green Transformation And Blue Opportunities In İzmir

Karaburun, Sarpıncık

2.1. Transformation and Opportunity Targets

Depending on the resource bottleneck, İzmir is faced with serious environmental, social and economic risks that require urgent measures in terms of the continuity of existing economic activities. The transition to green transformation offers important opportunities for İzmir to reduce these risks created by the current economic system. The basis of the transformation is to overcome resource bottlenecks and ensure the continuity of economic activities by protecting, developing and increasing the value of natural resources through efficient use of resources and effective waste management.

The transformation process for İzmir includes the opportunities offered by the emergence of new growth areas such as green sectors and clean technologies, as well as structural changes. Within the scope of the transformation, the development of the current potential of the sea and coastal areas of İzmir also carries an important agenda for our region.

In this direction, İzmir's green and blue transformation is shaped around three main axes that aim to reduce existing economic risks and create economic value around sustainable technologies and industries by protecting natural capital and increasing its value:

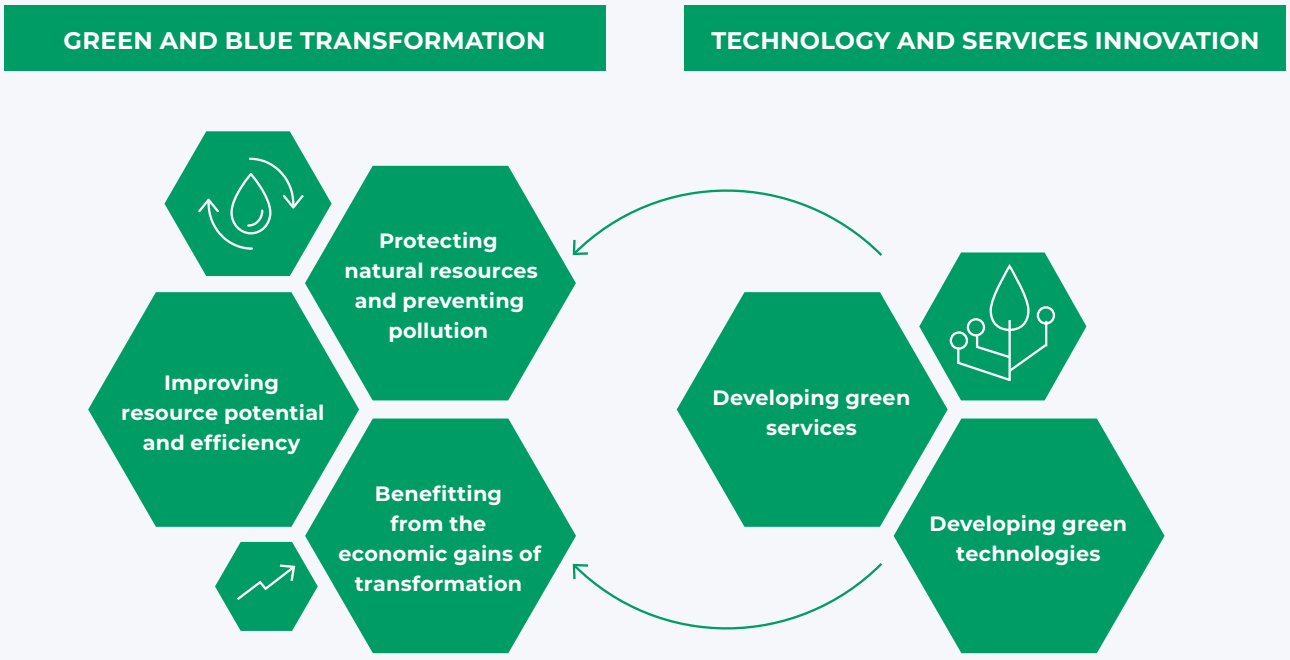
- Protection of natural resources and prevention of pollution (1)
- Increasing resource potential and efficiency (2)
- Taking advantage of the economic opportunities of transformation (3)

Technology and service innovation, which includes the development of green technologies and innovative applications and process improvements, plays the role of a dynamo for the transformation of existing activities in both production and service sectors. In this context, efforts to develop innovative techniques and technologies that cross the three main axes mentioned above are considered as a fourth axis in the conceptualization.

- Technology and service innovation (4)

In order to realize an improvement that will start in the short term and will continue increasingly with the green transformation in İzmir, it is necessary to focus the resources on certain points and direct them to

FIGURE 7. Transformation and opportunity axes in İzmir



the areas where the change will be most effective. In this direction, three inclusive and strategic fields where the impact of transformation can be observed at high levels in İzmir, which will create economic opportunities while reducing environmental impacts, have been determined as the fields of waste, water and energy. In the selection of these fields, defined as transformation/opportunity fields, the characteristics of the problems in the current economic structure and the potential healing effect of the transformation were taken into consideration. In addition, the existing assets of İzmir such as renewable energy, sea and coastal areas and the accelerating effect of the opportunities that will be created by utilizing this asset potential have been evaluated. By analyzing the cause-effect relationships in terms of problems and opportunities in the fields of waste, water and energy, the main targets and the sub-targets for the green transformation of İzmir and the creation of blue opportunities were determined through strategic selection.

TABLE 1. Priorities and targets for green transformation and blue opportunities in İzmir

Transformation / Opportunity Fieldı	Priorities & Targets	Strategic Sub-Targets	Transformation / Opportunity Axis
WASTE	1-Reducing waste generation	▸ Reducing the use of raw materials and chemicals ▸ Use of technology that reduces waste generation in production ▸ Reducing the use of packaging, simple packaging	1
	2-Increasing the use of waste as a raw material and energy source	▸ Increasing raw material recovery ▸ Realization of high quality recycling ▸ Increasing cooperation between enterprises for waste/ raw material exchange	1 and 3
	3-Improving waste management	▸ Modernization of waste management processes of enterprises and industrial zones ▸ Development of infrastructure for recovery and recycling ▸ Developing the technical and human capacity of the waste collection/recovery sector	1
	4-Ensuring waste disposal and preventing pollution	▸ Reducing the amount of landfilled waste	2
	5-Development of technologies for raw material efficiency and economic benefit from waste	▸ Development of recycling equipment/material technologies ▸ Development of cleaner production techniques and technologies for waste reduction	4

Transformation / Opportunity Fieldı	Priorities & Targets	Strategic Sub-Targets	Transformation / Opportunity Axis
WATER	1- Reducing water consumption	▸ Transition to production models and techniques that will reduce the water demand	1
	2- Protection of aquatic ecosystems and water reserves	▸ Prevention of water pollution ▸ Rehabilitation of practices that harm the aquatic ecosystem ▸ Strengthening area management models such as integrated basin management and integrated coastal zone management	2
	3- Reducing water losses and increasing reserve capacity	(No target suitable for intervention.)	1
	4- Utilization of blue economy potential	▸ Development of the maritime sector ▸ Development of aquaculture production and fishing ▸ Development of marine recreation and ecological tourism ▸ Developing techniques and technologies for the protection and efficient use of water resources	3
	5- Development of techniques and technologies related to water management	▸ Developing techniques and technologies to reduce water consumption ▸ Developing techniques and technologies to reduce water losses, protect reserves and increase their capacity ▸ Development of techniques and technologies to reduce hydrological disaster risks	4
ENERGY	1- Reducing energy losses and energy consumption	▸ Generalizing the use of clean production practices that will reduce energy consumption in production processes	1
	2- Increasing and generalizing the use of clean energy production	▸ Increasing clean energy production by establishing Clean Energy Systems/Power Plants ▸ Expanding practices that will increase the share of clean energy in household consumption ▸ Carrying out awareness studies on cultural change in energy consumption ▸ Generalizing certification, labeling and standardization practices that will increase clean energy consumption	2
	3- Development of clean energy technologies	▸ Developing clean production techniques and technologies that will reduce energy consumption ▸ Strengthening cost-effective domestic production that will reduce the use of imported inputs in clean energy production ▸ Development of new technologies for clean energy production and storage ▸ Development of efficient energy storage technologies and systems with reduced environmental damage ▸ Development of sustainable transport vehicles/systems	4

Green and Blue Transformation Axes

1. Reducing resource consumption, increasing resource potential and efficiency
2. Conservation of natural resources and prevention of pollution
3. Leveraging the economic opportunities of transformation
4. Technology and service innovation

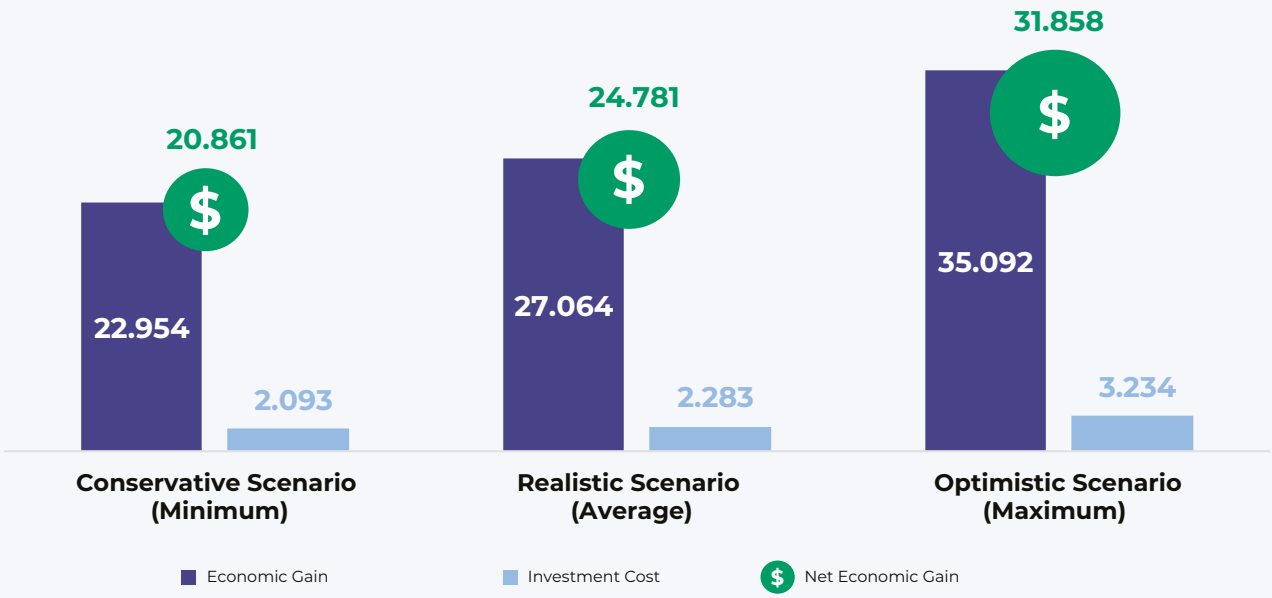
2.2. Potential Benefits of Transformation

It is expected that there will be significant changes in the current economic system with the realization of green transformation and blue opportunities for İzmir. The widespread use of clean production, waste management and energy efficiency practices, strengthening the clean energy production infrastructure and increasing use of clean energy will increase new investments with high environmental performance. The development of new sectors and technologies will create new job opportunities, labor skills and employment areas.

Within the scope of the perspective study, the economic, environmental and social gains that will occur at the **macro** and **sector** level in the next ten years with the effect of transformation and opportunity in İzmir were calculated. Sectoral gains based on detailed analyzes and evaluations are presented comprehensively at the end of the perspective study. The macro gains given in this section were calculated by using three transformation scenarios in waste, water and energy transformation fields in order to show the potential gains of transformation throughout İzmir. It is observed that the estimated gains in the scenarios, designed to provide minimum, average and maximum gains over general assumptions and are respectively called conservative, realistic and optimistic, have a significant share in İzmir's economy.

According to the transformation scenarios, a net economic gain of at least **$20.9 billion** seems plausible for the next ten years. This value corresponds to **48%** of the gross domestic income of İzmir in 2020. For the same period, it is predicted that the net economic gain to be achieved in the optimistic scenario may reach **$35.1 billion**, corresponding to **73%** of the gross domestic income. The sum of the investment cost for the transformation that will provide the aforementioned gain and the management cost for the ten-year period is expected to be **$3.2 billion** in the optimistic scenario (Figure 8).

FIGURE 8. Economic gains and investment costs over the ten-year period



Source: Calculated by the authors .

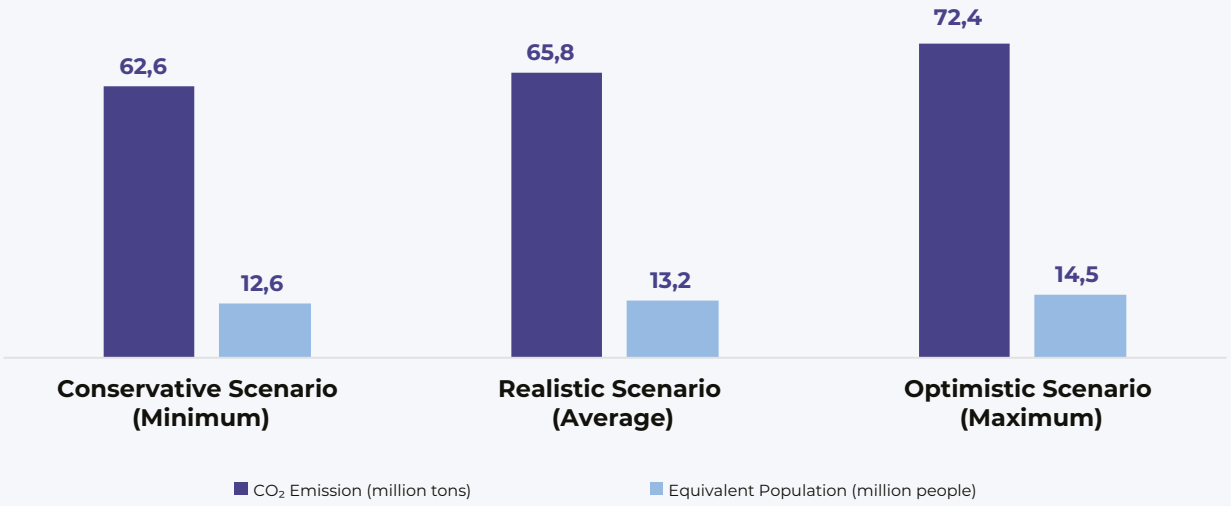
The economic gain envisaged here includes the increase in production in the solar and wind energy value chain due to the increasing investments in clean energy, as well as the gain through conservation and direct income. In this direction, economic, environmental and social gains to be achieved in the fields of waste, water and energy in a realistic scenario are presented in Table 2.

TABLE 2.. Macro gains to occur in the 10-year period with the effect of transformation and opportunity in the realistic scenario

Transformation / Opportunity Field	ECONOMIC	ENVIRONMENTAL	SOCIAL
WASTE	**$8 billion economic gain** ▸ * $6.4 billion in raw material savings ▸ * $1.6 billion waste recovery	3.3 million tons CO_2 emission reduction	Employment for 334 thousand people Preventing 700 thousand people from CO_2 emissions
WATER	**$149 million economic gain** ▸ * $149 million in water savings	135 million m^3 water conservation	Protecting the water needs of 1.6 million people
ENERGY	**$19 billion economic gain** ▸ * $2 billion in energy savings ▸ * $12 billion worth of clean energy generation ▸ * $5 billion increase in production in the clean energy value chain	Reducing 62.5 million tons of CO_2 emissions	Preventing 12.5 million people from CO_2 emissions Employment of 8.4 thousand people
TOTAL	**$27.1 billion economic gain**	Reducing 65.8 million tons of CO_2 emissions 135 million m^3 of water savings	Preventing 13.2 million people from CO_2 emissions Employment of 342,4 thousand people Protecting the water

With the green transformation in waste and energy fields in İzmir, it is predicted that a total of **65.8 million tons** of CO_2 equivalent greenhouse gas emissions can be prevented throughout a ten-year period. This value is equivalent to the CO_2 emissions produced by **13.2 million people.** In the most optimistic transformation scenario, it is foreseen that the amount of emission to be prevented will reach **72.4 million tons,** and the population equivalent to this emission will be **14.5 million people.** This value corresponds to the CO_2 emission equivalent of a population 3.3 times the size of İzmir's 2021 population.

FIGURE 9. CO_2 emissions to be reduced in a 10-year period and their population equivalents



Source: Calculated by the authors .

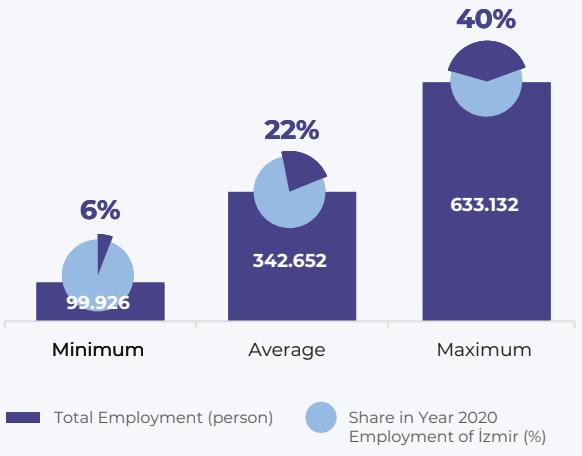
TABLE 3. Equivalent number of people and ratio of water saving potential to İzmir water potential

Million m³/year	Water Saving Amount (Million m³)	Equivalent Number of Persons by Annual Water Consumption	Ratio of Water Saving Potential to İzmir Total Water Potential (%)
Conservative Scenario (Minimum)	119,7	1.425.848	2,66
Realistic Scenario (Average)	134,9	1.606.909	2,99
Optimistic Scenario (Maximum)	209,1	2.490.768	4,64

With the resource efficiency practices to be carried out in the transformation field of water, 135 million m³ of water can be saved in İzmir in a 10-year period, according to the realistic scenario. This value constitutes 3% of İzmir's total water potential and is large enough to meet the annual water needs of 1.6 million people (Table 3).

The effect of the transformation on job creation is discussed in social gain calculations. Accordingly, in the realistic scenario, it is predicted that 342 thousand new full-time equivalent employment will be created in a ten-year period. This figure corresponds to 22% of the total employment value of İzmir for the population over the age of 15 in the year 2020. In the optimistic scenario, it is estimated that the employment to be created will reach 633 thousand and the share in total employment will reach 40% (Figure 10).

FIGURE 10. Employment to be created in the 10-year period and its share in total employment

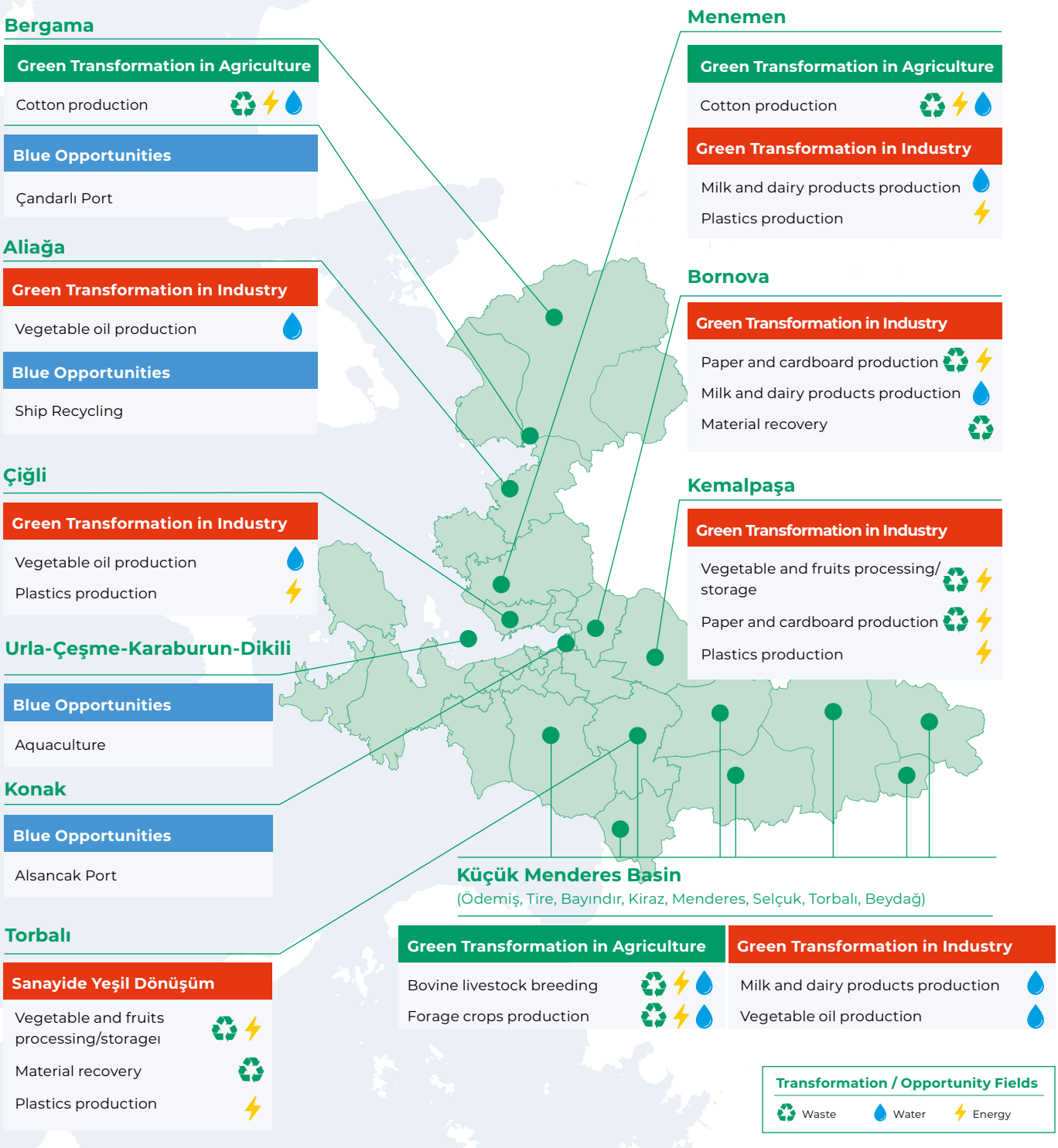


Source: Calculated by the authors .

2.3. Priority Sectors and Spatial Focuses

Sectors with the highest potential to make the greatest contribution to the realization of the targets set under waste, water and energy transformation/ opportunity fields in İzmir, and the spatial focuses of such were determined by a three-stage prioritization analysis and presented under three sector groups: agriculture, industry and blue opportunities. (Figure 11).

FIGURE 11. Transformation/opportunity fields and spatial focuses of priority sectors



The priority sectors and spatial focuses here are based on the calculation of the transformation interventions and potential gains presented by the perspective study. The method followed in the analysis study, the results obtained and the evaluations are given in detail in the background documents.

TABLE 4. Priority sectors and spatial focuses

Sector Groups	Sub Sector	Transformation / Opportunity Fields	Space
Green Transformation in Agriculture	Livestock (Bovine)	Waste, Water, Energy	Küçük Menderes Basin
	Forage Crops Production		Küçük Menderes Basin
	Cotton Production		Gediz Basin Bergama,Menemen
Green Transformation in Industry	Processing/Storage of Vegetables and Fruits	Waste, Energy	Kemalpaşa and Torbalı
	Paper and Cardboard Manufacturing		Kemalpaşa
	Recovery of Materials	Waste	Bornova and Torbalı
	Manufacturing of Plastic Products	Energy	Çiğli, Menemen, Torbalı, Kemalpaşa
	Oil Production	Water	Küçük Menderes Basin Çiğli, Aliağa
	Dairy Management and Cheese Production		Küçük Menderes Basin Menemen, Bornova
Blue Opportunities	Ports	Restructuring of the North Aegean (Çandarlı) Port	Bergama
		Revitalization of TCDD İzmir (Alsancak) Port	Konak, Kemalpaşa
	Aquaculture and Fisheries	Identifying Opportunity Areas	Urla, Çeşme, Karaburun, Dikili
	Ship Recycling	Development of the Rehabilitation Program	Aliağa

CHAPTER 3.

Transformation And Opportunity Interventions

The project/policy dimension of the perspective study includes the development of intervention scenarios to realize the transformation targets determined in the field of waste, water and energy opportunity/transformation, and then revealing the social, environmental and economic gains that such interventions will provide. Opportunity analyzes were carried out for each of the sectors prioritized under industry, agriculture and blue opportunities in order to reveal the sectoral gains offered by green transformation and blue opportunities in İzmir. In this context, initially a comprehensive current situation determination was made, which deals with the general economic outlook of the sector, production processes, the current situation in the field of transformation and its main problems. Afterwards, national and international best available techniques, exemplary projects, technology opportunities for solution were researched, intervention options were determined and final intervention sets were created through strategic choice.

3.1. Green Transformation in Industry

3.1.1. Processing/Storage of Vegetables and Fruits

The vegetable and fruit processing and storage sector, which develops in proportion to the density and diversity in vegetable and fruit production in İzmir, has an important share in the total food production of İzmir in terms of employment, operating density and export potential. The sector, which owns 12% of the enterprises operating in food production throughout the country, is the sub-sector that exports the most in the food industry with an annual export figure of 4 billion dollars.

The processing/storage of vegetables and fruits in İzmir includes a wide range of sub-sectors as a sector class, and **frozen/dried fruit and vegetable production,** vegetable/fruit canned production, and pickle production occur to be the sub-sectors that stand out in terms of expertise, size and dominance and thus addressed in respect to green transformation opportunities.

High amounts of energy and water are consumed due to processes such as washing, drying, evaporation and sterilization, which are intensively applied in the production processes involved in the processing and storage of fruits and vegetables, and significant amounts of waste are generated due to production waste. Waste management has become an important item on agendas because of the significant amount of waste and losses that occur during the processing and packaging of fruits and vegetables in İzmir. The production of frozen or dried fruits and vegetables alone generates 87% of the industry's total waste.

By-products such as pulp, seed and peel, generated from fruits and vegetables in production processes, are used as secondary/alternative raw materials for many sectors under the food industry. With this feature, the sector is a raw material supplier for many different sectors. The resulting organic waste products can be used for compost, sauce, animal food and/or fertilizer purposes. It is possible to reduce waste by up to 20% and to prevent product losses by increasing applications for automation in production processes.

Ash and slag take the first place among the waste types produced by the sector in İzmir, followed by wastewater treatment plant sludge. This is due to the high use of coal in processes that require heat treatment such as boiling, pasteurization and drying. The energy consumption of the sector, which uses thermal energy and mainly electrical energy, is observed to be approximately 24 million kWh/year. In the field of energy consumption, pickle production and frozen/dried vegetable production come up as prominent sectors. National studies reveal that the sector has a saving potential of 29-33% for raw materials, 10-17% for water and 14-22% for energy.

Fundamental Issues

- Due to the use of significant amounts of coal in drying ovens, high volumes of slag and ash waste are generated and the amount of carbon emissions increases.
- In the production process, significant amounts of raw materials are lost before they turn into a final product with high export value and are discarded as organic waste.
- Thermal energy and electrical energy consumption in the sector is high due to heating, drying, cooling and freezing processes. The use of old technology equipment and machinery with low energy efficiency is common.
- A large amount of thermal energy is used in pasteurization, sterilization and drying processes, and a significant amount of thermal energy loss occurs during steam production and distribution.
- Practices that increase energy consumption are common, such as not insulating in cooling and freezing processes, manually controlling some machinery and equipment, and not optimizing and calibrating boilers, motors, pumps and similar systems.
- The rate of use of renewable energy systems for self-consumption is low.

Interventions

Intervention 1. Reducing waste from fossil fuel consumption

Most of the waste generated in the fruits and vegetables processing/storage sector consists of slag and ashes from drying ovens using coal. Such wastes can be prevented by using natural gas and renewable energy sources instead of coal in drying ovens. In this direction, it is possible to realize a transformation with two alternative scenarios to meet the thermal energy need from renewable energy sources. According to this; Scenario 1 foresees the use of natural gas instead of coal in order to provide the necessary thermal energy during the drying phase of the production processes. In this context, a partial transformation will be achieved by replacing equipment such as coal-fired furnaces and boilers with their natural gas-powered counterparts. Scenario 2 envisages realization of electric dryer system investments and thus providing a complete transformation by meeting all the necessary energy needs from solar energy systems.

Intervention 2. Utilization of organic wastes through energy and compost production

It is possible to reduce product losses and the amount of organic waste generated by increasing practices towards automation in production processes. Furthermore, an important economic value can be obtained by recycling the organic wastes generated in the process instead of storing directly, thus using them as secondary raw materials.

Organic wastes generated by the sector can be used as alternative raw materials in the production of compost, sauce, animal food and/or fertilizer. It is possible to use wastes that are not suitable for processing or for direct use as secondary raw materials for energy and organic (compost) fertilizer production.

This has the potential to meet some of the thermal energy needed in heating, drying and freezing processes with the utilization of wastes in micro/small-scale biogas power plants to be established and the cogeneration/trigeneration systems to be set up in the enterprises. At the same time, organic fertilizers can be obtained from wastes in the biogas production process and reintroduced into the food chain.

Intervention 3. Ensuring energy efficiency with insulation and heat recovery practices

Minimizing heat losses in production processes will provide significant energy savings. In this context, besides using economizers or condensers, it is recommended to prefer valves, check valves, flanges and filter-like equipment and to implement energy efficiency practices such as insulating pipes and certain hot surfaces.

Intervention 4. Using automation applications and variable speed equipment in the production line

In order to reduce the raw material, energy, water, auxiliary material and human resource losses in the production line, it is recommended to replace the manually controlled equipment with low energy efficiency currently used in the system with automation systems.

TABLE 5. Transformation interventions for the fruit and vegetable processing/storage sector

Transformation / Opportunity Field	TARGET	INTERVENTION
WASTE	Reducing the amount of waste	1. Reducing waste from fossil fuel consumption
	Increasing the use of waste as a raw material and energy source	2 a. Obtaining energy from organic wastes
		2-b. Fertilizer production from organic wastes (compost)
ENERGY	Reducing energy losses and energy consumption	3. Insulation and heat recovery applications
		4. Use of automation applications and variable speed equipment in the production line

3.1.2. Paper and Cardboard Production

İzmir, İstanbul and Kocaeli provinces stand out in terms of number of enterprises and turnover in the paper and cardboard production sector, which has a 3% share in the total production of the manufacturing industry of our country. Enterprises operating in the paper sector in these three provinces constitute 60.1% of the total turnover of the paper sector in our country, while the share of İzmir in the sector occurs to be 6.3% in terms of the number of enterprises and 6.6% in terms of the employment created. Although the highest production in the sector is realized in corrugated cardboard, which is concentrated in the Marmara and Aegean Regions, the production of cleaning papers has also shown a rapid development in recent years. Companies operating in the paper sector in İzmir are large-scale facilities with high production capacity and mostly operate in the field of corrugated paper and cardboard production. Paper and cardboard production stands out in terms of resource consumption and waste generation on the basis of sub-sectors

Among the paper production inputs, the biggest cost belongs to cellulose. The main reason for this is the import of cellulose, as the raw material for paper-cardboard products. Energy costs come in the second place in production costs. Since a high amount of mechanical energy and heat energy is needed during production, almost all enterprises have steam production facilities and electrical power generation facilities. In these enterprises, in addition to the energy production facilities, there are water softening facilities to prepare operating water and waste water treatment facilities for the treatment of waste water. The most heavily produced wastes in the sector are observed to be the treatment sludge originating from these facilities and the scraps separated during production.

Fundamental Issues

- The input costs of the enterprises are observed to be quite high in the sector, where most of the raw materials and auxiliary materials are procured through imports due to the insufficient existence of industrial forests.
- Approximately 25% of the paper production cost comprises of energy expenses. The paper industry accounts for about 5% of total industrial energy consumption and is responsible for 2% of emissions from industrial production.
- In parallel with the production of high tonnages in paper production, large amounts of waste are produced.
- Sludges from wastewater treatment and mechanically separated scraps during pulping of waste paper and cardboard are the most common types of waste generated in this sector.- High energy prices also limit the competitiveness of the sector in global markets.

Considering the foreign dependency in pulp/cellulose and the energy consumption for paper produced from scratch corresponding to about three times more energy consumption than paper produced from recycling, the use of waste paper as a raw material attracts more and more attention in the sector day by day.

The paper recycling rate is as low as 40% throughout the country, and the systematic collection, storage and recycling of waste paper is considered as an important opportunity area in terms of providing alternative raw materials.

Interventions

Intevention 1. Improvement practices for the prevention of steam, heat and compressed air losses and leaks

Large amounts of energy are consumed to produce the compressed air, steam and high heat needed in the production lines. With simple and effective energy efficiency applications, detecting and eliminating the losses and leaks that will occur in these systems can provide significant energy savings. Improvement of compressed air leaks, insulation of steam condensate lines, reduction of steam leaks and use of automatic surface blowdown system have been determined as the main measures to be applied in this area.

Intervention 2. Replacement of existing machinery and equipment with energy efficient models

Generalization of new energy efficiency technologies and techniques is very important in terms of medium and long-term energy saving and carbon footprint reduction strategies in the paper industry. Significant gains can be achieved by using high-efficiency equivalents instead of low-efficiency motors and pumps, and replacing the vacuum pumps used in the production lines with turbo blowers. As a result of the improvement works to be carried out on the pump and pump systems, approximately 30% energy savings will be achieved.

Intervention 3. Roof applications for electricity generation from solar energy

With the use of solar energy systems (SES), through their many fixed and mobile applications, in the paper industry where energy consumption is relatively high, a significant reduction in the amount of greenhouse gas generated by the industry will be achieved. The increase in the use of clean energy resources will contribute to the energy supply security of the sector.

Intervention 4. Utilization of production wastes for alternative raw material production

All kinds of activities/applications/measures that reduce wastes or recover wastes into the economy are of great importance for businesses. In particular, the utilization of wastes that can be used directly as raw materials for another sector and the establishment of symbiotic relations will provide great economic benefits to all parties. By recycling one ton of used paper and reusing it in paper production, cutting down 17 grown pine trees, release of 36 tons of greenhouse gas emissions into the atmosphere, and waste of 3,500 Kw of electrical energy and 38.8 tons of water are prevented.

In this direction, for the reuse of production wastes, the use of sludge resulting from on-site wastewater treatment in enterprises as egg trays, the reuse of scraps that are mechanically separated during pulping of waste paper and cardboard, the reuse of paper scraps generated in production as raw materials, and the separation of packaging wastes such as metal and plastic and their sale to the recycling sector are determined as relevant sectoral interventions.

Intervention 5. Production of pulp from the wastes of field crops

Agricultural wastes, which are a source of organic cellulose, can be recycled and used as an alternative raw material source for the paper industry. In İzmir, approximately 1.28 million tons of field crop waste is annually generated. This value is equivalent to the potential raw material that will support the production of 25 thousand tons of paper per year.

TABLE 6. Transformation interventions for the paper and cardboard production sector

Transformation / Opportunity Field	Target	Intervention
ENERGY	Reducing energy losses and energy consumption	1. Improvement practices for the prevention of steam, heat and compressed air losses and leaks
		2. Replacement of existing machinery and equipment with energy efficient models
	Increasing and generalizing clean energy production	3. Roof applications for electricity generation from solar energy
WASTE	Increasing the use of waste as a raw material and energy source	4. Utilization of production wastes for alternative raw material production
		5. Production of pulp from the wastes of field crops

3.1.3. Materials Recovery

The recycling sector in İzmir has been in a rapid development trend in terms of the number of insured employees and workplaces in the last ten years (Figure 12). In the field of recycling, which covers a wide range of activities from collection of wastes to scrapping, and from recycling to disposal; ship recycling stands out under the category of "scrap fragmentation" in İzmir. The ship recycling sector is covered in detail in the Blue Opportunities section. Recovery of materials is another prominent sub-sector in İzmir in terms of specialization, concentration and its share within the country's production.

The recycling sector in İzmir covers a few complex facilities that process a small number of different types of waste in different processes, besides the facilities that process a certain type of waste such as plastic, paper, metal or vegetable oil. Although the waste processing capacity has increased significantly in recent years, there is a significant raw material deficit in the recycling sector and this deficit is met through imported waste. Imported wastes are used as cheap and continuous raw materials especially for the paper and plastic industries, of which production capacity has risen in recent years. Of the waste imported in İzmir as of the year 2019, 64% comprises of plastic waste and 29% of electronic scrap.

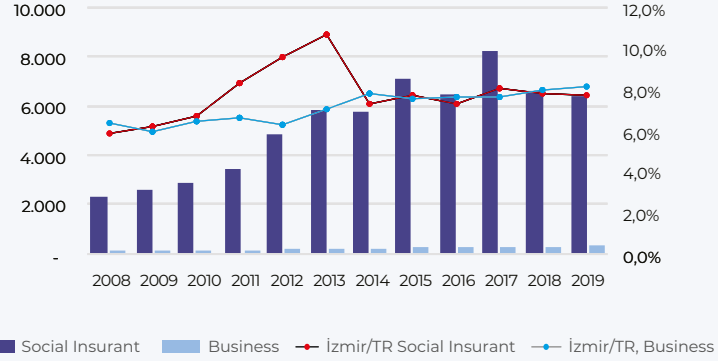
The main reason for the raw material deficit in the recycling sector is the extremely low recycling rates. The rate of recyclable materials is observed to be 23% within the 2 million tons of domestic waste produced throughout the province. In İzmir, generating wastes with economic value of over 700 thousand tons every year, only 10% of such wastes reach the recycling sector as raw material, while the rest is stored in the waste landfills in Harmandalı and Bergama.

There is no waste management system in İzmir to ensure that domestic waste is collected separately at the source, apart from pilot implementations. Mixed collected wastes are separated by street collectors or waste separators in landfills and given to recycling facilities. Developing the infrastructure for separation and collection at source is of vital importance for the recycling sector, which suffers from difficulties in accessing continuous and high quality raw materials and thus operates at low capacities.

Fundamental Issues

- As a result of the high heat treatment of the material in recycling, high amount of pollutant emissions occur and necessary precautions are not taken for such emissions.
- Intense pressurized water is used for waste washing in the recovery of consumption wastes and wastewater with high pollution level is generated. The amount of water drawn from underground wells and above the required quality for waste washing is not fully recorded.
- The quality of the product produced is low due to the use of low technology machinery and equipment in the recycling sector. In the process lines with high energy consumption, there are no units to prevent environmental effects such as a recovery unit and a degassing vacuum pump.
- There are difficulties in accessing quality and continuous raw materials in the sector. Wastes separated by primitive methods under unhealthy and unsafe conditions cannot provide sufficient quality and quantity of raw materials for the recycling sector.
- At the end of the waste treatment process, a significant amount of waste is generated from materials that are not recovered as raw materials. Waste sludge, plastics and metal wastes constitute 88% of the wastes generated.

FIGURE 12. Number of workplaces and employment trends of the recycling sector in İzmir (GBS, 2020)



Source: GBS, 2020

Interventions

Intervention 1. Cleaning the screens used during recycling by pyrolysis method

In the recycling process, the emission gases formed as a result of the transformation of the material due to heat during the burning of the wastes must be filtered. By cleaning the screens used in the recycling process through the pyrolysis method, the formation of significant waste and pollutant emissions can be prevented.

Intervention 2. Replacing the recycling machine/ process lines with newer technologies

The rate of use of pressurized water supplied from underground wells in the recycling of consumption wastes is observed to be at very high levels. It is necessary to reduce the use of clean water in the waste washing process -where it is possible to use lower quality water- and to monitor it in terms of quantity.

The use of high-tech equipment and units that enable the recovery of washing water in the waste treatment line has begun to become more widespread.

A significant amount of water and energy efficiency will be achieved as a result of replacing existing production lines of enterprises with energy efficient machine/process lines with wastewater recovery and emission treatment units.

Intervention 3. Collection of wastes at their sources

Effective waste management includes the recovery of recyclable waste in the generated wastes and the use of organic wastes as compost and energy sources. If the efficiency of the separate collection at source is improved, it will be possible to reduce the recyclable waste sent to landfill to a great extent and thus to avoid environmental problems. Although separate collection at source includes costs such as initial investment and training, it is a less costly method than the approach of re-separating and processing mixed collected wastes inside all waste flows.

TABLE 7. Transformation interventions for the materials recovery sector

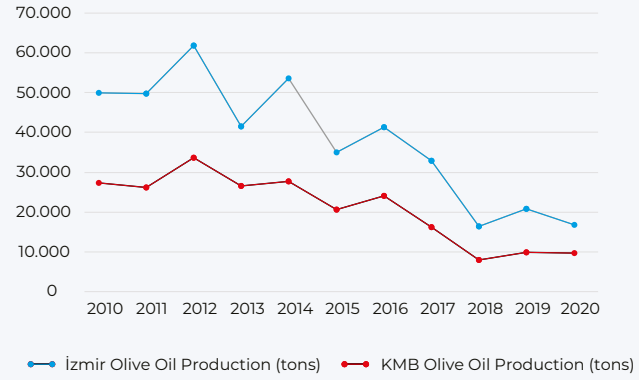
Transformation / Opportunity Field	Target	Intervention
WASTE	Increasing the use of waste as a raw material and energy source	1. Cleaning the screens used during recycling by pyrolysis method
	Improving waste management	3. Collection of wastes at their sources
WATER	Reducing water consumption and preventing water pollution	2. Replacing the recycling machine/process lines with newer technologies

3.1.4. Oil Production

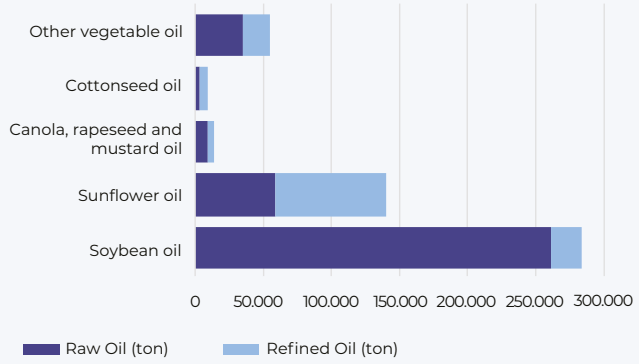
Oil production is among the critically important sectors for İzmir's economy. Among the oils produced, olive oil ranks first in terms of production amount and concentration. In İzmir, which has half of the employment in olive oil and pomace production and one third of the number of workplaces throughout the country, 43% of olive oil producers and 40% of olive pomace oil producers operate in the Küçük Menderes Basin. Approximately 90% of the enterprises registered under oil production in the Basin produce olive oil (Figure 13).

İzmir, where soybean, sunflower, canola/rapeseed/mustard and cottonseed oil is produced, bears 20% of the country's crude vegetable oil production capacity and the entire soybean and canola oil production. While dominantly refining processes are realized regarding sunflower oil production, crude oil is produced from imported seeds in soybean oil and then exported.

FIGURE 13. Olive oil and vegetable oil production in İzmir (TurkSTAT, 2020 /TOBB, 2022)



Source: TurkSTAT, 2020



Source: TOBB, 2022

Fundamental Issues

- **Black water, washing and separator waters formed in three-phase enterprises dealing in olive oil production are left to evaporate in artificial lagoons throughout the year until the beginning of the new season. Most of the lagoons do not comply with the established standards, and there are risks of leakage from the lagoons to the rivers and groundwaters during the rainy months. Fertile agricultural areas are used for this purpose for lagoons, which cause odor formation in hot weather.**
- **In the two-phase olive oil enterprises, no action is taken to treat the black water and other waste water remaining in the pomace as a result of the process. Improper disposal of wastewater causes serious and irreversible environmental problems. The capacities of olive oil producers are quite small, and their capacity to establish and operate a treatment plant with complex processes and high costs for the purification of black water is low.**
- **The fact that two-phase olive oil plants add separator and washing water to the pomace besides the black water increases the moisture content of the pomace, decreases its sales value and decreases the income of the enterprises.**
- **The majority of vegetable oil producing enterprises use closed-circuit systems with old technology. This causes energy, raw material and water losses in terms of enterprises and reduces the quality of the oil produced.**
- **Due to the large amount of steam required in the production of crude oil, the energy and water consumptions of the enterprises are observed to be quite high.**

The production structure of the sector in İzmir consists of a small number of large-scale vegetable oil producers and many small-scale olive oil enterprises. Olive oil producers in İzmir comprise mostly of small-scale sector and cooperative enterprises that operate seasonally and press for oil share or fee on behalf of olive producers. On the other hand, the majority of vegetable oil producers concentrated in Çiğli and Aliağa districts consist of large-scale facilities with refining technology.

Oil production is one of the sectors that produces wastewater with high water consumption and at the same time high pollution. In the production of vegetable oils, a significant amount of water is consumed in different forms such as process water, cooling water and hot water/steam. Most of the facilities producing crude oil throughout İzmir and in the Aliağa-Çiğli region carry out pre-refining activities and produce highly polluting wastewater. Due to the fact that olive oil production creates black water with a very high pollution load, its pollution is higher than other sectors. Especially in the Küçük Menderes Basin, where production is concentrated, black water is known to cause environmental damage that is difficult to compensate. However, İzmir is one of the provinces with the highest conversion rate to a two-phase system that consumes less water and does not generate black water.

The oil production sector is a water-dependent sector with its intensive use of water. In the upcoming period, it is likely to be directly affected by the water cuts that will occur due to the effects of climate change and the decrease in the quality of water resources, and the cost increases that will occur with the decrease in water potential. In this direction, the targets set for the transformation of oil production sector have been shaped on the basis of reducing water consumption, protecting water resources and adopting practices that will use water efficiently.

Interventions

Intervention 1. Conversion of production systems from three to two phases in the olive oil industry

The fact that water is not added to the decanter in two-phase continuous systems and the olive juice remains in the pomace significantly affects the amount of water used in olive oil production, as well as the amount of waste water and pollution level. Two-phase system conversion will significantly reduce the amount of wastewater and pollution load generated in olive oil production. This conversion will also provide gains such as a decrease in the amount of clean water used in production and an increase in olive oil quality.

Intervention 2. Use of steam condensing vacuum systems in vegetable oil production

In the refining of crude oil, high water temperature and high steam amounts are needed for the deodorization process, and large volumes of cooling water are used at this stage. The use of new vacuum systems, which eliminate the need for cooling water, has become widespread for color and odor removal in vegetable oil refining. In the ice condensing vacuum system, which does not use steam, a maximum of 10-20% of the energy used in conventional vacuum systems and 0.1% of the water is used, and a small amount of process waste water is generated.

Intervention 3. Purification and reuse of black water with the combined system of Steam Condensing Evaporator-Membrane Treatment System-SES in pomace processing plants

In two-phase olive oil facilities, black water remains in pomace and is transported to pomace processing facilities in the form of watery pomace, and thus the issue of black water is partially transferred to pomace facilities. In the process of processing pomace as an economically valuable product, a second press is applied to the pomace in order to reduce the moisture content, and this process creates black water. It will be possible to recover approximately 75-80% of the resulting black water by using steam condensing evaporator and biological membrane systems. Thus, besides the problems such as leakage and odor caused by keeping the black water in the lagoons, the pollution load of the black water will also be reduced significantly. It is critical to support these investments with clean energy systems, since

investments for water recovery create an additional cost for businesses in terms of energy expenses.

Intervention 4. Recovery of process wastewater in vegetable oil production

In the vegetable oil sector, there is practical experience in the treatment of process wastewater using appropriate treatment methods and their recovery after advanced treatment processes. It is possible to use the recovered water in facility cleaning, landscape watering needs or suitable processes. The technology to be used in the recovery of wastewater varies according to the intended use of the recovered water. If the water to be recovered will be used for irrigation purposes in agricultural or green areas, disinfection at the exit of the treatment plants may be sufficient, while in case of direct or indirect recycling, more advanced treatment alternatives should be used.

Intervention 5. Recovery of waste water in two-phase continuous system olive oil facilities

Although the pollution load of wastewater generated in two-phase production systems is not as high as the pollution load of black water, it still does not meet the wastewater standards that can be discharged to the receiving environment or waste water infrastructure facilities according to the Regulation on the Control of Water Pollution. For this reason, enterprises evaporate their wastewater by keeping it in lagoons or transfer it to pomace facilities by mixing it with pomace. Innovative treatment systems proposed for the advanced treatment of black water can provide recovery of two-phase wastewater with an efficiency of approximately 70%. In such systems, which are a combination of biological treatment and membrane technology, it becomes possible to reuse the recovered water as process water.

TABLE 8. Transformation interventions for the oil production sector

Transformation / Opportunity Field	Target	Intervention
WATER	Reducing water consumption	1. Conversion of three-phase production systems to two-phase production systems in the olive oil sector
		2. Use of steam condensing vacuum systems in the production of vegetable oil
	Water recovery and prevention of water pollution	3. Treatment and reuse of black water with the combined system of Steam Condensing Evaporator-Membrane Treatment System-SES in pomace processing plants
		4. Recovery of process wastewater in vegetable oil production
		5. Recovery of wastewater in two-phase continuous system olive oil facilities

3.1.5. Milk and Dairy Products Production

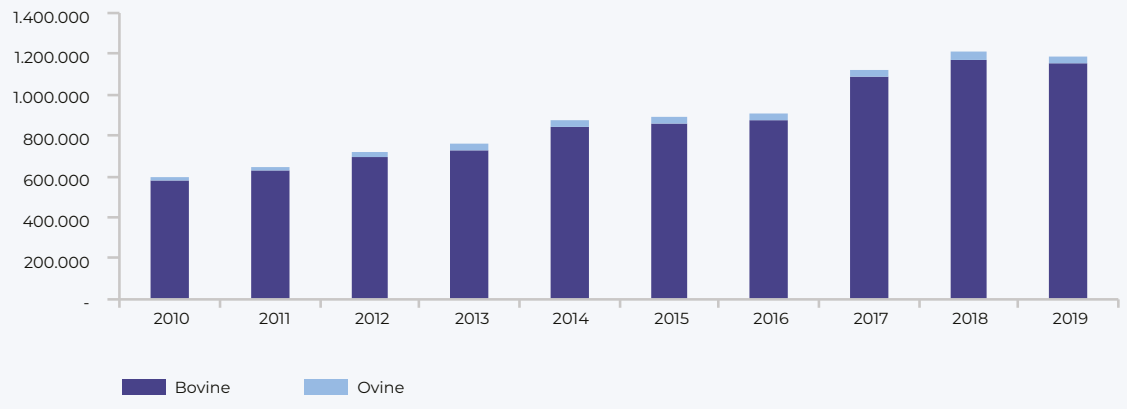
İzmir has an important place in terms of milk and dairy products production and comes up as the second province that produces the most raw milk. Approximately 78% of dairy farms are concentrated in the Küçük Menderes Basin. In the Basin, with an installed capacity of 1.7 million tons, especially Tire, Torbalı and Ödemiş stand out in terms of production. Particularly the dairy enterprises located in Tire are large enterprises with very high capacity, distributing milk and dairy products all over Turkey. The milk processed in the district is more than 70% of the total capacity of the Basin. Although the number of enterprises is high, the enterprises in Ödemiş, where the installed capacity is low, are small and medium-sized. Cooperatives are active in milk and dairy products in the basin, and the existence of cooperatives plays an important role especially in collecting the raw milk produced in the region from the producers without disrupting the cold chain. It is observed that there is an important specialization in İzmir for the production of milk and dairy products. Due to the structure of the sector, very different dairy products are produced and sub-sectors are intertwined. Throughout the province, milk production constitutes 40% of the sector's total employment, and cheese production constitutes 38%, and both stand out as the sub-sectors with the highest level of specialization.

The milk and dairy products manufacturing sector includes companies and institutions from many interconnected sectors, in terms of its structure. Within the milk value chain; dairy farmers, farmer cooperatives, producer unions, dairy farms and milk processing facilities and all businesses involved in the distribution and marketing processes of products are included.

Fundamental Issues

- In the drought scenarios envisaged for İzmir and Küçük Menderes Basin, milk and dairy products production comes at the top of the critical sectors that will be most affected by climate change, and it is estimated that some production stages of the sector's value chain will be interrupted due to water scarcity.
- In İzmir, where surface and ground water resources tend to be seriously depleted, there will be a very serious competition between the parties regarding the allocation and use of water in the coming period.
- In most of the studies carried out in the sector, it is revealed that there are not enough meters for monitoring and management of water consumption, and measurement and detailed water management reporting are not conducted in the studies and analyzes carried out in the enterprises.

FIGURE 14. Milk production by years in İzmir (TurkSTAT, 2021)



Source: TurkSTAT, 2021

"Water" is at the forefront of the issues that affect productivity and need to be managed in the dairy sector. The use of water in the sector ranges from the production of forage crop seed to waste disposal. Therefore, there is an intense use of water supplied from both precipitation and ground and surface water resources by the sector. The largest water user in the dairy value chain is forage crop farming, which represents 95% of the total water footprint. This is followed by livestock (3%), milk processing (2%) and feed production (0.02%) (Ercin, 2020). Within the scope of the perspective study, forage crops is also discussed as a priority sector under the title of Green Transformation in Agriculture.

The water footprint of one liter of milk production for İzmir is observed to be 761 liters. İzmir is the province with the highest blue water footprint with 305 million m^3 water usage in milk production and has a higher blue water footprint per unit product compared to other provinces that come after it in the ranking. If the water efficiency of dairy production in İzmir can be increased to the level of Konya, İzmir's sensitivity to water scarcity and its vulnerability in this regard can be reduced by 30%. Dairy management and cheese production stand out as the most water-consuming sub-sector in İzmir, and are concentrated in Küçük Menderes Basin, and Bornova and Menemen districts. In the dairy industry, water is consumed in the product, for cleaning purposes and as process water, and 98% of the water used is of drinking water quality. The areas where water is used the most occur to be cleaning in place (CIP) and pasteurization.

Interventions

Intervention 1. Installation of High Pressure Low Volume (HPLV) washing systems

Studies have shown that the water consumption required for the same process is reduced by 80-90% with high pressure washing systems. Opting for cutting the water flow with the trigger (shut-off) at the end of the hose will also reduce the water consumed during the operator's cleaning transitions while turning the water on and off.

Intervention 2. Making improvements/optimization in Cleaning in Place–CIP systems

Using the automated cleaning CIP method, in which the circulating water and detergent solution can be cleaned with the circulation of the rinsing water and detergent solution in the production line, without the need to disassemble the production line or the tools and equipment in closed circuits; and although the investment cost is high, it is advantageous due to factors such as enabling cleaning in place and lower contamination risk. CIP systems are widely used in many food processing plants, especially in the dairy sector.

Considering the suggested improvement activities; replacing the washing heads with spray rotating nozzles, system modifications to use the last washing water as the first washing water, and changing the chemicals used in cleaning and switching to the use of a single chemical come to the fore.

Intervention 3. Realizing the recycling and reuse of collection water by installing reverse osmosis systems

Reverse osmosis, which is the most reliable method for obtaining clean water, is a filtration system that can remove possible chemical, physical and microbiological pollution elements in mains water. Reverse osmosis is the only technology that can purify heavy metals to obtain drinking water, and is a water purification method with a physical process without any chemical touch from outside into the water. The system ensures the recovery of waste water up to 85%.

TABLE 9. Transformation interventions for the milk and dairy production sector

Transformation / Opportunity Field	Target	Intervention
WATER	Reducing water consumption	1. Use of High Pressure Low Volume (HPLV) washing systems
		2. Making improvements/optimization in Cleaning in Place–CIP systems
		3. Realizing the recycling and reuse of collection water by installing reverse osmosis systems

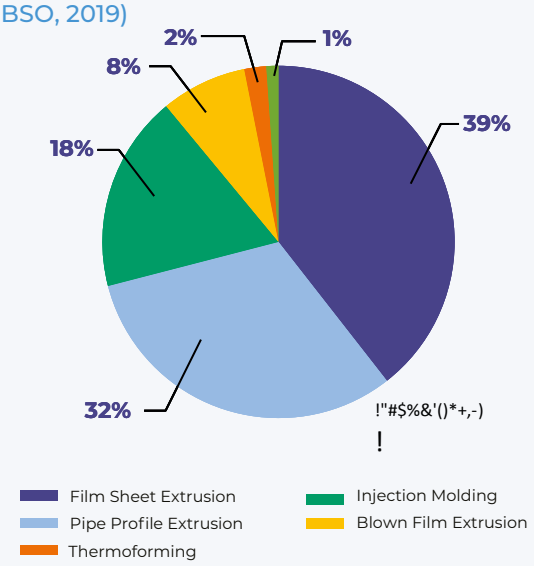
3.1.6. Plastics Production

Turkey's plastics industry ranks seventh in the world market with its annual production approaching 10 million tons and a turnover of 35 billion dollars. Hosting 6% of plastic manufacturers, İzmir ranks second in the country and first in the Aegean Region with a production volume of 411 thousand tons and a value of 1.6 billion dollars (PAGEV, 2017).

The plastics industry is a foreign-dependent industry in terms of raw materials and only 15% of its raw material needs are met from domestic sources. For this reason, the raw material costs of the sector are high and in some periods there are significant problems in the access of enterprises to sufficient and continuous raw materials. Thus, the use of recycled plastic raw materials gains importance for businesses operating at low capacity. However, the raw materials obtained in this way are of low quality since they are obtained from plastic waste by using physical processes, and this also reduces the quality of the plastic product manufactured. The sector, which is foreign-dependent also in terms of machinery/equipment, has the highest concentration in profile/bar production, plastic bag production and PVC door/window production.

Although the export volume is high, the general view of the sector in İzmir reveals that low value-added products are produced and exported, and the use of low technology is still widespread. The plastics industry is one of the industries that consumes the most energy with its heat treatment process. Profile/bar production, plastic bag production and PVC door/window production sub-sectors concentrated in Menemen, Çiğli, Kemalpaşa and Torbalı districts consume 88% of the energy required for the plastics industry throughout İzmir. The processes that consume the most energy are injection molding, film/sheet extrusion and pipe/profile extrusion (Figure 15).

FIGURE 15. Plastic products produced in İzmir (EBSO, 2019)



Source: EBSO, 2019

Fundamental Issues

- **Very high levels of energy is used in melting and shaping of plastics. The increase in electricity and natural gas costs weakens the competitiveness of plastics industrialists, which continue their activities with low profit margins. Except for large-scale enterprises, energy efficiency applications have not become widespread.**
- **Input costs are high in the sector dependent on imported raw materials; businesses have difficulties in accessing quality, sufficient and continuous raw materials. If secondary quality raw materials from recycled plastic waste are used, product quality decreases.**
- **Power cuts and fluctuations cause halts in production and significant losses in terms of raw materials, labor and time.**
- **In the sector with widespread use of old technology, usually low value-added products are produced and exported.**

The conversion of plastic waste into primary raw materials by chemical recycling is critical for the sector to reach cheap and high quality raw materials. Today, up to 15% of plastic waste can be recycled, while the rest is incinerated or released into the environment. At this point, it is thought that the global spread of sustainable production and consumption practices will have a radical impact on the plastics industry in the coming years. The production and diversification of biodegradable bioplastic raw materials in nature is important for the continuity of the sector at this point. Bioplastics, considered safer for the environment and human health, are expected to replace traditional plastics in the future.

Interventions

Intervention 1. Realizing practices towards reducing heat loss in the processes

The heat required for shaping the plastic materials is provided by heaters with high energy consumption. It is possible to save a significant amount of energy by preventing heat loss in the injection and extrusion benches during the melting of the material. In this direction, it is recommended to prefer practices such as covering the existing machines with insulating materials, using new machines with ceramic type insulation, and heating the barrel through which the raw material flows instead of heating the material with induction technology.

Intervention 2. Use of new technology in motors and drives

The use of conventional fixed-speed motors and pumps in plastic manufacturing increases energy consumption. Significant energy efficiency will be achieved with the use of new generation motors such as variable speed motors, servo motors, torque motors, which realize frequency control with the help of electronic circuits and thus shorten the cycle time during the plastic injection process. In addition, as an alternative to hydraulic and hybrid injection machines, energy savings can be achieved by using all-electric injection machines, especially in low-tonnage machines.

Intervention 3. Recovery of waste heat and use in cooling systems

Energy savings can be achieved by recovering the heat energy released during the manufacture of plastic products and using it as an energy source. Waste heat removed from the product, equipment and environment may be used as an energy source in industrial cooling systems, reducing energy consumption and reducing the energy costs of businesses.

Intervention 4. Taking insulation measures in the process line

The measures to be taken in terms of enterprises towards preventing heat losses in the production line are accepted as one of the fastest and shortest ways to save energy. For this purpose, it is recommended to implement energy efficiency practices such as insulating the pipes and some hot surfaces in the production line.

Intervention 5. Insulation applications in compressed air systems

Systematically detecting and eliminating compressed air leaks provides significant energy savings. For this purpose, insulation techniques should be applied in the compressed air systems of the enterprises.

TABLE 10. Transformation interventions for the plastics production industry

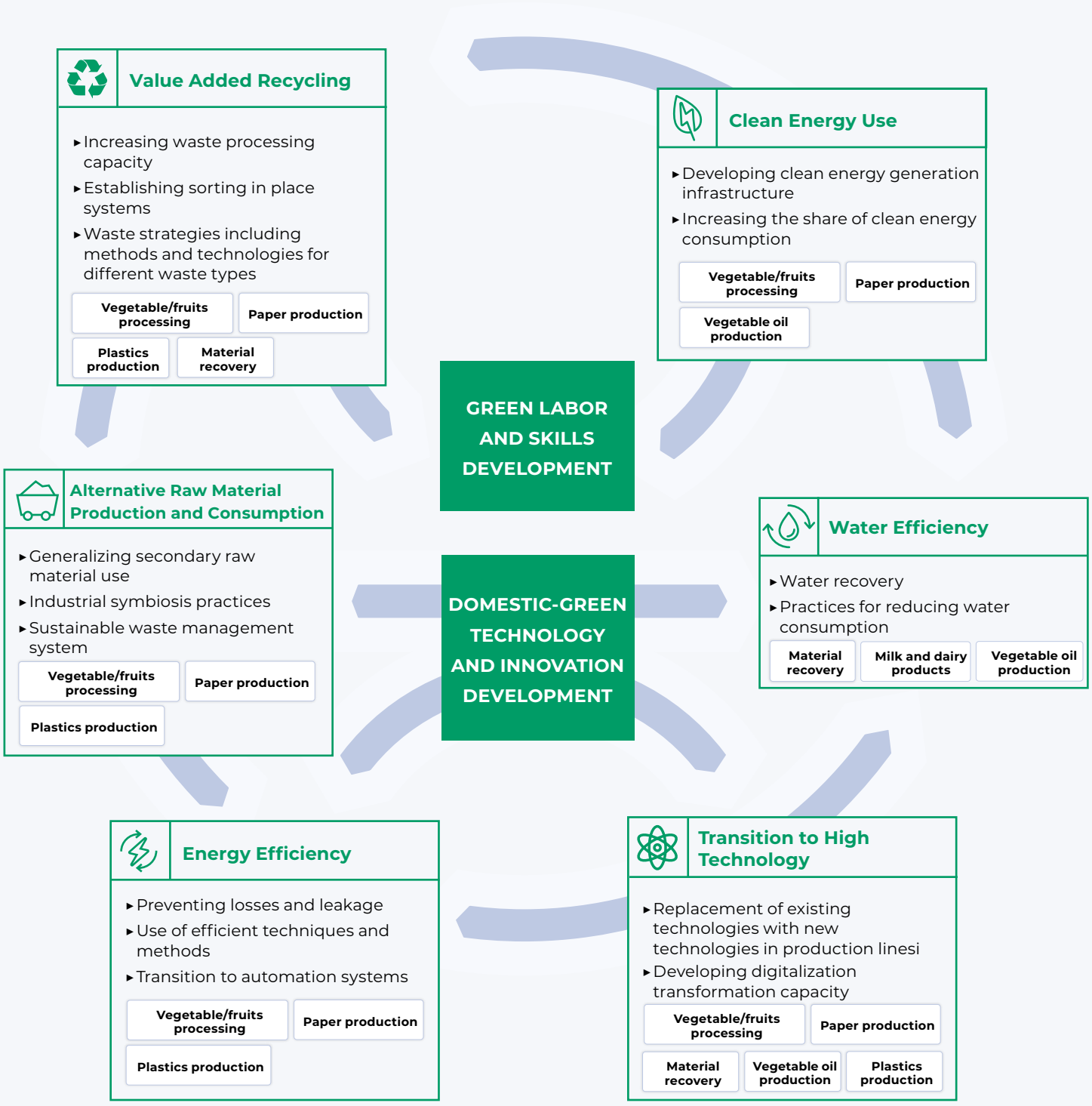
Transformation / Opportunity Field	Target	Intervention
ENERGY	Reducing energy losses and energy consumption	1. Realizing practices towards reducing heat loss in the processes
		2. Use of new technology in motors and drives
		3. Recovery of waste heat and use in cooling systems
		4. Taking insulation measures in the process line
		5. Insulation applications in compressed air systems

3.1.7. General Interventions for Green Transformation in Industry

The transformation scenarios based on the analysis of the sectors prioritized in the fields of waste, water and energy within the scope of the perspective study also provide important clues for the overall transformation of the İzmir industry.

It is possible to group the transformation interventions identified in selected sectors under certain main headings. These interventions reveal that there is an important interaction and relationship between sectors for the green transformation of the industry (Figure 16).

FIGURE 16. Intervention correlations for green transformation for industry in İzmir



Applications to Reduce Energy Consumption

High energy consumption is one of the main problems for all selected sectors. High energy losses, applications that reduce energy efficiency and use of low/old technology increase energy consumption. The share of fossil fuel use, including natural gas and coal, is high in meeting the high energy demand. This creates high CO_2 emissions on the one hand and a significant amount of solid waste on the other. Although İzmir has a very important potential in terms of renewable energy resources, the share of renewable energy in the energy consumed in industry is low.

In order to reduce energy consumption in the industry, generalization of energy efficiency practices in all sectors should be considered as a priority. A significant energy gain can be achieved with applications such as prevention of heat losses, replacement of inefficient techniques and methods with efficient ones, and automation systems with low investment cost and low return time. The transition of production processes to high technology is a critical component of the transformation to be realized in the field of energy. However, such transition requires a significant initial investment cost and financing need.

Widespread Use of Clean Energy

In most of the sectors, energy costs have a significant share within the total costs of enterprises. It is very important for enterprises, which have weakened competitiveness due to high energy input prices, to turn to renewable energy sources for their own consumption.

Transition to High Technology

In İzmir industry, business structures and, accordingly, technical and managerial capacities vary greatly within and between sectors. In terms of business structure, whether it consists of cooperatives or large companies, the use of low technology in the production processes of selected sectors is observed to be common.

The use of low technology and old techniques in production is one of the factors that increase energy and water consumption and cause loss of raw materials. The replacement of existing old technologies with new ones will ensure efficient use of resources and efficiency throughout the entire value chain of the sectors.

While the transition to high technology is vital for the green transformation of the sectors, it also brings with it a significant financial need for businesses due to dependence on imports in technology production. Due to the initial investment costs, the transition to high technology is not found cost effective and thus not preferred by medium and small scale enterprises.

Reducing Import Dependence by Production of Alternative Raw Materials from Wastes

There is foreign dependency in the supply of raw materials especially in the paper and plastics industries, marked as sectors prioritized for the green transformation of İzmir. Due to the increase in foreign exchange rates and oil prices, there are serious problems in accessing raw materials in sectors with increasing input costs. This situation has brought the use of alternative raw materials recycled from waste into the agenda in the paper and plastics production sectors. As a matter of fact, in both sectors, energy and water consumption, transportation, etc. costs decrease significantly in productions made with the use of recycled raw materials.

The level of alternative raw material use in paper and plastic production in İzmir, as it is throughout the country, remains low due to the inability of enterprises to reach sufficient raw materials. The recycling sector has an important role in the production of continuous and high quality alternative raw materials. Although the waste processing capacity has increased significantly in recent years, there is a significant raw material deficit in the recycling sector in İzmir and this deficit is met through imported wastes. At this point, the necessity of an effective waste management system, in which wastes are separated and collected at the source, is observed to emerge for İzmir. Thus, sufficient and clean waste will be included in the recycling system and it will be possible to produce quality alternative raw materials.

One of the tools that serve to popularize the use of alternative raw materials is the establishment and generalization of industrial symbiosis collaborations in which enterprises share their idle resources among themselves. Administrative, technical and financial infrastructure should be established for the establishment of an inclusive industrial symbiosis network system that will operate institutionally and systematically for many years in İzmir.

Value Added Recycling

Bringing all kinds of unused resources into the economy is one of the most important requirements for the green transformation of İzmir. The transformation interventions determined for the selected sectors are aimed at reducing resource use, ensuring efficiency, and reintegration of all kinds of resources, such as water, energy, by-products, solid waste, etc. presently left out of the system as waste, back into the economic system.

In line with the infrastructure deficiencies and legal regulations brought by the existing waste management system, the recovery and value-added recycling of waste raw materials is observed to be insufficient in İzmir. In recent years, the recycling sector, which produces secondary raw materials by processing wastes such as plastic, metal, waste oil and paper and observed to display increases in its production capacity, needs to be dealt with as a priority to provide continuous and clean waste. To such end, systems where recyclable wastes and organic wastes are collected separately must be planned, and waste strategies including appropriate methods and technologies for different types of waste should be developed by considering the waste hierarchy according to the existing waste composition specific to İzmir. In order to increase recycling rates, deposit practices such as reimbursed waste collection systems and card systems that provide discounts from waste tax should be implemented in order to support households' separation efforts at source.

Practices to Reduce Water Consumption

The pressure caused by the effects of climate change on water resources has been felt as water scarcity in the industry sector of İzmir in recent years. The sectors that consume heavy water experiencing difficulties from time to time in water supply, the inability of the Organized Industrial Zones to supply water to the companies, and the increasing depth of underground wells can be considered as the first signs of water scarcity predicted by the future drought scenarios. There is a significant risk in terms of ensuring the continuity of production in the coming years, especially in sectors that produce water-dependent production. At this point, it is very important to adopt techniques and technologies that will ensure water efficiency, and to expand investments for the reuse of wastewater generated in production. The improvement, reuse and recycling of used water is considered as one of the tools that contribute to the conservation of the usable water potential. Due to the low value of water in line with water pricing policies, the economic gains to be achieved by the implementation of these interventions remain low. At this point, the economic gain to be achieved by the transformation should not be considered over the cost of water supply and disposal, but in terms of ensuring the continuity of the future activities of the sectors.

In the general economic order, as the amount of resources used in the production of goods and services decreases, the price increases, and with such balance, efficient use of the economic resources is ensured. However, when it comes to the use of water as a resource, it is not possible to talk about this balance. Water, which is the most basic economic resource of economic activities, is consumed at an uncontrolled rate since it is not seen as a commercial input. It is common for industrial establishments operating outside the organized industrial zones to obtain water free of charge from the wells they own. On the other hand, it is known that more than 70% of the existing water resources are used in agricultural activities for free or at low fees. In the climate scenarios for the future, it is estimated that İzmir will experience moderate-to-high drought by 2030 and there will be a significant decrease in the amount of usable potential water. This situation may lead to prioritization of water in sectoral allocation, some sectors to experience water shortages and stop their activities. At this point, water should be accepted as a limited and critical economic resource and priced accordingly at its value.

Domestic-Green Technology and Innovation Development

The use of green technologies is one of the main tools in the implementation of the interventions identified for transformation. Especially in the field of resource management, water, raw materials and energy efficiency, renewable energy systems, clean energy equipment and recycling; the transition to innovative techniques and high technologies is seen as the driving force of transformation. However, the transition of sectors to new techniques and technologies

brings with it high costs due to foreign dependency in environmental technologies. The use of domestic technology in the implementation of transformation interventions provides significant advantages in terms of return on investment and economic gains to be achieved. At this point, it is necessary to increase domestic green technology development in order to ensure the widespread use of sustainable technologies, innovative practices and processes.

Green Labor and Skill Building

The green transformation in industry is likely to have serious impacts on the local labor market. With the effect of technological developments, a decrease in labor demand, transformation of job profiles and the necessity of new skills emerge. However, with the emergence of new technologies and products, new jobs are being created and existing jobs are turning into greener jobs. For green jobs that will emerge with the transformation, the labor needs to acquire new skills beyond the use of technology. It is important to support small and medium scale enterprises in the transformation of the labor.

It is difficult to clearly reveal the labor effect on the basis of the available data. Labor force analysis and related interventions were not included in this study. At this point, with the transformation, how the existing labor dynamics will be shared in terms of the qualifications, skills and sectors of the labor, the social effects of such sharing and the effects on the employment structure should be analyzed in depth, and road maps for the transformation of the labor should be determined.

3.2. Green Transformation in Agriculture

3.2.1. Bovine Livestock Breeding

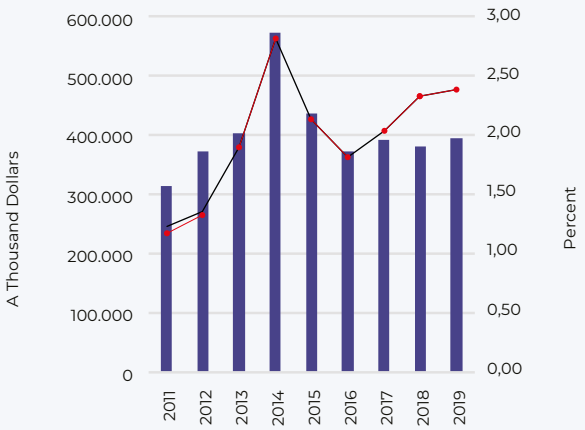
Bovine livestock breeding is an important source of livelihood in İzmir, especially for districts that are far from the central districts and located in more rural areas. İzmir, with its 4.3% share, is the third province of our country with the highest bovine livestock. In the province, where the animal production value reached 397.7 million dollars as of the year 2020, approximately 80% of the bovine assets are dairy cattle. In the province that meets approximately 5% of Turkey's total milk production, productivity per animal has increased significantly in the last ten years. In the same period, the number of dairy cattle increased by 88%, while milk production increased by 97%.

The region with the highest number of bovine animals in İzmir is the Küçük Menderes Basin (KMB). The presence of animals in this region corresponds to three-quarters of İzmir's total. In the 2010-2020 period, the number of bovine animals increased by 58% in Turkey and by 97% in İzmir, while the same increased by 112% within the KMB (Figure 17 and Figure 18).

The basin includes 65% of the bovine animal holdings operating throughout the province. More than 80% of businesses are small-scale family businesses with less than 50 animals.

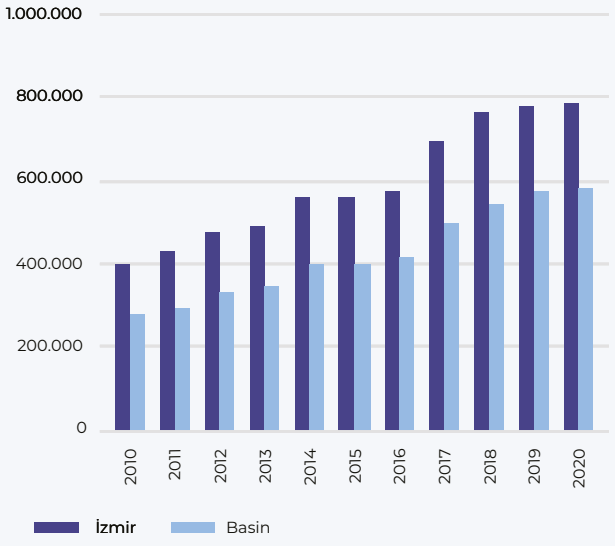
According to climate change scenarios, Küçük Menderes Basin is considered as one of the most risky regions of our country in terms of absolute water scarcity. In the basin, where the ground and surface water potential tends to decrease in terms of quantity and quality, there have been significant problems in water supply in recent years. Furthermore, the rapidly increasing animal population in the last decade increases the need for forage crops, and especially for silage maize within this group, putting pressure on agricultural production in the region and leading to a narrowing of the crop pattern (Figure 19). The widespread use of silage maize cultivation, which is a product with high water needs, increases water consumption in the basin.

FIGURE 17. Animal production value in İzmir (TurkSTAT; 2021)



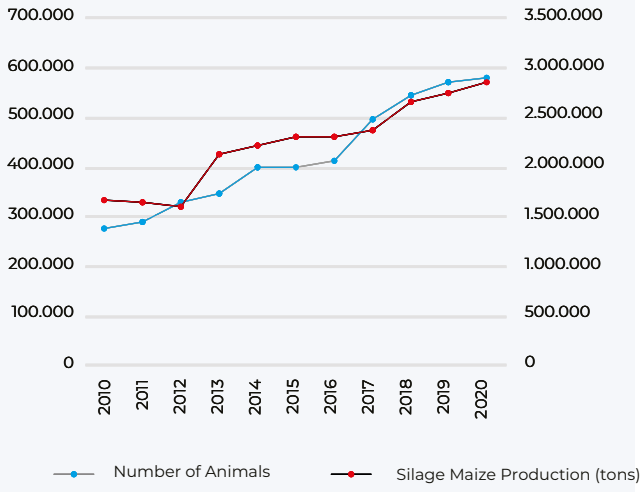
Source: TurkSTAT; 2021

FIGURE 18. Number of bovine animals in İzmir and KMB (TurkSTAT, 2021)



Source: TurkSTAT; 2021

FIGURE 19. Relationship between bovine livestock breeding and silage maize production in the basin (TurkSTAT, 2020)



Source: TurkSTAT; 2020

Fundamental Issues

- There are no medium and long-term targets and policies regarding the bovine livestock industry. Livestock input costs are high and tend to increase continuously.
- In order to obtain roughage, which has the largest share among the input costs, the production of silage maize with a high water consumption rate is increasing. Ground and surface water potential in the basin tends to decrease rapidly due to silage maize cultivation.
- The rapid increase in bovine livestock breeding facilities located on fertile agricultural lands shrinks the agricultural lands.
- Animal wastes generated in small-scale enterprises are not stored under appropriate conditions and are not evaluated economically. Keeping of wastes creates serious nitrate pollution in water and soil.
- Since the technical and managerial capacities of small-scale family businesses in the basin are low, efficiency practices in production, effective waste management and use of technology have not become widespread.

In addition, considering the inefficiency of the commonly used surface irrigation systems and the threats posed by climate change and the threats to be created in the near future, it is obvious that the primary target in the region is the efficient use of water. If livestock breeding continues under the current conditions, it is foreseen that there will be no water for silage maize cultivation in the next ten years.

The fact that the majority of the businesses in the basin are small scale family businesses results in the inability to systematically dispose of the waste arising from livestock activities. The waste generated in family businesses is generally collected in one place and kept until dried, and then used as fertilizer in the agricultural lands in the region. This method creates significant water and soil pollution due to mixing of the pollutants in the stored waste into water resources and dispersing them to agricultural lands by irrigation.

Interventions

Intervention 1. Development of ovine livestock breeding

Bovine livestock breeding activities in the basin are mainly carried out for milk production. The increase in costs in recent years has led to a decrease in the milk income obtained from bovine livestock breeding. Milk income from sheep and goat farming activities differs significantly depending on whether the nutritional needs are met in a completely closed environment or partially on pasture. Detection and improvement of pasture lands in the region, as well as the expansion of ovine livestock breeding activities will significantly reduce the amount of silage maize consumed in the region, as well as protect the economic returns to the producer, thus contributing to the protection of water resources.

Intervention 2. Establishment of rainwater collection systems in enterprises with 50 or more bovine animals

Only 30% of the rainwater is added to the groundwater and the remaining 70% cannot be utilized adequately. Collecting and storing rainwater and using it for different purposes is an effective method both in terms of protecting the environment and water resources and in terms of economic gain.

Rainwater harvesting indicates the system of collecting and accumulating rainwater and runoff water and using the stored water for purposes such as agriculture, irrigation and cleaning. It is thought that the rain water to be collected in the bovine livestock facilities can be used for cleaning the animals, meeting their water needs, washing the facility, filling the pools or ponds for irrigation and washing the operating vehicles.

Intervention 3. Production of agricultural products with high economic potential and low water requirement

The basis of excessive water consumption in the basin is the preference of wrong products that are not suitable for the climate and consume too much water. Mostly maize silage is used as feed in cattle breeding in the region, while approximately 80% of the maize silage produced meets the feed needs of the region, approximately 20% is used for economic income. Effective use of the limited water resources in the region will be ensured if agricultural products that are compatible with the climate and soil conditions of the region and have low water needs are produced, which will provide economic gain at the same or higher level than the gain obtained from maize in the area where silage maize is produced with the sales target. When the economic return and water consumption amounts per decare of some of the agricultural products traditionally grown in the region and some of the medicinal and aromatic plants with potential are compared, it is understood that a transition to a product pattern, which consumes water resources less in a way that will keep the economic return constant or increase it, is possible. However, it is known that unplanned production in agricultural products significantly affects product supply, and therefore economic gain, together with other factors such as climatic conditions. For this reason, it is important to consider the transformation in question together with the planning studies.

Intervention 4. Establishment of small-scale biogas facilities in enterprises with 50 or less bovine animals

Animal wastes generated by small-scale family businesses in the basin are not used as raw materials by biogas plants due to the high collection costs. Considering that the enterprises of this scale are in the majority among the existing livestock enterprises, it is seen that a significant amount of animal waste cannot be evaluated economically. At this point, with the establishment of a biogas facilities for small-scale enterprises, both economic income will be obtained and water and soil pollution will be prevented. The obtained biogas will be sufficient for cooking, hot water preparation and heating of a relatively small area, while the compost obtained from the system will reduce the need for chemical fertilizers.

Intervention 5. Establishment of specialized production zones for bovine livestock breeding activities

As the size of the enterprises in biogas plants decreases, the fixed costs per animal increase. With the establishment of special livestock facilities that will gather small-scale enterprises in the region, the wastes of enterprises can be collected in common areas and disposed of more systematically. Investments such as cold milk storage units and milking equipment for common use will be realized. The creation of specialized production zones on lands that are not suitable for agriculture will also prevent the shrinkage of agricultural lands and the burden of waste-based pollution.

TABLE 11. Transformational interventions for the bovine livestock sector

Transformation / Opportunity Field	Target	Intervention
WATER	Reducing water consumption Reducing water losses and increasing reserve capacity	1. Development of ovine livestock breeding
		2. Establishment of rainwater harvesting systems in enterprises with 50 or more bovine animals
		3. Supporting the production of agricultural products with high economic potential and low water requirement
WASTE	Increasing the use of waste as a raw material and energy source	4. Establishment of small-scale biogas facilities in enterprises with 50 or less bovine animals
		5. Establishment of specialized production zones for bovine livestock breeding activities

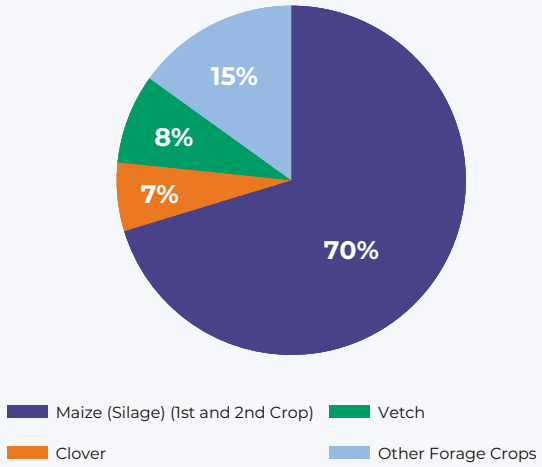
3.2.2. Forage Crops Production

İzmir is an important agricultural center where diverse plant species are cultivated thanks to suitable climatic conditions and fertile agricultural areas that make up 28% of its land. The increase in bovine livestock activities in the province with insufficient pasture areas has brought along the production of roughage. Feed costs constitute approximately 70% of the costs in animal production, therefore it is of great importance to provide quality roughage at lower costs for the sustainability of production. Mostly alfalfa, silage maize, vetch, sainfoin and oats are grown as forage crops, and in İzmir, where 3.8 million tons of forage crops are produced annually, the largest amount of silage maize is grown in terms of both cultivation area and production amount (Figure 20). İzmir ranks first among the provinces producing silage maize with a share of 11% (ZMO, 2020).

In terms of forage crop cultivation area and production amount, Küçük Menderes Basin stands out in parallel with its livestock activities. The region, where it is possible to harvest two crops per year due to its climate and soil characteristics, is actually one of the basins of our country that suffer from absolute water scarcity in terms of water potential. While there is a serious downward trend in the groundwater level over the years, the quality of surface water resources decreases with the impact of agricultural and industrial activities.

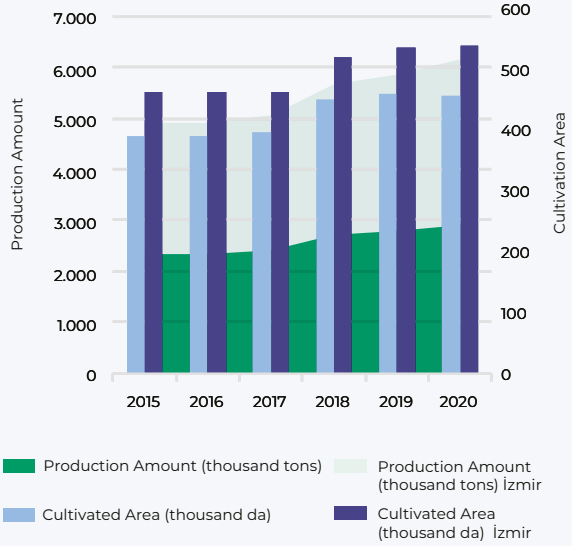
Although silage maize is a water dependent product, unit water consumption varies according to many factors. DSİ data, which includes surface water resource allocations according to the crop pattern, exhibit that there is an actual water consumption of approximately 655 m^3 per decare in the Basin when flooded irrigation technique is used in silage maize production. In the estimation studies made in line with the current meteorological data, the water requirement per decare is given as 1.097 m^3 in order to ensure full efficiency in production (TAGEM, 2022). This information shows that there is about 35% yield loss in production due to the lack of water in silage maize production in the Basin. While the yield of silage maize should reach 10 tons per decare under normal conditions with proper seed selection and planting, production and irrigation techniques, the yield of silage maize produced as the first crop in the Küçük Menderes Basin drops down to about 6 tons per decare. 60% of the silage maize produced in the basin throughout the year is grown as the second crop with the aim of generating an additional income from the vacant agricultural lands after the first harvest. The low rainfall in the Basin during this planting period increases the use of blue water, and the yield per decare decreases by 20% in the second planting (Figure 21).

FIGURE 20. Distribution of forage crops by cultivation areas in İzmir (İTOM, 2019)



Source: İTOM, 2019

FIGURE 21. Silage maize cultivation and production in İzmir and Küçük Menderes Basin (İTOM, 2020)



Source: İTOM, 2020

Interventions

Intervention 1. Effective use of water with drip irrigation system

In the surface irrigation method, the water coming from the irrigation channels spreads to the field surface and, depending on the soil structure, it drains underground immediately or after staying on the surface for a while. In the meantime, the plant takes the water it needs through its roots, and the excess water mixes with the groundwater. In drip irrigation, the water is released to the soil in drops close to the roots of the plants, through pipes, and there is no underground flow. With this method, since only a certain part of the land is wetted, the need for irrigation water is reduced, and larger areas can be irrigated with the available water in limited water conditions.

There are significant differences in water loss between surface and drip irrigation methods. While water loss is between 35% and 60% in surface irrigation method, water loss is between 5% and 25% in sprinkler and drip irrigation.

Intervention 2. Effective use of water with subsurface drip irrigation system

Subsurface drip irrigation systems offer a modification of the drip irrigation system and are the irrigation method with the least loss of water and energy among pressurized irrigation systems. In the subsurface drip irrigation method, water is given directly to the root zone of the plant. Thus, evaporation from the soil surface occurs in a negligible amount, and the irrigation time and irrigation duration are planned correctly during the operation period, while transpiration from the leaf surface is reduced. For the subsurface drip irrigation method, the water application efficiency is observed to be around 95%.

Intervention 3. Use of metering systems in the distribution of surface water resources

A significant portion of the irrigation unions operating in the Küçük Menderes Basin do not have a meter system and water pricing is based on the size of the field. Producers make the payment determined by the irrigation unions per decare, and they can

Fundamental Issues

- **Küçük Menderes Basin suffers from absolute water scarcity in terms of water potential. The amount and quality of usable ground and surface water resources in the basin are on a trend to decrease rapidly.**
- **The most basic nutrient in livestock activities in the Basin is silage maize, and producers are growing silage maize at increasing rates in order to reduce feed costs.**
- **While the net water requirement of silage maize is 569-670 mm, the total irrigation water requirement per decare can reach 1,000 mm depending on the irrigation technique used. According to the knowledge and awareness level of the producers, the amount of water consumed may exceed the amount needed.**
- **It has been stated that the flood irrigation method is used at a rate of approximately 90% in the production of silage maize.**
- **Some of the silage maize is produced in order to meet the feed needs of the existing livestock, and some for sale to other regions.**
- **Biogas plants have an increasing share in the demand for silage maize. These facilities charge higher prices for silage maize than cattle producers.**
- **Meters are mostly not used in the distribution of surface water resources and the water fee is priced according to the production area, regardless of the amount of consumption. This fact encourages producers to use surface irrigation method.**

use the surplus water in the production process without paying any additional cost. If the unions use a metering system in water distribution, it will be possible to make water pricing based on the amount of water consumed. In this case, the change in the pricing method will limit the producers' surplus water consumption. In addition, if a condition is imposed on the use of pressurized irrigation systems in irrigation areas, surface water resources will be used much more effectively.

Intervention 4. Use of unmanned aerial vehicles (UAV) in agricultural spraying

Traditionally, agricultural spraying is carried out with a hydraulic field sprayer attached to the tractor. Pesticides are diluted with water at the required rate, taking into account factors such as nozzle type in the sprayer, nozzle hole diameter, and the speed of the tractor. Pesticides are applied in three periods: before planting, before crop emergence and after crop emergence. Due to the damage caused by the tractor wheel to the product in the spraying activity after the product sprouts, a yield loss of approximately 4-7% occurs. Today, the use of unmanned aerial vehicles for agricultural spraying has become increasingly common. This method provides significant economic, environmental and social gains. In spraying carried out by UAV, savings of 95% in the amount of water used for the dilution of pesticides, 40% in the amount of pesticide consumption and up to 97% in spraying costs are achieved; while the loss of efficiency caused by the tractor wheel is prevented, the total carbon emission is reduced due to not consuming diesel, the exposure of farmers to pesticides is prevented, and the spraying time can be reduced 40 times. The most important disadvantage of unmanned aerial vehicles is that they are highly affected by climatic conditions such as wind speed and cannot be used in unsuitable weather conditions.

TABLE 12. Transformation interventions for the forage crops production sector

Transformation / Opportunity Field	Target	Intervention
WATER	Reducing water consumption	1. Effective use of water with drip irrigation system
		2. Effective use of water with subsurface drip irrigation system
		3. Use of metering systems in the distribution of surface water resources
ENERGY **WASTE**	Reducing energy losses and consumption Reducing waste generation	4. Use of unmanned aerial vehicles (UAV) in agricultural spraying

3.2.3. Cotton Production

World cotton production is concentrated in countries where the textile industry is developed, and our country is the seventh country that produces the most cotton. While an increase of approximately 25% has been observed in domestic cotton production in the last thirty years, the increase in consumption in the same period is around 250%. 19% of the agricultural areas where cotton is planted throughout the country are located in the Aegean Region and 6% are located in İzmir. Cotton production in the province is concentrated in the Gediz Basin, especially in Bergama and Menemen. Approximately 63% of cotton production lands in İzmir are located in these two districts (Table 13). Since cotton cultivation is realized through irrigated agriculture in the region, yield values are generally high. In the Bergama-Menemen region, the fiber cotton yield is 220 kg per decare, above the country average of 180 kg/da. Due to the low annual precipitation and high evaporation in the region, cotton production is generally made with surface and groundwater, and 5,156 m^3 of water is consumed for one ton of cotton production (Mekonnen and Hoekstra, 2010).

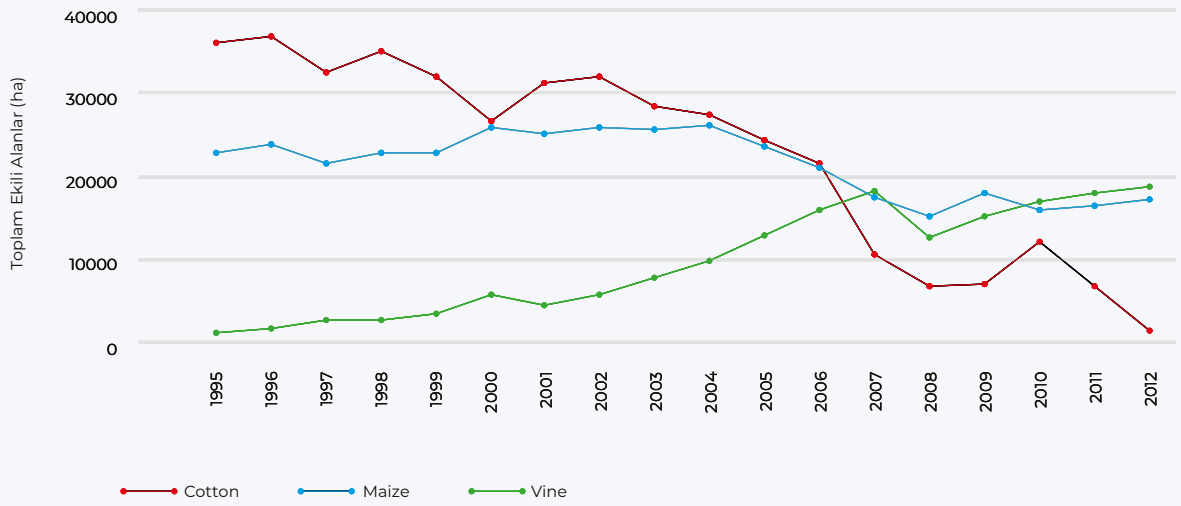
It is observed that the cotton cultivated areas in the Aegean Region have shrunk by 65% in the last 25 years. Changes in the crop pattern have been experienced as the farmers of the region switched to silage maize instead of cotton (Figure 22).

TABLE 13. Cotton production in İzmir

District	Total agriculture area (da)	Irrigated area (da)	Non-irrigated area (da)	Cotton cultivated area (da)	Yield (kg/da)	Production (tons)
Bergama	421.999	267.081	154.918	107.000	550	58.850
Menemen	232.191	229.431	2.760	103.500	550	56.925
İzmir	3.433.091	1.995.496	1.437.595	334.311	567	189.556

Source: İTOM, 2019

FIGURE 22. Change in Gediz Basin crop pattern (Çetinkaya and Günaçtı, 2018).



Source: Çetinkaya and Günaçtı, 2018

In addition to intensive water consumption, high amounts of fertilizers and pesticides are used in cotton production, which is an important source of economic income for the region. With the transition from cotton to silage maize, the need for peak irrigation in the region shifted from July-August to June, thus reducing the total demand for irrigation water to be supplied from non-precipitation sources. Although agricultural water consumption has decreased after the shift to silage maize production, it is seen that the profitability of the farmers also declined. The reason for this is that the yield of cotton is higher than that of silage maize. As a matter of fact, in the profitability analyzes for all product patterns in the Gediz Basin, cotton is the product with the highest income with a net return of $185.5 per decare (Kalkınç and Kaynak, 2020).

Interventions

Intervention 1. Effective use of water with drip irrigation system

Compared to surface irrigation techniques, pressurized irrigation systems conserve both water and energy, increase product quantity and quality, and do not create environmental pollution. Especially the use of drip irrigation systems provides water application efficiency up to 90-95% and increases the water use efficiency of plants (Tunalı et al., 2019). The results of the research show that drip irrigation systems provide an increase in efficiency as well as water conservation in cotton farming. These systems also prevent the weed problem and excessive fertilizer consumption caused by irrigation of the entire land in surface irrigation, and reduce labor costs and fertilizer costs. In this direction, a significant amount of water saving and economic gain will be achieved by using drip irrigation systems in all cotton production areas in Bergama and Menemen districts.

Intervention 2. Effective use of water with subsurface drip irrigation system

The intervention that can be suggested to solve the excessive water consumption problem of cotton farming in İzmir and especially in Menemen and Bergama counties is the generalization of modern irrigation methods. Subsurface drip irrigation systems,

Fundamental Issues

- Due to the fact that cotton is a plant with high water demand and farmers tend to use excessive water through flood irrigation methods, there is intensive water use.
- A high amount of agricultural chemicals are used in cotton production. Excess chemical consumption increases input costs in production, pollutes water resources, and causes health problems such as cancer as well as water and soil pollution.
- Since there are no metering systems in the distribution of surface water resources, water pricing is made according to the production area, regardless of the amount of water consumed. Due to the fact that most of the privately owned water wells are unlicensed, producers cannot benefit from the support given for transition to pressurized irrigation systems. Thus, the transition of producers to pressurized irrigation systems gets postponed.
- Price fluctuations and uncertainties in the cotton market prevent manufacturers from making long-term plans and investments.
- Due to the rapid depletion of water resources, producers tend to produce silage maize instead of cotton, which needs less water than cotton. While this transformation increases the import level of cotton, which is the basic raw material of the textile industry, it causes a loss of income for the producers.
- The knowledge and experience of the producers on certification programs (Good Cotton Practices etc.), which would increase the added value in cotton production and reduce the use of chemicals and water at the same time, remains limited.

a modification of the drip irrigation system, are considered to be the most suitable irrigation method for plant species that use water intensively, thanks to the water and energy savings they provide. If all cotton production in Menemen and Bergama counties is to be carried out with subsurface drip irrigation system, significant water savings and protection of usable water potential will be achieved.

Intervention 3. Cultivation of naturally colored cotton

Apart from white cotton, cotton types naturally with green, brown and different shades of these colors have been known and grown for a long time. However, because the yield of white cotton is higher and it can be dyed to the desired color with cheap dye, colored cotton types have not become very common. Today, naturally colored cotton, which eliminates dyeing, the most polluting activity of the textile production process, is seen as an opportunity for the sector in terms of transition to sustainable production. It is envisaged to save water, energy and raw materials by growing naturally colored cotton and using this cotton in textiles. Considering these advantages, the scenario of converting half of the cotton grown in the Menemen-Bergama region to naturally colored cotton has been proposed as an intervention proposal. Naturally colored cotton, which eliminates the most polluting processes in the textile dyeing sector, is processed 3 times cheaper than white cotton, does not harm human health and is environmentally friendly, will be able to make significant contributions to the sustainability and economy of İzmir if supported by the right marketing and branding strategies.

Intervention 4. Use of unmanned aerial vehicles in agricultural spraying

The benefits that can be achieved with the traditionally used spraying method and unmanned aerial vehicles are described in the section "3.2.2. Forage Crops, Intervention 4". Within the scope of the intervention prepared in this direction, it is aimed to reveal the gains to be achieved if agricultural spraying with the use of UAVs is carried out in the entire cotton production area of the Menemen-Bergama region. Cotton is a plant with a very high amount of pesticide use. Therefore, the potential gains of the proposed intervention will be higher than for other agricultural products. In addition, as stated in the forage crops section, it will be possible to use UAVs supplied for cotton production in agricultural spraying activities of other agricultural products in appropriate periods. In this case, the gains to be achieved will be even further than the potential determined within the scope of the intervention.

TABLE 14. Transformation interventions for cotton production

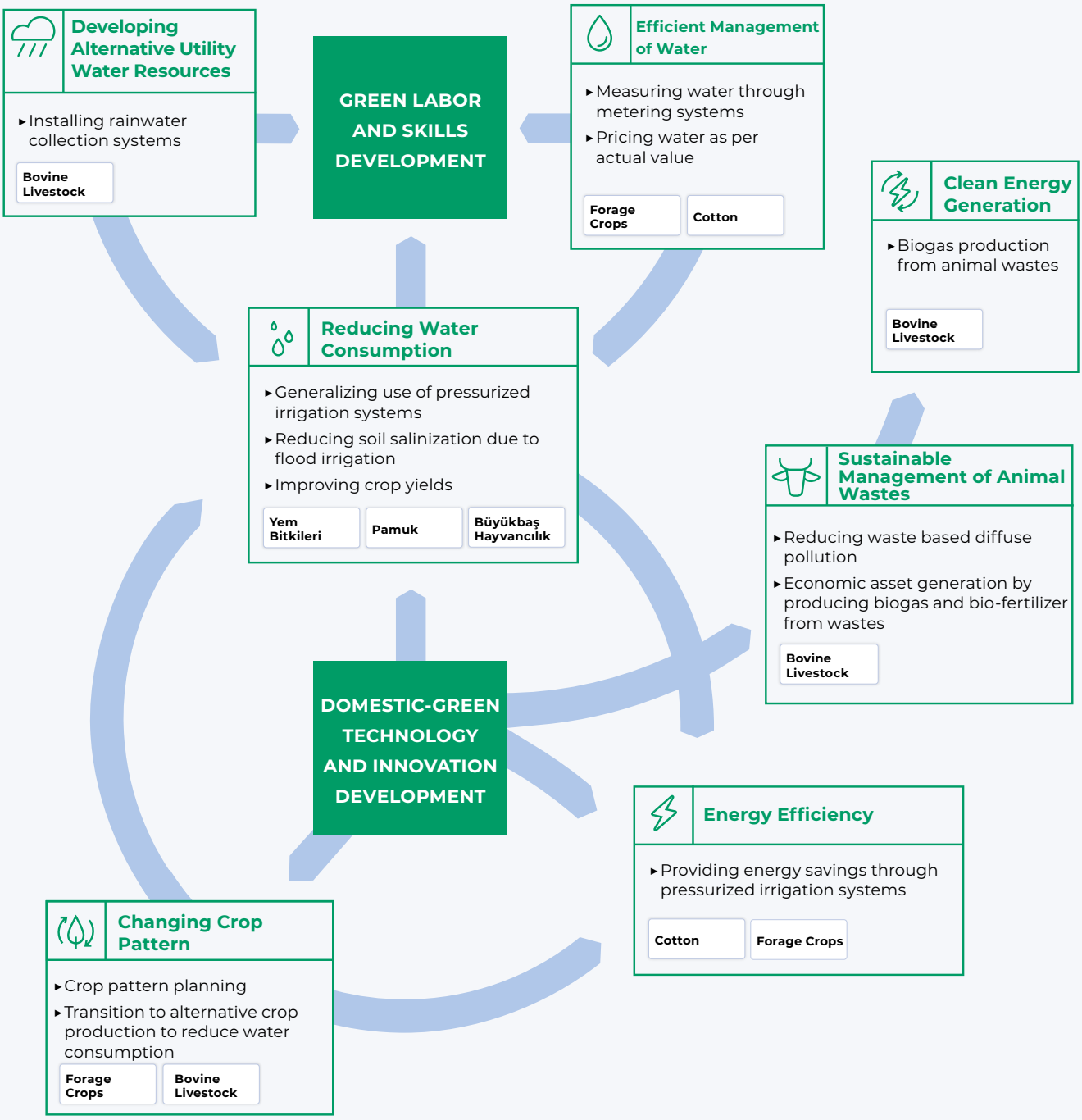
Transformation / Opportunity Field	Target	Intervention
WATER	Reducing water consumption	1. Effective use of water with drip irrigation system
		2. Effective use of water with subsurface drip irrigation system
		3. Cultivation of naturally colored cotton
ENERGY **WASTE**	Reducing energy losses and consumption Reducing waste generation	4. Use of unmanned aerial vehicles in agricultural spraying

3.2.4. General Interventions for Transformation in Agriculture

The main problems experienced in In İzmir regarding the focus areas of bovine livestock breeding, forage crops and cotton sectors, standing out in terms of their impacts on waste, water and energy, and priority interventions for transformation have been determined. Although the interventions have been determined for the focus areas where the selected sectors have a relatively greater impact in terms of the growth areas in İzmir, they will also be guiding in terms of the transformation and gains to be made in İzmir as a whole. Since the interventions are formed through general approaches, potential gains will differ according to factors such as soil structure, terrain and climatic conditions during the implementation phase.

In the perspective study, the interventions developed for the agricultural sector are considered in two groups, namely structural and conjectural. Interventions to change the crop pattern are the most important structural interventions for real green transformation in agriculture. Agricultural activities carried out with a crop pattern that leads to the rapid depletion and pollution of the natural resource potential of the region will not be sustainable in the medium and long term, despite all the conservation measures to be implemented. Therefore, switching to a product pattern compatible with the natural resource potential of the region in agricultural production is considered as the most fundamental intervention. However, in this transformation process, there is need for several stages such as the determination of products that will adapt to the natural resource potential of the region and other conditions such as climate and soil while maintaining or increasing the current income levels of the producers, carrying out small-scale production trials, determining marketing terms and channels, training the producers and expanding the production. For this reason, it will not be possible for the transformation to take place all at once and as a whole. In the process of changing the product pattern, which will be possible to be realized gradually, it is very important to implement measures for agricultural crops that are already produced in the region and cause high resource consumption and pollution. With conjectural interventions developed in this direction, it is aimed to minimize the negative effects of the existing crop pattern on natural resources. Although examples of interventions that require investment are included in the perspective document, it is considered that some regulations not requiring investment can also provide significant gains in this process. For instance, regulations such as setting a quota for the number of bovine animals that can be raised in the relevant region, applying the water quotas determined in the basin water allocation plans, bringing the water consumed under control by making metering obligatory for individual wells, including those without license, can also provide significant gains.

FIGURE 23. Intervention relations for green transformation in agriculture in İzmir



Planning of Agricultural Activities According to Natural Resources, Regional Conditions and Economic Gains

Agricultural producers produce the crops that they believe will bring the most income in their agricultural activities, which they carry out with the aim of generating economic income. Although the level of producer knowledge about the cultivation method of the crops and the compatibility of the product with the regional conditions are important, the most important factor in the selection of the crops occur to be the prices of the agricultural products in the previous period. The price of the product, which was low in supply due to various reasons such as the production area and climatic conditions in the previous period, increases, which then causes the producers to produce the same product in high quantities in the next year with the aim of providing high income. This approach, which is mostly explained with the "spider web theory", ends with a lower product price in the following year, but the same process continues in the crop pattern selection for the following year. Even though the incentives provided to some products allow to go beyond this theory, the prices of the products in the previous period continue to be important. In this process, preserving the existence of water and soil remains in the background, and the goal of producing the product that will bring the most income in the highest amount comes to the fore. Planted agriculture such as fruit growing and animal husbandry activities, remain somewhat outside of this approach in terms of pattern change times due to their nature.

At this point, planning a region-specific crop pattern while considering the factors such as water potential, climatic conditions and soil structure will increase the welfare of the producers whose income level decreases within the spider web theory, besides providing food security and sustainable use of natural resources. Among the interventions proposed within the scope of the perspective document, an intervention that will set an example for the gains that can be achieved if products with very high water consumption are replaced with products with the same or higher economic return is included. If three ovine animals are raised instead of one dairy cattle in the Küçük Menderes Basin, approximately 1.3 billion m^3 of water can be saved in a 10-year period, in line with the decrease in the need for silage maize. The aforementioned gain was determined by assuming that non-irrigated farming would be carried out in areas where no silage was produced. In case of irrigated farming, the amount of water to be saved will vary. In the final case, the harmonization of alternative products to the region, efficiency level, and the economic gain to be achieved within the supply-demand balance to be determined by comprehensive product pattern planning specific to İzmir should be revealed through small-scale applications.

Providing Efficiency in Water Management

Different approaches are followed throughout the world in pricing the water used in agricultural production. Pricing based on recovering all or part of the investment cost for water distribution and maintenance and operating costs, pricing based on irrigated area and crop grown, pricing based on water usage time, pricing based on seasonal precipitation conditions, pricing based on crop yield, and pricing based on water volume methods are among the pricing approaches used by countries according to their current water potential worldwide. The volume-based pricing approach stands out in terms of its potential to promote efficiency in water consumption. The first condition in the volume-based pricing approach is to measure the amount of water consumed in agricultural activities. Determining the price to be demanded from the producers per unit water volume emerges as an issue that needs to be handled meticulously and studied in detail in this method. A delicate balance must be struck between the efficient use of water and the protection of farmer income.

Very high amounts of water are used in the production of cotton and forage crops, which stand out in the perspective study. Bovine livestock breeding activities, on the other hand, increase water consumption to a large extent due to the dependency relationship with forage crops. Almost all of the irrigation organizations that provide the management of surface water resources in focus areas, regardless of the amount of consumption, offer water to use based on the agricultural production area, and at

very low prices. Paying the water fee on agricultural area basis results in the farmers consuming as much water as they wish with surface irrigation methods. The idea that more water will provide higher efficiency, together with the water pricing method per decare, causes the rapid depletion of water resources. In this context, the intervention for the use of smart meters in areas subject to SW irrigation will ensure effective management of surface water resources by pricing water over quantity used. The change in water pricing policy will also encourage farmers to switch to drip irrigation systems.

Excessive water withdrawal from unregistered wells remains as a problem in regards to the use of ground water resources. Due to the unregistered wells, producers cannot benefit from loans and supports for the modernization of irrigation systems and continue production through surface irrigation methods. Due to consideration for food security and the economic fragility of the rural population, these wells cannot be intervened, but on the other hand, support for the effective use of water cannot be provided.

Providing Efficiency in Water Consumption

The fact that mostly surface irrigation methods are used in agricultural production causes excessive and inefficient consumption of water, and also causes irreversible problems such as soil salinization. Producers do not favor pressurized irrigation methods due to reasons such as level of awareness, economic conditions, labor costs, and low priced or free water provided. Studies show that the pressurized irrigation techniques of subsurface and surface drip irrigation systems reduce water consumption significantly, as well as bringing other gains such as energy and agricultural chemicals conservation and increased efficiency. In this direction, drip irrigation methods come to the fore in interventions for cotton and silage maize production in the perspective study. Within the scope of livestock activities, rainwater harvesting intervention stands out in terms of protecting the existing water potential in the region.

Elimination of Pollutant Load through Utilization of Waste Potential

Manure formed as a result of bovine livestock breeding is an important diffuse pollutant. Not being stored or disposed of under appropriate conditions, it causes the nitrogen and phosphorus load in its content to pollute the soil and water. On the other hand, fertilizer has an important economic potential in terms of energy and fermented fertilizer. Relatively large-scale cattle farms can collect their manure in certain areas and deliver it to the biogas facilities, but the existing businesses in the focus area are mostly small businesses with less than 50 animals and they have no manure collection areas. In addition, for biogas plants, obtaining fertilizer from many small businesses constitutes a huge transportation and labor cost. The inability to store manure in small enterprises under suitable conditions causes both soil and water pollution and prevents the use of its economic potential. The two interventions proposed in this context are aimed to prevent the polluting effect of manure generated in small enterprises and to benefit from its economic potential.

Transition to High Technology in Agricultural Production

Agricultural production is mostly carried out by traditional methods, and the production processes and the amount of resources used are determined according to the knowledge and experience of the farmer. In today's world, advances in technology are rapidly integrated into agricultural production processes and provide great economic, environmental and social gains. Technologies that save water and energy in agricultural production reduce the use of agricultural chemicals, while protecting natural resources in terms of quality and quantity and increasing crop yield or reducing loss. Ultimately, it contributes to food safety and security together with the increase in producer income.

The use of high technology is inevitable for green transformation in agriculture, but it is critical for R&D and innovation activities to focus on this area and to develop domestic technologies in order to prevent the increase in imports to be caused by the use of technology.

TCDD İzmir Limanı, Alsancak

3.3. Blue Opportunities

3.3.1. Ports

The port sector is of critical importance for cities of which economic, social and spatial development has historically been shaped by their port. Ports, which are large commercial and strategic infrastructures, support trade flows and the movement of goods and people, thereby acting as facilitators of commerce and economic development. By creating income, employment and added value and helping the development of other sectors, ports provide a competitive advantage to the cities where they are located and even to the neighboring regions. The development of a number of other industries such as maritime transport, shipbuilding, ship recycling is also related to ports. Many ports in the world have become integrated with production and become energy and industry clusters, apart from their function of providing the entry and exit of goods. In this respect, supporting port developments increases the revenues arising from port services in the regions, encourages the clustering of energy and industrial companies in the vicinity of the port, and creates multi-faceted positive economic effects, especially in production, export and employment, in line with the effects on regional production (EC, 2022).

İzmir handles over 80 million tons of cargo with its 16 ports, which corresponds to approximately 16% of the country's cargo. The port infrastructure of the region consists of TCDD İzmir Port, Aliaga region ports, Dikili and Çesme ports. TCDD İzmir Port and Aliağa region ports, which can be said to handle almost all regional cargo with a share of 98%, constitute the main focus of policies and evaluations regarding freight transport. Although not yet active, the North Aegean (Çandarlı) Port, planned as a public investment of national importance, for which the construction of the breakwater has been completed but the superstructure remains under construction, is notable for its high potential.

Since the superstructure of Çandarlı Port has not been built yet, it has the opportunity to be planned in accordance with the requirements of the day, it has strong accessibility to the North Aegean Motorway, and the availability of restructuring of the port with a focus of the energy sector in the region and more specifically with the development of the port-industry for the production of wind energy equipment provides advantageous conditions.

The only port operated by the public among İzmir ports is TCDD İzmir Port. TCDD İzmir Port, put into service in 1959, is today the largest port in the Aegean Region and the second largest in our country in terms of quay length and hinterland size. TCDD İzmir Port is also the only port of the Aegean Region capable of serving all types of ships and freight in terms of service diversity. With this feature, TCDD İzmir Port constitutes the most important logistics infrastructure of the region.

Another important element worth mentioning in terms of regional logistics infrastructure occurs to be Kemalpaşa Logistics Center, of which infrastructure has been completed and aimed to be developed together with its superstructure and operating model. Logistics centers are considered as critical units for ports today, as they transport freight to ports in a comfortable, fast and efficient manner, contain many critical functions such as loading, storage and customs clearance, and support combined transportation. In this respect, Kemalpaşa Logistics Center is a major regional infrastructure that should be taken into account in the development of İzmir ports and the freight handling they undertake.

The sector in which İzmir contributes the most to Turkey's sectoral production and added value is "water transport", that is, the maritime transport and port services sector, with a share of 28% (İZKA, 2021). Strengthening the regional ports together with the needed logistics and transportation investments will contribute to the regional economy of İzmir and the added value production in our country. In this respect, when the regional blue opportunities are evaluated, the issue of ports comes to the fore.

Factors such as being regional public investment, weight of benefits relative to costs and possible contributions to regional competitiveness were taken into consideration during prioritization regarding the actions that can be realized. From this point of view, the first of the issues that are considered to be of priority is making the TCDD İzmir Port, which has been facing load loss for the last twenty years, more efficient with both port-specific investments and, as a complement, Kemalpaşa Logistics Center investment and railway connections. The second priority issue is the reconsideration of the Northern Aegean (Çandarlı) Port, of which construction is yet underway, its development with an understanding of "specialization in project freight" for the export of wind energy equipment and its integration with production at the same time.

Apart from these two areas of focus, regional studies on İzmir ports consider two additional issues of critical importance for the region. These are the strengthening of Aliağa ports with the understanding of port clustering and the creation of the İzmir Port Authority in a manner that will bring the holistic management approach that İzmir ports need (İZKA, 2022a). These suggestions, which are not examined within the focus of the perspective study, are highly related to both TCDD İzmir Port and Kemalpaşa Logistics Center, and the Northern Aegean (Çandarlı) Port developments. It is considered that the steps that will improve clustering, specialization and combined transportation, as in the examples of port regions that are important in world transportation, can take the İzmir port ecosystem forward as a whole and contribute to the regional ports to make a leap.

Revitalization of TCDD İzmir (Alsancak) Port

TCDD İzmir Port is the only active port operated through public enterprise in our country, and it still handles the most containers in the Aegean Region. The port, considered to be the most basic element of the historical and economic geography of İzmir, stands out with its features such as being able to work with all types of ships and freight, offering intermodal transportation with a railway connection, and bearing the identity of having been the export port of Western Anatolia for many years.

İzmir Port, as the largest in port area and quay in the Aegean Region, has been responding to the port demands of Western Anatolia, Aegean Region and İzmir for many years on its own. However, long-term observations of container cargo volumes show that the port has suffered a dramatic loss of cargo. While the share of the port in container handling in Turkey was 35% between 1990-1995, this ratio has decreased to 5% as of today. The total share of İzmir ports in container handling is observed to be around 15%. Accordingly, the total share of İzmir ports has almost halved in the last 25 years.

Recently the number of ports in our country has increased, large investments have been made with the privatizations, and competitive factors have gained importance. The new ports concentrated in the Marmara Region and the rapid growth of Mersin Port after the privatization process were the factors that led to the decrease in the share of İzmir ports. Under such competitive conditions, the fact that the necessary investments were not made after the 2004 privatization decision regarding the TCDD İzmir Port negatively affected the port performance.

On the other hand, the only facility in the region with the status of logistics village or logistics center occurs to be Kemalpaşa Logistics Center (KLC), which has not been completed yet. Within the scope of the KLC project, which had been expected to be completed in 2015 when its construction began, three infrastructure tenders were held until 2021, and the facility infrastructure was completed to a large extent with the works carried out. The center, of which first phase is planned as 1.3 million m², is expected to reach 3 million m² through a longer term development. The infrastructure of the center has been completed to a large extent and studies are currently underway to establish an investment and operating model.

Fundamental Issues

- The economic efficiency of TCDD İzmir Port is gradually decreasing.
- There are deficiencies in the approach channel of the port, port equipment and port operation.
- Since Kemalpaşa Logistics Center has not been completed yet, it has not been integrated into the ecosystem.

Within the scope of the intervention, TCDD İzmir Port modernization and field expansion investments and

KLC investments towards realizing the transportation potential of the region, and ensuring an effective integration by connecting these two important infrastructure units with a railway line are discussed.

Interventions

Intervention 1. Strengthening the capacity of TCDD İzmir Port

"TCDD İzmir Port Operation Plan" was prepared in 2011 with the aim of determining the acts and actions needed to be carried out in order to modernize and increase the capacity of the TCDD İzmir Port. In the said report, infrastructure, superstructure and equipment investments to be made until 2035 and the revisions to be made in the administrative field are planned for short, medium and long terms. Withinthe scope of the study, an intervention scheme was developed in line with the investments in the business plan.

Dredging of the İzmir Bay Approach Channel and Maneuver Circle: In order for the port to serve new generation large ships, a two-stage application is envisaged in the İzmir Port Operation Plan; deepening the port to -14 meters in the first stage and dredging to -16 meters in the second stage. In case the approach channel is deepened by 1 cm, considering the average ship sizes, there will be an additional load increase of 90 to 120 tons per ship for container ships. In this way, more effective and efficient operation of the port will be ensured in terms of economies of scale (İZKA, 2019).

Commissioning of the Existing Embankment and Dock of the Second Part of İzmir Port: Within the scope of the İzmir Port Operation Plan, it has been proposed to complete the unfinished embankment of the port area and to build a new dock in front of the embankment for being allocated to container loads. The new area planned as a container terminal will increase port efficiency and productivity by solving the port's lack of hinterland (İZKA, 2019).

Dock Arrangements (Shifting Docks No. 10 through 19 Towards Sea): The existing docks of the port are insufficient to serve new generation ships. Docks also have insufficient strength against vertical and horizontal forces due to their low conditions. For this reason, it is recommended to shift the docks in order to provide service to larger ships and to improve the use of high-capacity cranes (İZKA, 2019).

Restructuring of the Warehouse Building: The existing warehouse building needs to be rearranged for the general cargo loads remaining in the port. One of the most basic functions of ports, as logistics hubs, is to provide safe and secure storage facilities for the freight arriving at the port. In this context, the arrangement of the existing warehouse building will increase the general cargo loads processed at the port (İZKA, 2019).

Elimination of Port Equipment Deficiencies: The equipment investment has two components: the modernization of Izmir Port and the increase in capacity. The modernization of port equipment will ensure efficient operation of the port and reduce operating costs. However, in order to meet the increased load volume, it will be necessary to increase the number of equipment together with such modernization (İZKA, 2019).

Fundamental Opportunities

- TCDD İzmir Port is still the port with the largest share among the regional container ports despite the volume loss experienced in the last 10 years. This shows that the port has development potential.
- Despite the lack of modernization and operational problems, the port is preferred by regional exporters. Development steps in accordance with the historical role and strategic position of the port will be met.
- İzmir has a strong innovation and entrepreneurship ecosystem. It is possible to benefit from the innovation and entrepreneurship ecosystem of the region during the port modernization process. In addition, world-wide technologies can be utilized in this context.
- Logistics centers working with ports in the world, and dry port examples that strengthen port hinterland areas have gained importance. The development of Kemalpaşa Logistics Center can be handled together with that of İzmir Port, located in the city and has a railway connection.

Intervention 2. Realization of Kemalpaşa Logistics Center superstructure investment

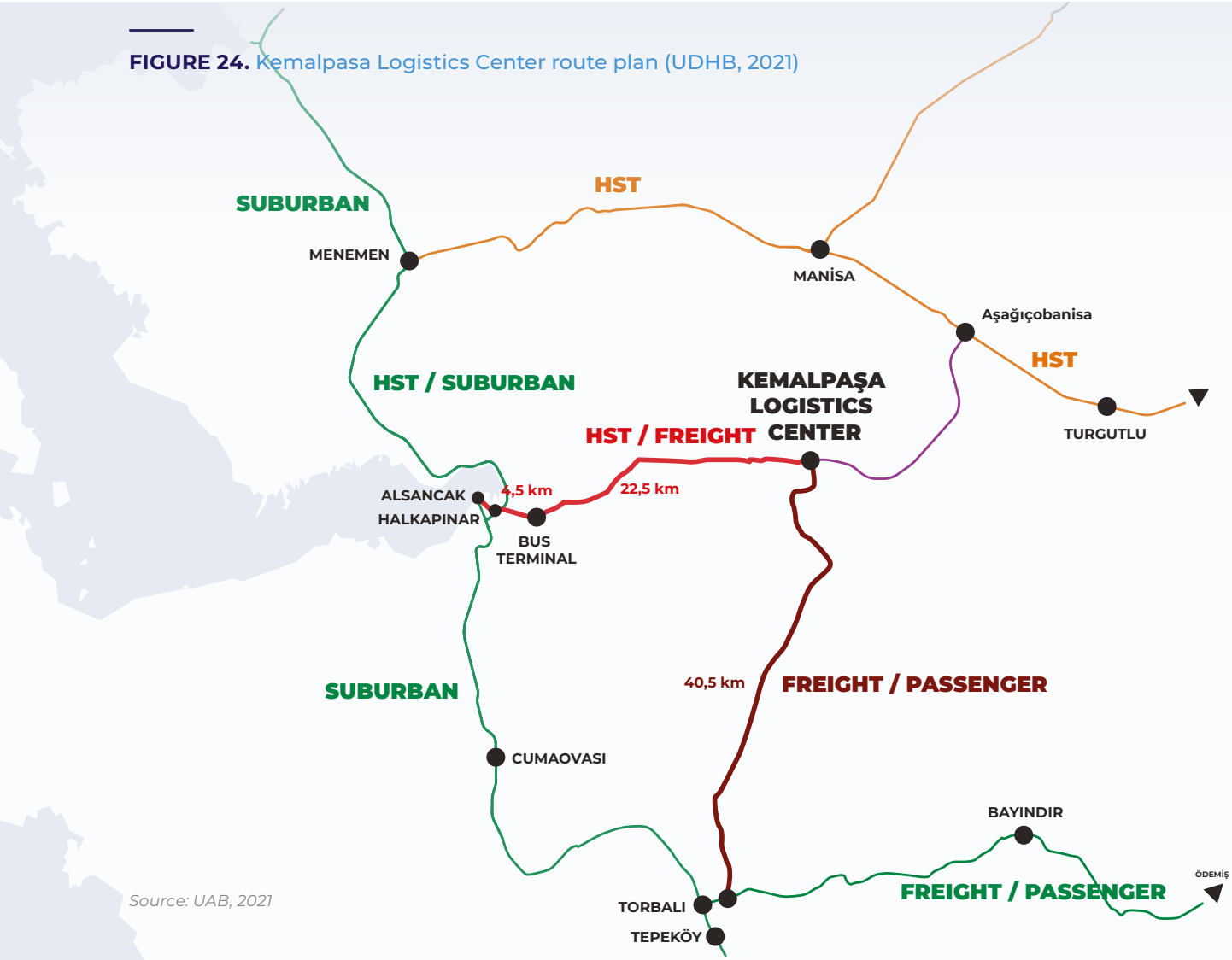
The factor that drives the development of the ports is the freight amount. Logistics centers are considered as critical units for ports today, as they enable the transportation of cargoes to ports in a comfortable, fast and efficient manner, fulfilling many critical functions such as loading, storage, customs clearance, and enabling combined transportation in which different modes of transportation needed for fast transportation are integrated. The realization of Kemalpaşa Logistics Center, of which infrastructure has been completed to a large extent and works on its superstructure and operating model are underway within the regional agenda, as well as the establishment of connections between the center and the ports is a critical issue for the port ecosystem situated inside the region.

Within the scope of the superstructure investment of Kemalpaşa Logistics Center, which is defined as an intervention element; storage facilities and warehouses, railway platforms, railway loading areas, open container storage areas, storage areas for general cargo, truck parking areas, car parks, vehicle maintenance-service areas, social facilities, administration buildings, customs building, fire brigade, places of worship, recreation areas, railway lines between workshops-maneuvering-fuel tanks-loading unloading areas and stock areas, and internal connection roads and landscaping are envisaged to be completed.

Intervention 3. Establishment of the railway connection between TCDD Izmir Port and KLC

Kemalpaşa Logistics Center-Alsancak Port Railway Line is projected as a double line with a total length of 30.5 km, and its electrification, signaling and telecommunication works are included within the scope of the investment.

FIGURE 24. Kemalpasa Logistics Center route plan (UDHB, 2021)



Source: UAB, 2021

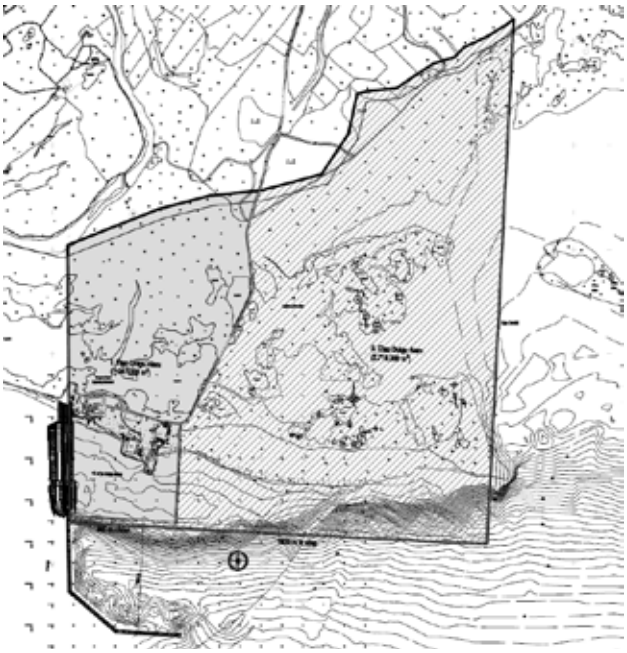
Restructuring of the North Aegean (Çandarlı) Port

The North Aegean Port in Çandarlı is a large-scale port investment project planned as a public investment. The construction of the breakwater, which started in 2011, was completed in 2014, and a 1,500-meter-long breakwater was built with a cost of 110 million Euros. Due to the lack of bidders for the 12 million TEU related to the port, the project was divided into lots of 4 million TEUs, but a second tender was not held and the construction activities were suspended. Although Çandarlı Port is not yet in operation, it is noteworthy because it is a large-scale project planned and partially started for İzmir (İZKA, 2019).

When the Çandarlı Port was planned, there was no second port in İzmir other than TCDD İzmir Port serving container loads in the region, while the number of ports serving container loads in the region increased to four over time. The high initial investment cost of the Çandarlı Port, the long construction period, the distribution of the cargo in the region to the existing ports, the fact that the ports in the region, especially the Socar Terminal, have deep draft and modern port equipment negatively affect the economic feasibility of the port. In order to develop a sound demand forecast and calculations in this regard, it is necessary to renew the relevant feasibility studies, and to review the capacity and investment targets for the port in the light of current developments throughout the world (İZKA, 2019).

In the detailed feasibility studies carried out by our Agency in 2022 on the subject, the development of Çandarlı Port and the Wind Industry Specialized Industrial Zone connected to it were discussed in detail. In this development scheme, which also examines the geographical and physical structure of the area, a total of 1,000,000 m² port area is envisaged as loading and storage area (Figure 25). It has been accepted that the port will have 500 meters of quay length, 18 meters of depth, 20 tons/m² loading area ground resistance, and 10 tons/m² storage area ground resistance.

FIGURE 25. Two-Stage Development of the Çandarlı Port Area (İZKA, 2022b)



Source: İZKA, 2022b

Fundamental Issues

- Çandarlı Port is a large port investment that has been partially started, but remains unfinished and inactive.
- Port feasibility and objectives (being the largest transit port in the Mediterranean) have lost their rationality to a great extent due to the delay in investment.
- Transportation and logistics problems negatively affect the development of İzmir wind energy equipment industry.

Our region hosts the production, R&D, maintenance and repair centers of global original equipment manufacturers (OEMs) operating in the wind energy sector. İzmir wind industry has already employed 7,500 people and realize exports worth over 500 million dollars annually. The first blade and tower factories, wind turbine maintenance and repair facility, wind energy R&D center and nacelle factory in our country were established in İzmir. Wind energy equipment manufacturers are concentrated especially in Northern İzmir and there is a certain demand for a port with suitable transportation, logistics and handling facilities at the point of export of the large-sized products produced. Considering that the industry will develop rapidly with offshore wind power plants, it is considered necessary to plan a port associated with the industry in order to maintain the position of our country, which is among the top five countries regarding the wind industry in Europe, according to Wind Europe data. Currently, it is difficult to realize new investments due to the production of large-size equipment in the sector and the lack of investment area suitable for the needs of the sector in terms of logistics requirements.

In this direction, it has come to the fore to prepare the Çandarlı Port, which has a highway connection, to be easily accessible and capable of meeting the needs of the sector (where large-scale project cargoes can be transported). Good practice examples such as Aalborg, Esjberg, Hull, Bilbao also show that the location selection and design of the production sites of large-sized turbine components are made in such a way that the logistics of the produced equipment can be carried out in the easiest way. Considering that the sector is clustered in İzmir and its surroundings, it is seen that Çandarlı Port, which is currently under construction, is the most suitable candidate for such a task in our country. In this context, the scenario of developing Çandarlı Port in accordance with the export of wind energy equipment is discussed within the scope of the perspective study.

Interventions

Intervention 1. Development of Çandarlı Port on the basis of wind energy

In order to support the continuity of the development trend for the wind industry in İzmir, the logistics needs of the sector must be met in line with the current and developing global trends. It is critically important for Çandarlı Port to be developed as a specialized port in project cargo transportation to serve the wind energy equipment production sector and other sectors with similar loads, in line with the advantage of its current situation, location and transportation connections. In this respect, the development of the port in the form of a general cargo terminal designed for the export and import of offshore energy equipment on an area of approximately 1 million m² was taken as a basis within the scope of the intervention. Accordingly, it is envisaged to develop the port by making investments in both infrastructure and superstructure and equipment.

Intervention 2. Construction of the highway connection

The North Aegean Highway extends to the port area, and there is a distance of approximately 2.5 km as a straight line. Within the scope of the intervention, it was envisaged that the highway and the port highway connection be realized and the port will have suitable road accessibility to meet the sector's needs.

FIGURE 26. North Aegean Highway and Çandarlı Port

Intervention 3. Clean Energy Specialized Organized Industrial Zone Investment

The establishment of a Clean Energy Specialized OIZ for the wind industry in the hinterland of Çandarlı Port, and the sector obtaining a production area integrated with the port, as in the examples abroad, is an investment that can carry İzmir to much higher levels in this field. The industrial zone, which will have an area of approximately 2.7 million m², will be realized with an investment cost of 66 million dollars (İZKA, 2022b). With the completion of the ongoing investments for the wind energy sector in Aliağa Organized Industrial Zone, Bergama Organized Industrial Zone and Kınık Organized Industrial Zone, the export, production capacity and sectoral employment of national and international wind turbine manufacturers operating in İzmir today are expected to increase significantly. In addition, the West Anatolian Free Zone (BASBAŞ), as the third free zone of İzmir, was established in the Aşağıkırıklar area of Bergama district with the Presidential Decree

published in the Official Gazette dated 08 September 2021. In addition to the Clean Energy Specialized OIZ, the development of the free zone, an important element of the hinterland of Çandarlı Port, will be able to support export-oriented companies to invest in the region.

Intervention 4. Construction of the railway connection

Within the scope of Aliağa-Çandarlı-Bergama New Railway Infrastructure and Çandarlı Port Railway Connection project to be implemented by the Ministry of Transport and Infrastructure, it is planned to increase the İZBAN line from 136 km to 186 km. The construction work, contracted in 2018 but was liquidated afterwards, included the construction of 8 stations with a 57 km line. In the project, there is a connection to Çandarlı Port at the 25th kilometer after Zeytindağ station, and this section constitutes an additional 8 km line (Figure 28). Within the scope of the intervention, a cost/benefit analysis was carried out for the construction of this line with a total length of 33 km.

Fundamental Opportunities

- The fact that the Çandarlı Port superstructure has not been completed yet will allow the superstructure to be designed and projected with a new understanding.
- The fact that there is no construction in the hinterland of the port allows the port to be designed by considering it together with the hinterland of the port, which is currently idle and the superstructure construction has not started.
- The North Aegean Highway was opened and reached a point 2 km from the port. Thanks to a port connected to the highway, the transportation and logistics problems of the wind energy equipment sector can be solved and the development of the sector can be accelerated.
- Port specialization and division of labor between regional ports is getting stronger throughout the world. The fact that there is an industrial development focused on renewable energy in the north of the city and that this sector needs special logistics opportunities in export and import supports the specialization potential of the port.
- • There is an opportunity to invest in a Clean Energy Specialized OIZ in the area associated with the port. In addition, the third free zone of İzmir (Western Anatolia Free Zone-BASBAŞ) is being established. The transportation and logistics problems of the wind energy equipment sector can create the potential that makes this region stand out for the sector in question.

FIGURE 27. Draft scheme of Çandarlı Port and integrated Wind Industry Specialized Industrial Zone investment (İZKA, 2022b)

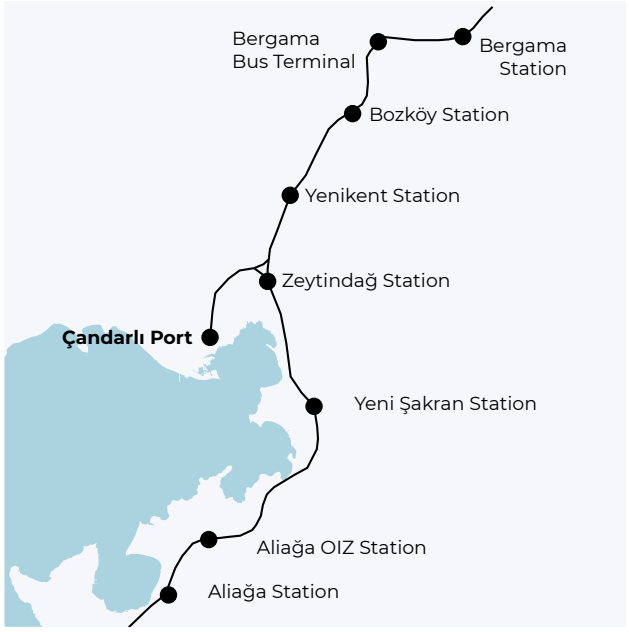
SPECIALIZED ORGANIZED INDUSTRIAL ZONE
Approximate area of 2,665,000 m²

1ST STAGE ÇANDARLI PORT
Approximate area of 1,000,000 m²

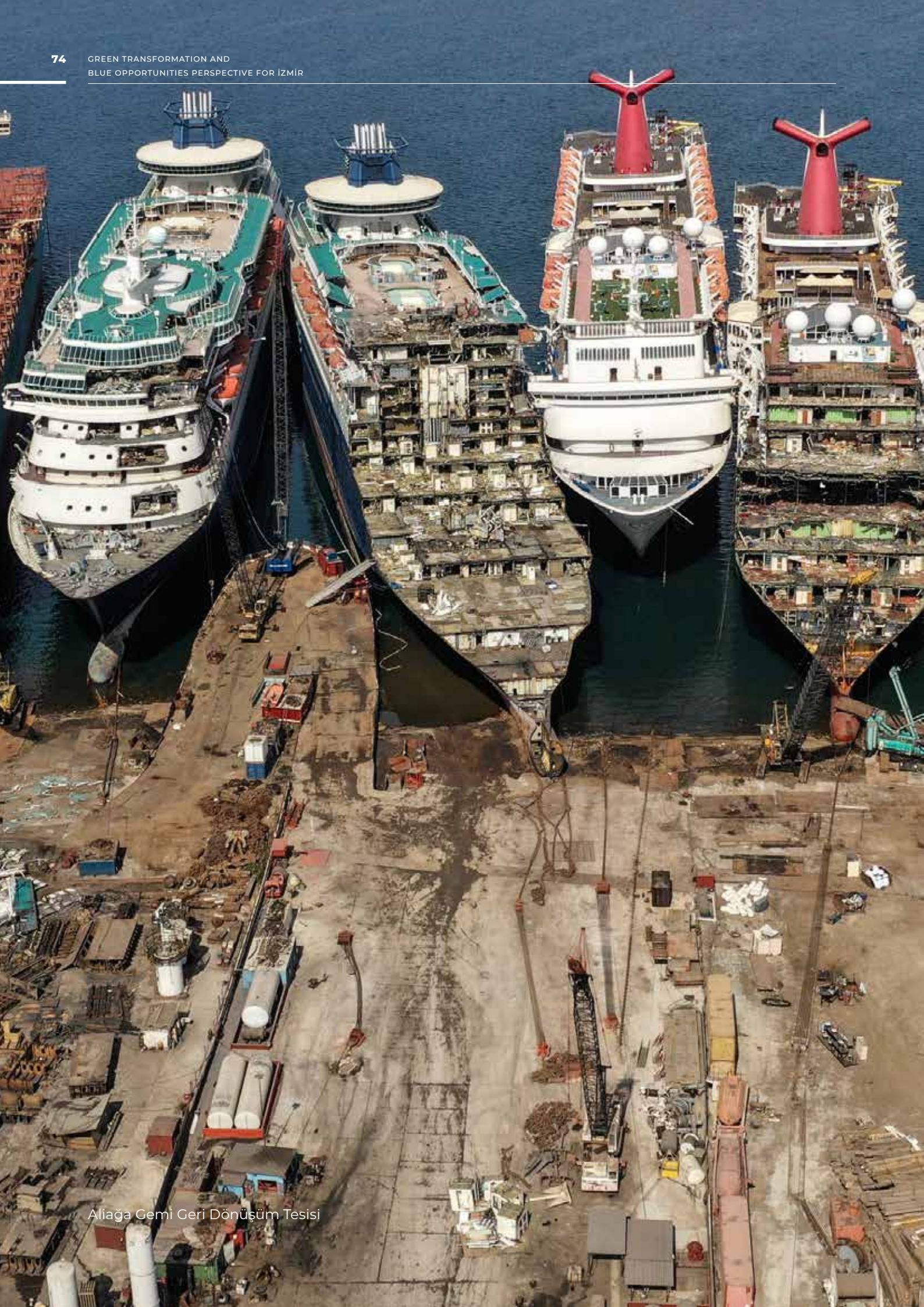
2ND STAGE ÇANDARLI PORT
Approximate area of 1,940,800 m²

Source: İZKA, 2022b

FIGURE 28. Aliağa-Çandarlı-Bergama Line railway project (TCDD, 2021)



Source: TCDD, 2021



Aliağa Gemi Geri Dönüşüm Tesisi

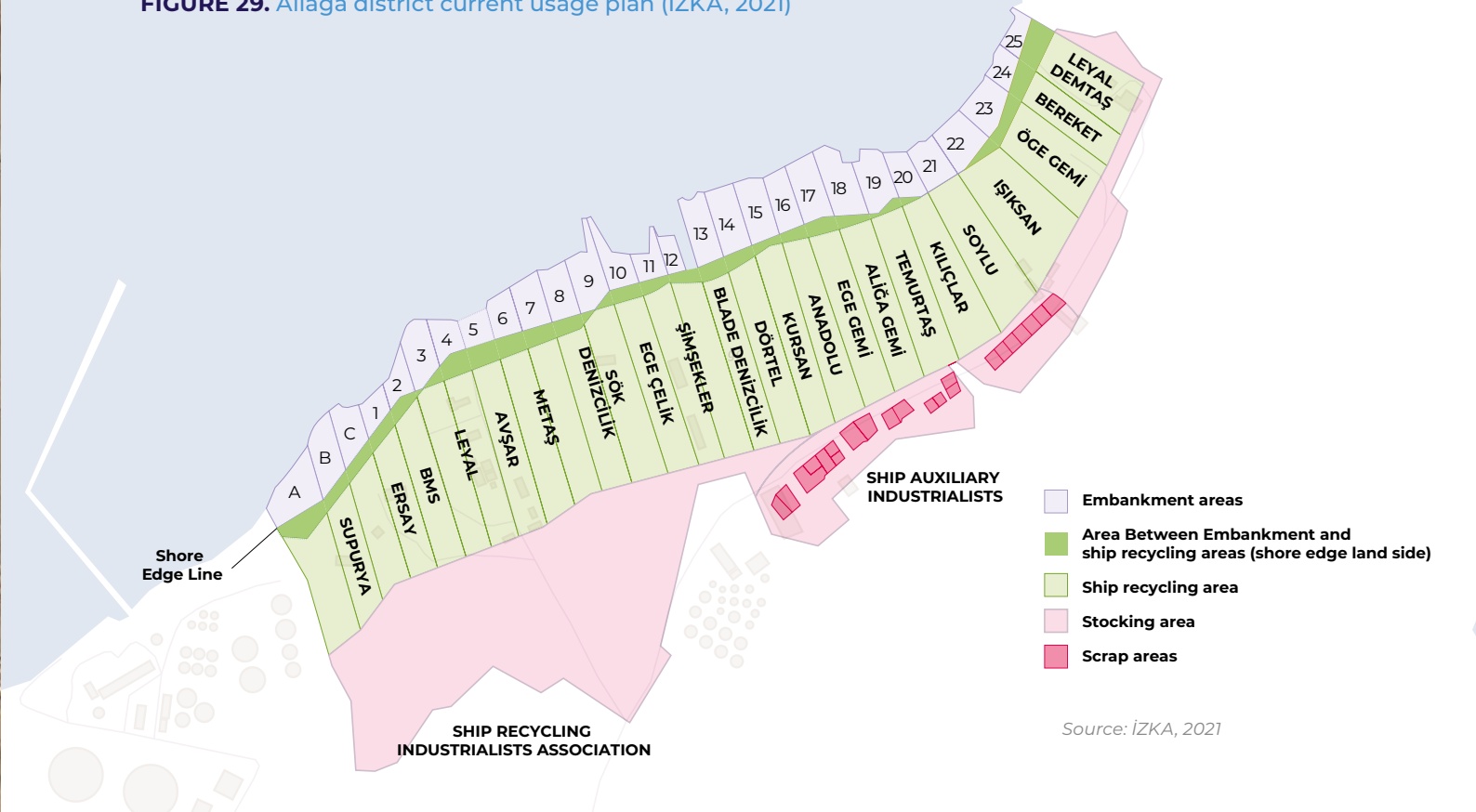
3.3.2. Ship Recycling

The most economical and environmentally friendly option for ships that have reached the end of their useful life is recycling. However, not applying the right methods, insufficiently developed environmental awareness or not taking the necessary precautions for safety lead to problems in the ship recycling sector. This situation necessitated the determination of international standards. While the international standards determined to reduce the negative effects of the sector on the environment and to protect human health have brought limitations on waste management, occupational health and safety and dismantling methods, they have also increased shipbreaking costs.

Due to the existence of strict environmental protection laws and regulations, the industry has moved from developed countries to developing countries. Worldwide, 599 ships were recycled in 2020, followd by 616 ships in 2019, and 745 ships in 2018. According to data based on empty displacement tonnage weight (LDT), it is observed that 35% of 599 ships are recycled in Bangladesh in 2020, followed by India and Pakistan with 33% and 15%. Turkey, on the other hand, is the fourth country in the recycling of ships with a share of 14%. Turkey is the only country in the Mediterranean region where ship recycling is carried out. In addition, unlike the countries with a large sector share (Bangladesh, India, Pakistan), Turkey meets the requirements of the EU Ship Recycling Regulation.

The ship recycling industry has added approximately $500 million in added value to the country's economy as of the year 2020 (İZKA, 2021). Officially only in the Aliağa region of İzmir, 22 companies in 28 parcels operate in the sector (Figure 29). 8 of the mentioned facilities have already been included in the European Commission Ship Breaking List by meeting the necessary criteria, and 9 facilities applied to be included in the list. As of the year 2020, 855,000 tons of ships were recycled on LDT basis in Aliağa Region. Although the number of ships converted in the last 10 years has shown a decreasing trend, the tonnage of ships tends to increase, over a fluctuating course (Figure 30).

FIGURE 29. Aliağa district current usage plan (İZKA, 2021)

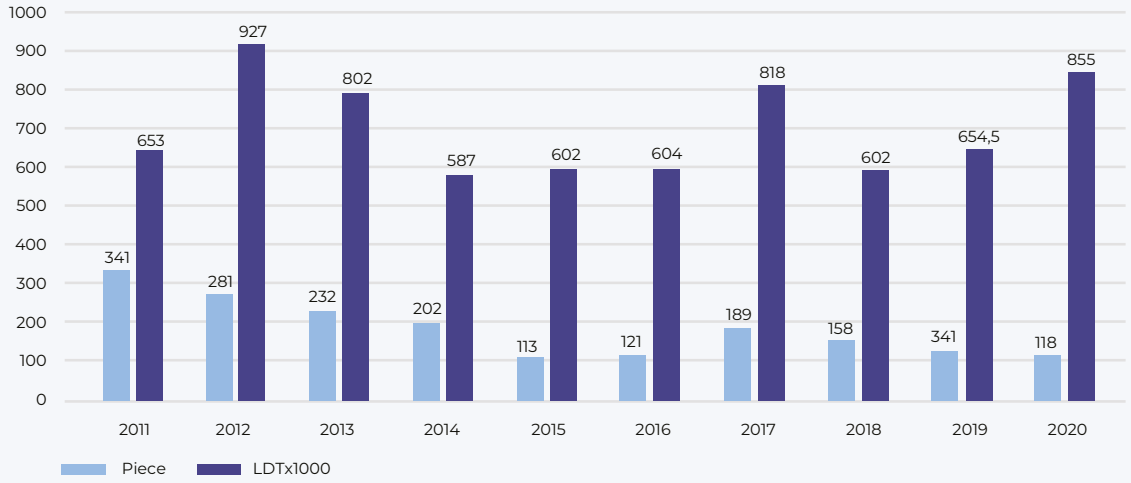


Source: İZKA, 2021

98% of scrapped ships contain steel. Except for the waste rate, 95% of this content consists of reusable materials. The recycling of steel, important in terms of raw materials for the iron and steel industry, provides significant energy savings. Since producing steel from the iron ore found limited in nature requires more energy than producing scrap steel, businesses prefer scrap steel in production.

In our country, 855,000 tons LDT was dismantled in 2020, and the steel obtained was sold as raw material to 8 iron and steel enterprises operating in İzmir (İzmir Development Agency, 2021). Factories located in regions outside of İzmir cannot supply shipbreaking scrap from the Aliağa Region due to high transportation costs, and all of the steel obtained from this sector is used in the region. It is estimated that around 790,000 tons of raw materials were supplied to the steel mills in the region thanks to 855,000 tons LDT ship recycling realized in 2020.

FIGURE 30. Ship recycling units and LDT in Turkey (DTO, 2021)



Source: DTO, 2021

Fundamental Issues and Opportunities

- "Ship Dismantling Regulation" was issuedunder the Basel Convention. The fact that the sector is subject to an international convention and is more controlled than the top three countries in the world regarding shipbreaking ensures that it is relatively superior in terms of environment and human health. On the other hand, due to the method of dismantling, the use of machinery and equipment and taxes, more costly dismantling is carried out compared to these other countries in the world where ship dismantling takes place intensively, which creates a competitive disadvantage. In order to achieve cost advantage, various efficiency-oriented interventions should be implemented.
- In 2019, substances such as crude oil derivatives, heavy metals, PAHs (polyaromatic hydrocarbons), TBT and dieldrin that cause environmental pollution were found to exist in Aliağa within the scope of the "Effects of Shipyards on the Marine Environment and Determination of Cleaner Production Techniques (TER-TEMİZ) Project" carried out by the Ministry of Environment, Urbanization and Climate Change.
- The sector has occupational accident risks such as falling from heights, fire, explosion, falling objects, jamming, and cable breakage. 25% of the 64 fatal occupational accidents that occurred in Aliağa between 2010 and 2018 were experienced in the Ship Recycling Sector, and a total of 16 people lost their lives in these accidents.

Interventions

Intervention 1. Replacing the oxy-propane gas cutting method with waterjet cutting

Oxy-propane gas cutting ignites rapidly, threatening occupational safety and worker health and causing carbon emissions. Cutting with water jet is the process of cutting with high pressure water. In a system where small size abrasive particles are added to the pressurized water, the water compressed to a pressure of approximately 4000 bar is used as a cutter by passing it through a nozzle with a small hole at the end. With this cutting method, there is no change in the mechanical and chemical properties of the material, and there is no risk of ignition at high temperatures. This system, which can be used to cut many thin and thick materials, also does not cause any gas emissions. Within the scope of the intervention developed in this direction, a cost/benefit analysis was conducted for using the water jet cutting method instead of the oxy-propane gas cutting method for the 22 ship recycling enterprises in Aliağa.

Intervention 2. Reducing the volume of wastewater collected by the grids on the coastline and preventing overflow on rainy days

A grid system is used to keep the oil, fuel and water leaking from the ships to prevent mixing with the sea during the ship dismantling operations. On rainy days when the capacity of this system becomes insufficient, oil-containing wastewater overflows into the sea. In addition, due to the large volume of wastewater, the cost of transportation to the treatment plant increases, and some companies may dump the wastewater into the sea instead of sending it for treatment in order to avoid transportation costs.

If a separator system is installed in addition to the grid system on the shoreline in the shipbreaking area, wastewater will be separated into two phases as oil and clean water, and the oil phase with reduced volume will be conveyed to the treatment plant with a lower transportation cost. In this context, significant gains will be achieved both economically and environmentally.

Intervention 3. Making the inspections related to the sector more effective

Marine water pollution occurs in case of leakage or seepage from the dismantled ships. For the control of marine pollution, the Provincial Directorate of Environment, Urbanization and Climate Change carries out inspections with drones; they take samples from marine water every six months and from the grids of enterprises at certain intervals, and analyze them. However, in case of contamination in the results of the samples taken, no penalty can be applied since the business responsible cannot be determined. Within the scope of the intervention developed in this direction, it is recommended to install a camera system that continuously monitors certain points in the coastal region in order to control marine pollution. Thanks to this system, it will be possible to quickly detect the marine pollution that will occur in the event of a leakage or seepage in the ships coming to dismantling. In addition, uninterrupted monitoring will ensure that the responsible enterprise is determined in a short time and that marine water pollution will be prevented by rapid intervention in leakage and seepage incidents.

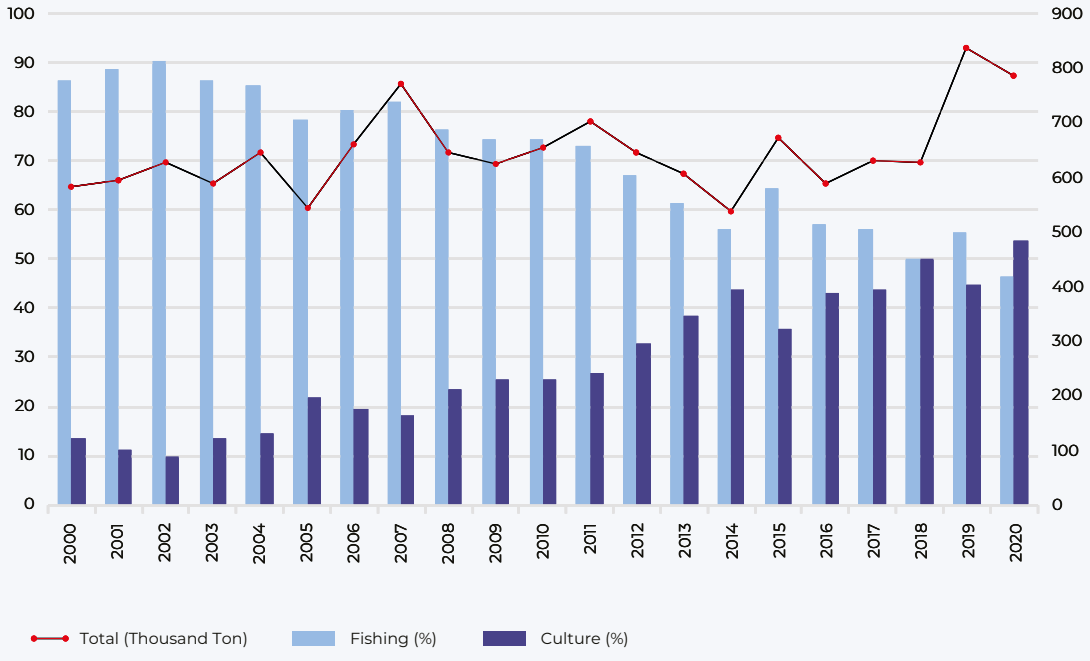
3.3.3. Aquaculture and Fishery

The production amounts of aquatic products around the world tend to increase in both fishing and aquaculture. Recently, it is observed that the rate of increase in aquaculture is higher than that of fishery. Between 2014 and 2018, the amount of aquaculture increased by 16.4% while the amount of fishing increased by 6.7%. The country with the largest share in the world according to the total production amounts in 2018 is the People's Republic of China with a share of 35%. The People's Republic of China is followed by Indonesia, India, Vietnam and Peru, respectively. Our country, on the other hand, ranks 12th with a production share of 0.35%.

Global fish production reached 178.5 million tons in 2018, corresponding to an increase of 3.3% compared to the previous year. 54% of the production in question was obtained from fishing and 46% from aquaculture. Approximately 88% of world fish production is used for direct human consumption, and the per capita annual consumption occurs to be approximately 20.5 kg. In Turkey, this rate is 6.1 kg (FAO, 2020).

Turkey's geographical location and available natural resources offer suitable opportunities for fisheries and aquaculture. The divergent characteristics of the seas in our country allow both fishing and aquaculture in these seas (TEPGE, 2021). While aquaculture production in our country comprised mostly of fishing in the past, in parallel with the developments in the world, the share of aquaculture in our country has increased over the years. In 2018, the share of fishing and aquaculture in total production reached the same point. Although aquaculture production increased by 19% in 2019 compared to the previous year, due to the abundant anchovy fished from the Eastern Black Sea region, production by fishing has exceeded this share (Figure 31).

FIGURE 31. Aquaculture production amounts and shares of fishery and aquaculture in Turkey (General Directorate of Fisheries and Aquaculture, 2021)



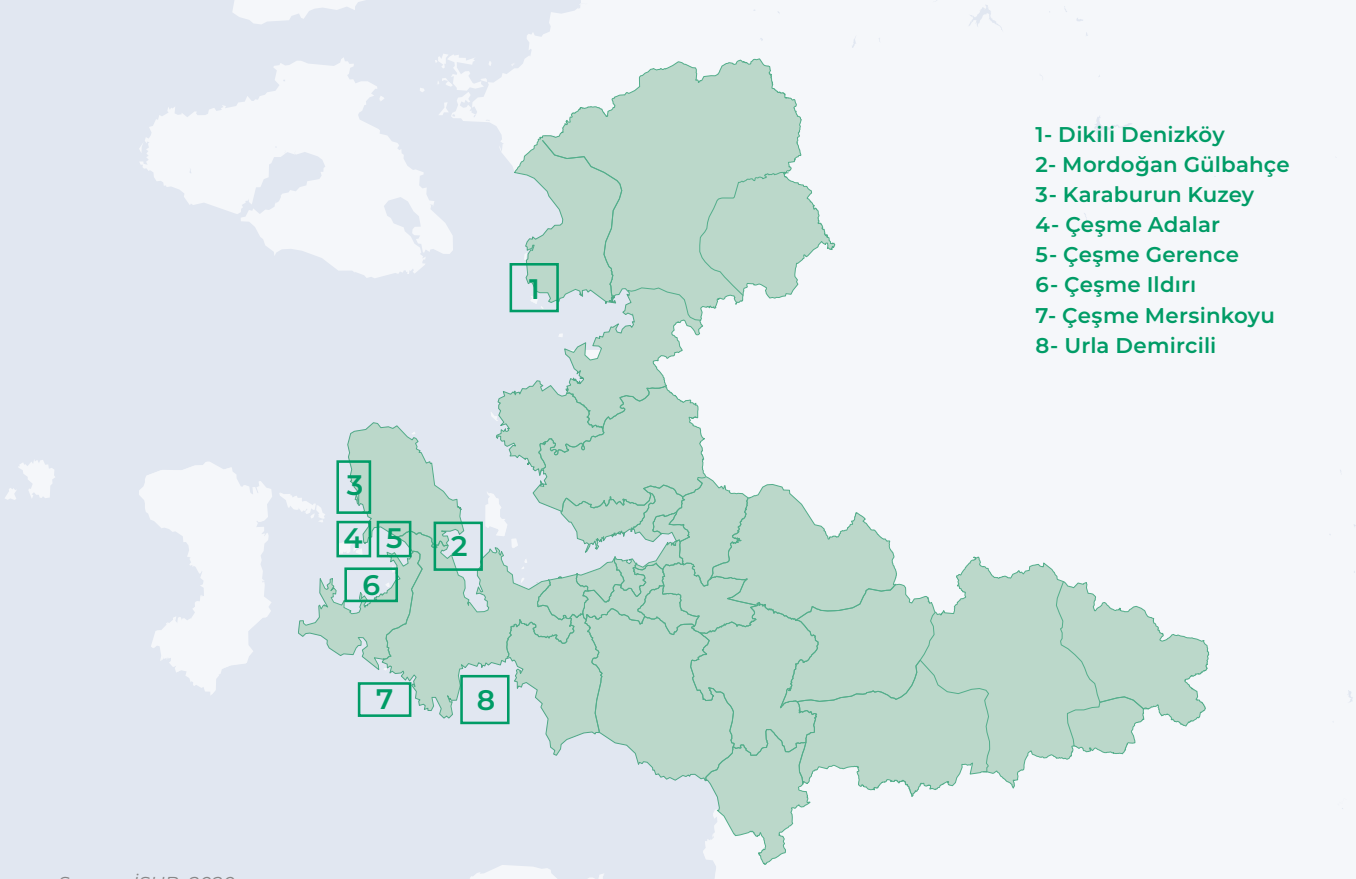
Source: General Directorate of Fisheries and Aquaculture, 2021, 2021

Similar to the worldwide production trend, Turkey's aquaculture production continues to increase and the share of aquaculture in total production is also on the rise. The role of our country in foreign trade in aquaculture is undeniable. It is evaluated that our country will become a pioneer in aquaculture and aquaculture production in terms of meeting the nutritional demands that will emerge in the world in the future.

The Black Sea Region stands out with a share of 80% in fishing among the seas of our country, followed by the Aegean Region with a share of 9.5%. In aquaculture, Muğla province ranks first with a share of 33.5% according to 2020 data. İzmir, which meets 23.6% of the total aquaculture production, ranks second after Muğla.

İzmir has a significant potential for aquaculture production with its 629 km long coastline. Aquaculture breeding constitutes an important part of the aquaculture production of the province, of which 17 districts have coastline. In the province, aquaculture farming is realized in 8 different areas in Dikili Denizköy, Mordoğan Gülbahçe, Karaburun Kuzey, Çeşme Adalar, Çeşme Gerence, Çeşme Ildırı, Çeşme Mersinkoy, and Urla Demircili, and mainly sea bass and sea bream are bred (Figure 32). With the intensive production of the said species in the Mediterranean and European countries, the competitiveness of İzmir in aquaculture decreases and this fact brings to the agenda the course of mixing new species into aquaculture activities. İzmir has the potential to be an important hub for blue biotechnology entrepreneurship with its richness in marine biodiversity, its faculties in the fields of fisheries, biotechnology, medicine, pharmacy, and life sciences, and its research centers and technology development zones.

FIGURE 32. Areas where aquaculture is carried out in İzmir (İSUB, 2020)



Source: İSUB, 2020

Interventions

Intervention 1. Meeting the needs for coastal logistics facilities and coastal structures

It is necessary to allocate necessary areas for the breeders in the fishery coastal structures, to create storage areas and to ensure cooperation and coordination between institutions, in order to be used in transporting fry and feed from the shore to the cages and bringing the products grown in the cages to land.

Intervention 2. Reducing prejudices about aquaculture produced in a culture environment with accurate and effective information

Promotional activities regarding the sharing of objective and scientific information and the healthy, nutritious and delicious quality of culture fish should be carried out, public service announcements, printed and visual materials should be prepared.

Intervention 3. Carrying out R&D activities for alternative feed use

R&D activities should be carried out for the use of alternative feed raw materials (plant species such as soybean, canola, cottonseed, sunflower seed, corn, hazelnut and red lentils, and micro and macro algae) in order for İzmir province to maintain its competitiveness in the aquaculture sector.

Intervention 4. Breeding of new species

R&D studies on the breeding and processing of new species and research on their marketing should be supported.

Intervention 5. Supporting blue biotechnology studies

Evaluating the potential of aquatic products to be transformed into high value-added products in the fields of medicine, cosmetics and food will provide important gains. In this field, obtaining biopolymer from shellfish, production of sea eggplant in culture environment and evaluation of collagen in different areas are observed to be prominent aspects in terms of supporting R&D and product commercialization activities.

Fundamental Issues and Opportunities

- **Providing living space for the personnel in aquaculture facilities, storing the feed, delivering feed to the cages, disembarking the harvested product, sorting the fish etc. logistics facilities are needed at the landing points in order to carry out aquaculture activities. Many fish farms do not have land facilities, as their land contact points are usually located in protected areas or areas where building permits are not granted. There is a lack of coastal logistics structures such as piers for the transportation of raw materials and harvested products.**
- **Another problem in the aquaculture sector is prejudices regarding aquaculture. As in some of the reasons put forward in the conflicts between aquaculture and tourism, etc., there are some prejudices about aquaculture in the public due to the belief that the fish contain chemicals (hormones, drugs etc.) and that the fish are unhealthy due to inactivity.**
- **One of the leading problems in the aquaculture sector is feed costs. Fishmeal production is decreasing due to the restrictions imposed for the protection of stocks in fishing, and thus it cannot meet the demand for ever-increasing aquaculture production and its price rises. Since the fishmeal and oil obtained in Turkey is not sufficient to meet the feed requirementit becomes unavoidable ro realize import for these products. This means foreign dependency in raw material supply and prices. In order to reduce foreign dependency, it will be necessary to catch more anchovies and sprats for fishmeal and oil production when it is desired to increase the hunting in the country. This will increase the pressure on stocks, and it will require a much larger proportion of anchovy, which could be used directly for human consumption as it is cheaper in price and rich in food content, to be used instead as feed in fish farms. Therefore, the issue has to be handled multidimensionally.**
- **The inadequacy of mixing of new species into breeding is another problem area that also includes an opportunity perspective. Within the scope of blue biotechnology, species such as algae, shellfish and sea eggplant offer significant opportunities.**

CHAPTER 4.

Transformation And Opportunity Gains

The economic, environmental and social impact of interventions for transformation in selected sectors in the opportunity/transformation fields of waste, water and energy has been revealed for the next ten-year period through an estimation study based on cost-benefit analysis. The gains and costs determined in the intervention scale for each sector under industry, agriculture and blue opportunities are presented in this section. These gains include the gains to be achieved through critical interventions to be implemented in the sectors. Critical interventions determined by a strategic selection method are selected solution proposals that can provide fast results and that prioritize the problems that the local seeks to solve immediately in the transformation of the sector.

In the gain calculations, certain assumptions and scenarios were made by considering the needs of the local in the light of the best techniques. In this direction, besides the interventions that complement each other, the interventions that should be implemented as alternatives to each other in the agriculture and industry sectors were determined and relevant gain calculations were conducted. At the stage of aggregation of the gains at the sector level, investments and gains are stated over the lowest and highest values instead of the sum of the interventions proposed in the relevant field

Aliağa, Tüpraş

4.1. Green Transformation in Industry

Sector / Field		INTERVENTION	GAINS			Total Cost
			Economic	Environmental	Social	
PROCESSING/STORAGE OF VEGETABLES AND FRUITS	WASTE	Reducing waste from fossil fuel consumption - Partial Conversion	▸ Reduction in coal-related energy costs by $240.8 million ▸ Reduction in solid waste landfill costs by $49.1 million	▸ 860 thousand tons of ash and slag waste reduction ▸ 470 thousand tons of CO_2 emission reduction ▸ 35,105 m^2 protected land area	▸ Annual emission reduction of 94 thousand people	▸ 450 thousand investment cost ▸ $113.8 million natural gas consumption expense
		Reducing waste from fossil fuel consumption - Full Conversion	▸ Reduction in coal-related energy costs by $240.8 million ▸ Reduction in solid waste landfill costs by $49.1 million	▸ 860 thousand tons of ash and slag waste reduction ▸ 940 thousand tons of CO_2 emission reduction ▸ 35 thousand m^2 of protected soil area	▸ Annual emission reduction of 188 thousand people	▸ 231.6 million investment cost ▸ $46.2 million operating expense
		Obtaining energy from organic wastes	▸ Reduction in energy costs by $6.8 million ▸ Reduction in solid waste storage costs by $18 million	▸ 68 million kWh energy savings ▸ 29.2 thousand tons of CO_2 emission reduction ▸ 13 thousand m^2 of protected soil area ▸ Utilization of 320 thousand tons of organic waste	▸ Annual emission reduction of 5.8 thousand people	▸ $6.3 million investment cost
		Fertilizer production from organic waste (compost)	▸ $16.7 million additional revenue ▸ Reduction in solid waste storage costs by $18 million	▸ Utilization of 320 thousand tons of organic waste ▸ 34.5 thousand tons of CO_2 emission reduction ▸ 13 thousand m^2 of protected soil area	▸ Annual emission reduction of 6.9 thousand people	▸ $500 thousand investment cost ▸ $2 million operating expense
	ENERGY	Insulation and heat recovery practices	▸ $49.4 million reduction in energy costs	▸ 494 million kWh energy savings ▸ 212.4 thousand tons of CO_2 emission reduction	▸ Annual emission reduction of 42.4 thousand people	▸ $9.6 million investment cost
		Automation applications and use of variable speed equipment in the production lines	▸ $3.6 million reduction in energy costs	▸ 36 million kWh energy savings ▸ 15.5 thousand tons of CO_2 emission reduction	▸ Annual emission reduction of 3.1 thousand people	▸ $1.9 million investment cost
PAPER AND CARDBOARD PRODUCTION	ENERGY	Improvement practices for the prevention of steam, heat and compressed air losses and leaks	▸ $31.2 million reduction in energy costs	▸ 177.1 million kWh energy savings ▸ 76.2 thousand tons of CO_2 emission reduction	▸ Annual emission reduction of 15.2 thousand people	▸ $2.1 million investment cost
		Replacing existing machinery and equipment with energy efficient models	▸ 60.5 million reduction in energy costs	▸ 343.7 million kWh energy savings ▸ 147.8 thousand tons of CO_2 emission reduction	▸ Annual emission reduction of 29.6 thousand people	▸ $10.8 million investment cost
		Roof SES Installation	▸ $31 million reduction in energy costs	▸ 176.1 million kWh energy savings ▸ 75.7 thousand tons of CO_2 emission reduction	▸ 1.2 thousand people employed ▸ Annual emission reduction of 15.1 thousand people	▸ $6.7 million investment cost
	WASTE	Utilization of production wastes for alternative raw material production	▸ $84.1 million reduction in energy costs ▸ $22 million reduction in solid waste storage costs	▸ 2.8 million tons of CO_2 emission reduction ▸ 386.6 thousand tons of waste reduction ▸ 15.8 thousand m^2 protected land area	▸ Annual emission reduction of 568.4 thousand people	
MATERIAL RECOVERY	WASTE	Cleaning the screens used during recycling by pyrolysis method	▸ $1.2 million raw material cost reduction ▸ $0.5 million worth of plastic recovery	▸ 1.4 thousand tons of waste reduction ▸ 2.1 thousand tons of CO_2 emission reduction	▸ Annual emission reduction of 432 people	▸ $379 thousand investment cost
	WATER	Replacing the recycling machine/process line with newer technologies	▸ $16.6 million reduction in water expenses	▸ 12.7 million m^3 water recovery	▸ Annual water needs recovery of 151.3 thousand people	▸ $28.8 million investment cost

Sector / Field		INTERVENTION	GAINS			Total Cost
			Economic	Environmental	Social	
VEGETABLE OIL PRODUCTION	WATER	Conversion of production systems from three to two phases in the olive oil industry	▸ 127.4 thousand-196.7 thousand $ reduction in water expenses	▸ 97.3 thousand-147.9 thousand m³ water savings ▸ 147.9-224.9 thousand m³ wastewater reduction ▸ Reducing 15.0-22.8 thousand tons of pollution load	▸ Annual water needs recovery of 1.2 - 1.8 thousand people ▸ Reducing the annual pollution load of 913 thousand people	▸ $1.5-2.3 million investment cost
		Use of steam condensing vacuum systems in vegetable oil production	▸ $3.4 - $4.9 million reduction in energy expenses ▸ (natural gas-coal)	▸ 190 thousand m³ wastewater reduction ▸ 2.3 million m³ of cooling water savings ▸ 14 - 38 thousand tons of CO_2 emission reduction (natural gas-coal)	▸ Annual emission reduction of 2.8-7.6 thousand people ▸ Annual water needs recovery of 27.4 thousand people	▸ $1.5 million investment cost
		Purification and reuse of black water with the combined system of Steam Condensing Evaporator-Membrane Treatment System-SES in pomace processing plants	▸ $1.8 - $2.4 million reduction in energy and water expenses	▸ 52.6 thousand m³ - 105 thousand m³of water recovery ▸ 8-16 thousand tons of pollution load reduction ▸ 2,4 - 4.4 thousand tons of CO_2 emission reduction	▸ Annual emission reduction of 0.5-0.9 thousand people ▸ Annual water needs recovery of 0.6-1.3 thousand people ▸ Annual pollution load reduction of 3.6-5.5 thousand people	▸ $0.8 - 1.4 million investment cost
		Recovery of process wastewater in vegetable oil production	▸ $18.4 million reduction in water expenses ▸ $7.2 million reduction in wastewater discharge expenses	▸ 14 million m³ of water recovery ▸ 115 thousand tons of pollution load reduction	▸ Annual water needs recovery of 167 thousand people ▸ Annual pollution load reduction of 6.8 thousand people	▸ $3.3 million investment cost ▸ $5.6 million operating costs
		Recovery of waste water in two-phase continuous system olive oil facilities	▸ $25.9 – $41.0 million reduction in energy and water costs	▸ 61-123 thousand m³ of water recovery ▸ 22.5 -40.4 thousand tons of CO_2 emission reduction	▸ Annual emission reduction of 4.5-8.1 thousand people ▸ Annual water needs recovery of 0.7-1.5 thousand people	▸ $3.3 - 5.3 million investment cost
MILK AND MILK PRODUCTS	WATER	Use of High Pressure Low Volume (HPLV) washing systems	▸ $2.9 million reduction in water expenses	▸ 2.2 million tons of water recovery	▸ Annual water needs recovery of 26 thousand people	▸ $907 thousand investment cost
		Cleaning in Place - CIP	▸ $4.3 million reduction in water expenses	▸ 3.3 million tons of water recovery	▸ Annual water needs recovery of 38.7 thousand people	▸ $4.7 million investment cost
		Realizing the recycling and reuse of collection water by installing reverse osmosis systems	▸ $25 million reduction in water expenses ▸ $7.4 million reduction in wastewater discharge costs	▸ 19.2 million tons of water recovery ▸ 76.7 thousand tons of pollution load reduction	▸ Annual water needs recovery of 228.7 thousand people ▸ Annual pollution load reduction of 4.7 million people	▸ $4.8 million investment cost ▸ $5.8 million operating costs
PLASTICS PRODUCTION	ENERGY	Realizing practices towards reducing heat loss in the processes	▸ $4.3 million reduction in energy costs	▸ 43 million kWh energy savings ▸ 18,5 thousand tons of CO_2 emission reduction	▸ Annual emission reduction of 3.7 thousand people	▸ $181 thousand investment cost
		Use of new technology in motors and drives	▸ 25.3 million reduction in energy costs	▸ 253 million kWh energy savings ▸ 109 thousand tons of CO_2 emission reduction	▸ Annual emission reduction of 22 thousand people	▸ $11.6 million investment cost
		Recovery of waste heat and use in cooling systems	▸ $5.8 million reduction in energy costs	▸ 58 million kWh energy savings ▸ 25 thousand tons of CO_2 emission reduction	▸ Annual emission reduction of 5 thousand people	▸ $2.6 million investment cost
		Taking insulation measures in the process line	▸ $9 million reduction in energy costs	▸ 90 million kWh energy savings ▸ 38.7 thousand tons of CO_2 emission reduction	▸ Annual emission reduction of 7.8 thousand people	▸ $623.7 thousand investment cost
		Insulation applications in compressed air systems	▸ $9.5 million reduction in energy costs	▸ 95 million kWh energy savings ▸ 41 tons of CO_2 emission reduction	▸ Annual emission reduction of 8 thousand people	▸ $ 140 thousand investment cost

It is seen that the interventions determined as a result of the sector studies conducted under the title of *Green Transformation* in Industry are aimed at; increasing the use of clean energy, value-added recycling practices, production and use of alternative raw materials, applications for ensuring energy and water efficiency, and high technology use. In the light of these interventions, it is estimated that the total economic gain to be achieved in the next ten years with the green transformation of İzmir industry in priority sectors will be $725 million in the best scenario. With the implementation of transformation interventions, it seems possible to prevent 1.6 million tons of waste before being generated, and to save 54 million m³ of water and 1.8 billion kWh of energy. Green transformation interventions in the industry, requiring a total investment cost of 338 million dollars, will be able to prevent 4.6 million tons of CO_2 equivalent greenhouse gas emissions. With the implementation of the interventions, the lowest and highest values of the gains that can be achieved in the fields of waste, water and energy are given in detail in the table below. Considering that the economic life of the investments proposed within the scope of the interventions is 15 years on average, the economic gain is estimated to reach $1 billion, the amount of waste and CO_2 equivalent greenhouse gas to be prevented before generated to reach 2.4 and 6.9 million tons, and water and energy to be saved to reach 81 million m³ and 2.7 billion kWh, respectively.

Sector		Spatial Focus	Investment Cost ($)	GAINS (10-Year)		
				Economic ($)*	Environmental	Social
WASTE	Processing and Storage of Vegetables/ Fruits	Kemalpaşa, Torbalı	1-238 million	▸ 209 -269 million	▸ 1.2 million tons of waste reduction ▸ 0.5 - 1 million tons of CO_2 emission reduction ▸ 48 thousand m² protected land area ▸ 68 million kWh energy savings	▸ Annual emission reduction of 100 -195 thousand people
	Paper and Cardboard Production	Kemalpaşa	-	▸ 106,1 million	▸ 387 thousand tons of waste reduction ▸ 2.8 million tons of CO_2 emission reduction ▸ 16 thousand m² protected land area	▸ Annual emission reduction of 568 thousand people
	Material Recovery	Bornova, Torbalı	379 thousand	▸ 1,7 million	▸ 1.4 thousand tons of waste reduction ▸ 2 thousand tons of CO_2 emission reduction	▸ Annual emission reduction of 432 people
WATER	Vegetable Oil Production	KMH, Çiğli, Aliağa	10,4-13,8 million	▸ 51-68.5 million	▸ 17 thousand m³ water savings ▸ 338-415 thousand m³ wastewater reduction ▸ 40-83 thousand tons of CO_2 emission reduction	▸ Annual emission reduction of 8-17 thousand people ▸ Annual recovery of water needs of 199 thousand people ▸ Reducing the annual pollution load of 7.7 million people
	Milk and Dairy Products Production	KMH, Menemen, Bornova	10,4 million	▸ 33.8 million	▸ 25 thousand m³ water saving ▸ 77 thousand tons of pollution load reduction	▸ Annual recovery of water needs of 293 thousand people ▸ Annual pollution load reduction of 4.7 million people
	Material Recovery	Bornova, Torbalı	28,8 million	▸ 16.6 million	▸ 12.7 million m³ water recovery	▸ Annual recovery of water needs of 151 thousand people
ENERGY	Processing and Storage of Vegetables/ Fruits	Kemalpaşa, Torbalı	11,5 million	▸ 53 million	▸ 228 thousand tons of CO_2 emission reduction ▸ 530 million kWh energy savings	▸ Annual emission reduction of 46 thousand people
	Paper Production	Kemalpaşa	19.6 million	▸ 122.7 million	▸ 300 thousand tons of CO_2 emission reduction ▸ 697 million kWh energy savings	▸ Annual emission reduction of 60 thousand people ▸ 1.2 thousand employment gain
	Plastics Production	Çiğli, Menemen, Torbalı, Kemalpaşa	15.1 million	▸ 53.9 million	▸ 232 thousand tons of CO_2 emission reduction ▸ 539 million kWh energy savings	▸ Annual emission reduction of 47 thousand people

** Economic gain calculations provide net gains calculated after deducting ten years of operating costs.*

Urla

4.2. Green Transformation in Agriculture

Sector / Field		Intervention	GAINS			Total Cost
			Economic	Environmental	Social	
BOVINE LIVESTOCK BREEDING	WASTE	Establishment of small-scale biogas facilities in enterprises with 50 or less bovine animals	▸ Savings of $422.4 million in energy expenses	▸ Improvement in soil with 1.93 million tons of fertilizer replacement ▸ Utilization of 8,11 million tons of animal waste ▸ Reducing 18.5 thousand tons of nitrogen and 2.01 thousand tons of phosphorus pollution from cattle manure ▸ Reducing coal consumption by 974.6 thousand tons with the use of biogas	▸ Disposal of nitrogen load equivalent to annual domestic wastewater of 4.6 million people ▸ Disposal of the phosphorus load equivalent to the annual domestic wastewater of 1.6 million people ▸ Annual emission reduction of 557 thousand people	▸ $101.7 million investment cost ▸ $87.3 million operating costs
		Establishment of specialized production zones for bovine livestock breeding activities	▸ $13.4 billion revenue generation	▸ Reducing 18.5 thousand tons of nitrogen and 2.01 thousand tons of phosphorus pollution from cattle manure ▸ Utilization of 8,11 million tons of animal waste ▸ Production of 267.9 million m^3 biogas from waste of which potential currently cannot be utilized ▸ 1.26 billion kWh reduction in fossil fuel-based electrical energy consumption	▸ Disposal of nitrogen load equivalent to annual domestic wastewater of 4.6 million people ▸ Disposal of the phosphorus load equivalent to the annual domestic wastewater of 1.6 million people ▸ Annual emission reduction of 50.4 thousand people	▸ $618 million investment cost ▸ $8.5 billion operating costs
	WATER	Development of ovine livestock breeding *	▸ $75.8 million revenue due to breeding 3 ovine animals instead of 1 bovine animal ▸ $114.6 million water cost reduction**	▸ 1.3 thousand hm^3 water savings due to the decrease in the demand for silage maize ▸ Prevention of 15.7 thousand tons of nitrogen and 2.4 thousand tons of phosphorus load originating from cattle breeding before being generated ▸ Reduction of 4.6 million tons of animal waste	▸ Water savings of 29.65% of İzmir's annual water potential ▸ Water savings of 135.60% of KMB's annual water potential ▸ Disposal of nitrogen load equivalent to annual domestic wastewater of 3.9 million people ▸ Disposal of phosphorus load equivalent to annual domestic wastewater of 1.8 million people	▸ $90.2 million initial investment cost
		Establishment of rainwater harvesting systems in enterprises with 50 or more bovine animals	▸ $10.7 million water cost reduction	▸ Protection of the 21.9 hm^3 water potential of the KMB	▸ Recovery of annual water needs of 2.6 million people	▸ $47.2 million initial investment cost

** The stated results are for raising sheep and goat instead of 307.661 cattle over 2 years old, in case of improvement of pasture areas in the KMB. While calculating the investment cost, the economic value of the existing cattle is deducted from the total investment cost. In cases where existing infrastructures can be used, the economic value of the existing cattle should be added to the gains section, ignoring the initial investment cost.*

*** The water price is calculated over the average of the water price determined for 1 m^3 of water by the unions using metering system.*

Sector / Field		Intervention	GAINS			Total Cost
			Economic	Environmental	Social	
FORAGE CROPS PRODUCTION	WATER	Effective use of water with drip irrigation system	▸ $102.1 million water cost reduction* ▸ $24 million reduction in irrigation electricity costs	▸ 1.2 thousand hm³ water savings ▸ 240 million kWh energy savings ▸ 106.4 thousand tons of CO_2 emission reduction	▸ Water saving at the rate of 26.4% of İzmir's annual water potential ▸ Water savings at the rate of 120.8% of the annual water potential of the Küçük Menderes Basin (KMB) ▸ Annual emission reduction of 21.3 thousand people	▸ $75.8 million investment cost ▸ $15.2 million maintenance cost
		Effective use of water with subsurface drip irrigation system	▸ $110.5 million water cost reduction* ▸ $26 million reduction in irrigation electricity costs	▸ 1,3 thousand hm³ water savings ▸ 260 million kWh energy savings ▸ 115.2 thousand tons of CO_2 emission reduction	▸ Water saving at the rate of 28.60% of İzmir's annual water potential ▸ Water savings at the rate of 130.8% of the annual water potential of the Küçük Menderes Basin ▸ Annual emission reduction of 23 thousand people	▸ $133.2 million investment cost ▸ $26.6 million maintenance cost
		Use of metering systems in the distribution of surface water resources	▸ $29.7 million increase in water revenue	▸ 140.9-222.5 hm³ water savings depending on the irrigation system used	▸ Water savings at the rate of 3.13% - 4.9% of İzmir's annual water potential ▸ Water savings of 14.3%-22.6% of the annual water potential of the Küçük Menderes Basin	▸ $5.4 million investment cost
	ENERGY - WASTE	Use of unmanned aerial vehicles in agricultural spraying	▸ $2.4 million reduction in energy costs ▸ $0.4 million reduction in water costs ▸ $3.8 million reduction in pesticide costs ▸ $83.5 million revenue with increased productivity	▸ 0.8 hm³ water saving ▸ 2.3 million liters of diesel fuel savings ▸ 34,3 tons reduction in pesticide consumption ▸ 5 thousand tons of CO_2 emission reduction	▸ Annual emission reduction of a thousand people ▸ Recovery of annual water needs of 10 thousand people	▸ $3.9 million investment cost
COTTON PRODUCTION	WATER	Effective use of water with drip irrigation system	▸ $7.3 million reduction in irrigation electricity costs ▸ $221.1 million additional revenue with increased productivity ▸ $39.7 million water cost reduction*	▸ 463.1 hm³ water savings ▸ 72.9 million kWh energy savings ▸ 32.3 thousand tons of CO_2 emission reduction	▸ Water savings at the rate of 10.3% of İzmir's annual water potential ▸ Water savings at the rate of 30.4% of the annual water potential of the Gediz Basin ▸ Annual emission reduction of 6.4 thousand people	▸ 28,4 milyon $ investment cost ▸ 5,7 milyon $ investment cost
		Effective use of water with subsurface drip irrigation system	▸ $8.1 million reduction in irrigation electricity costs ▸ $221.1 million additional revenue with increased productivity ▸ $44.3 million water cost reduction*	▸ 516.3 hm³ water savings ▸ 81.3 million kWh energy savings ▸ 36 thousand tons of CO_2 emission reduction	▸ Water savings at the rate of 11.5% of İzmir's annual water potential ▸ Water savings at the rate of 33.9% of the annual water potential of the Gediz Basin ▸ Annual emission reduction of 7.2 thousand people	▸ $60 million investment cost ▸ $12 million maintenance cost
		Cultivation of naturally colored cotton	▸ $10.6 million reduction in electricity costs in the manufacturing industry phase ▸ $16.1 million reduction in water costs in the manufacturing industry phase ▸ $2.7 billion additional revenue through the value increase of cotton	▸ 12.3 hm³ water savings ▸ 47.2 thousand tons of CO_2 emission reduction	▸ Recovery of annual water needs of 191.6 thousand people ▸ Annual emission reduction of 9.4 thousand people	▸ No additional investment required.
	ENERGY	Use of unmanned aerial vehicles in agricultural spraying	▸ $3.3 million reduction in energy costs ▸ $0.3 million reduction in water costs ▸ $18 million reduction in pesticide costs ▸ $72.2 million additional revenue with increased yield	▸ 0.6 hm³ water savings ▸ 1.6 million liters of diesel fuel savings ▸ 947.2 tons reduction in pesticide consumption ▸ 3.4 thousand tons of CO_2 emission reduction	▸ Recovery of annual water needs of 6.8 thousand people ▸ Annual emission reduction of 677 thousand people	▸ $1.7 million investment cost

In the sectoral evaluations under the title of *Green Transformation in Agriculture*, suggestions have been developed for the effective management and consumption of water, the development of alternative water sources, the planning of agricultural production activities according to the regional conditions and economic gains, the sustainable management of animal wastes, and the transition to high technology in production. In this direction, it is estimated that the total economic gain to be achieved in the next ten years with the interventions for İzmir's green transformation in agriculture will be $7.9 billion in the best scenario. As a result of the implementation of transformation interventions with a total investment cost of 907 million $, it seems possible to restore 12.7 million tons of animal waste to the economy and to protect 626 billion m³ of water. With the transformation, 341 million kWh of energy savings will be achieved in agricultural energy consumption, and 1.3 billion kWh of biogas energy will be produced. With green transformation interventions in agriculture, 2.9 million tons of CO_2 equivalent greenhouse gas emissions can be prevented. If the proposed investments can be used effectively in an average of 15 years, the amount of animal waste that can be recycled to the economy will potentially reach 19 million tons, the amount of water that can be protected will reach 939 billion m³, energy savings will reach 511.5 million kWh, and the biogas energy to be produced will be approximately 2 billion kWh.

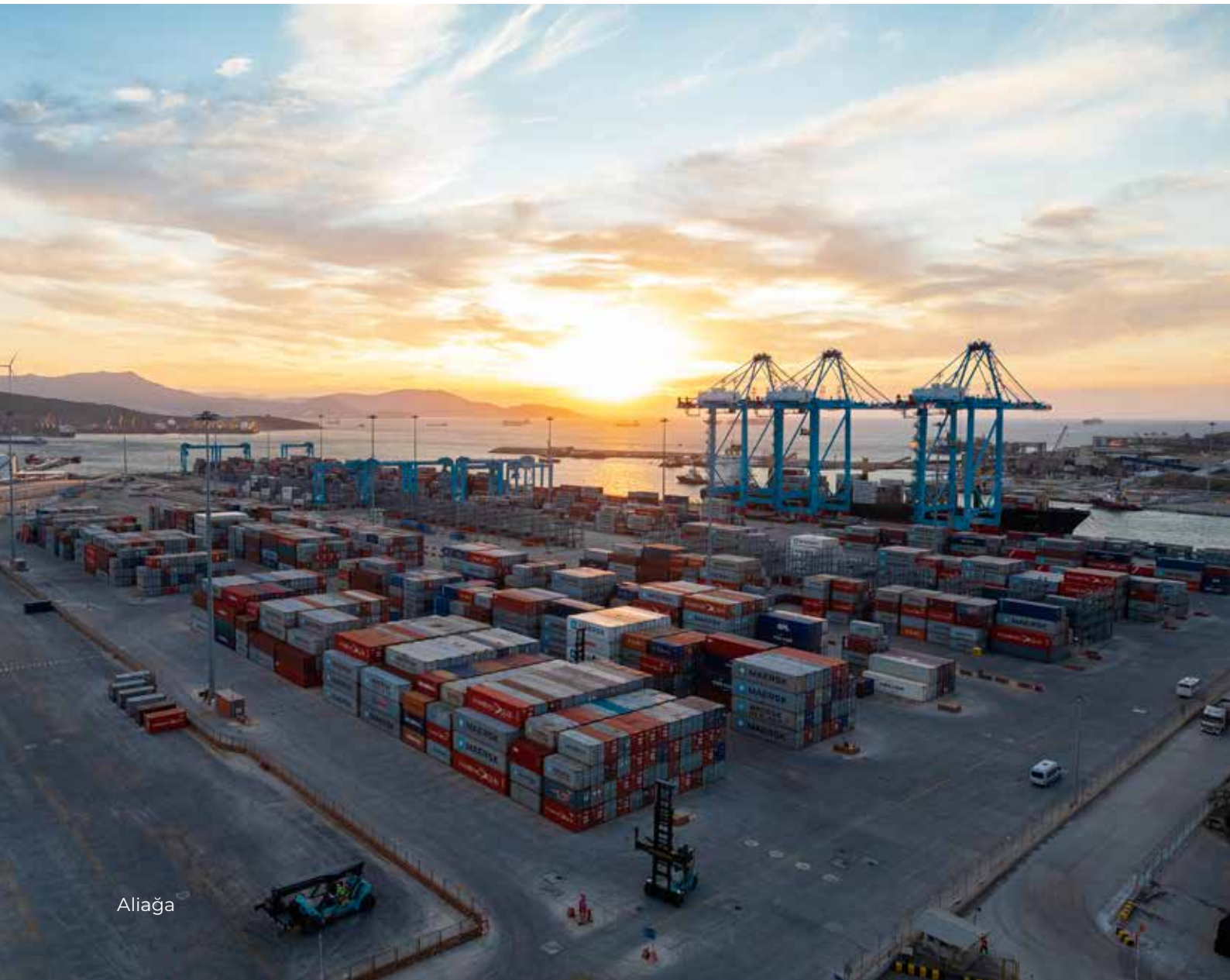
Sector		Spatial Focus	Investment Cost ($)	GAINS (10-Year)		
				Economic ($)*	Environmental	Social
WASTE	Bovine Livestock	Küçük Menderes Basin	▸ 101.7-618 million	▸ 335.1 million – 4.9 billion	▸ Soil improvement with 1.9 million tons of fertilizer replacement and reduction of 8.1 million tons of animal waste ▸ Preventing water and soil pollution caused by 18.5 thousand tons of nitrogen and 2 thousand tons of phosphorus ▸ 974.6 thousand tons of reduction in coal consumption ▸ 1.3 billion kWh reduction in fossil fuel-based electrical energy consumption	▸ 4.6 million equivalent persons nitrogen, 1.6 million equivalent persons phosphorus disposal ▸ 50.4 thousand - 557 thousand years of emission reduction
WATER	Bovine Livestock	Küçük Menderes Basin	▸ 47.2-90.2 million	▸ 10.7 – 190.4 million	▸ 21.9 - 1,336.7 hm³ water savings ▸ Preventing 15, 7 thousand tons of nitrogen and 2,4 thousand tons of phosphorus load ▸ 4.6 million tons of reduction in animal waste ▸ Protection of 29.7% of İzmir water potential and 135.6% of KMB water potential	▸ Recovery of annual water needs of 2.6 million people ▸ Preventing 9 million equivalent-person nitrogen, 1.8 million equivalent-person phosphorus load
	Forage Crops	Küçük Menderes Basin	▸ 5,4-133,2 million	▸ 29,7 – 110,9 million	▸ 140.9 – 1,331.8 hm³ water savings ▸ 240-260 million kWh energy savings ▸ Protection of 3.1-28.6% of İzmir water potential and 14.3-130.8% of KMB water potential	▸ Annual emission reduction of 21.3-23 thousand people
	Cotton	Menemen-Bergama	▸ 34,1-60 million	▸ 261,3 million – 2,5 billion	▸ 12.3- 463.1 hm³ water savings ▸ 32.3-47.2 thousand tons carbon emission reduction ▸ 72,9-81,3 million kWh energy savings ▸ Protection of 10.3-11.5% of İzmir water potential and 30.4-33.9% of Gediz Basin water potential	▸ Annual emission reduction of 6.5-9.4 thousand people ▸ Recovery of annual water needs of 191.6 thousand people
ENERGY	Forage Crops	Küçük Menderes Basin	▸ 3,9 million	▸ 90,2 million	▸ 0.8 hm³ water savings ▸ 2.3 million liters diesel fuel savings ▸ 34,3 tons reduction in pesticide consumption ▸ 5.0 thousand tons carbon emission reduction	▸ Annual emission reduction of a thousand people ▸ Recovery of annual water needs of 10 thousand people
	Cotton	Menemen-Bergama	▸ 1,7 million	▸ 93,8 million	▸ 0,6 hm³ water savings ▸ 1,6 million liters diesel fuel savings ▸ 947.2 tons reduction in pesticide consumption ▸ 3.4 thousand tons carbon emission reduction	▸ Annual carbon emission reduction of 677 people ▸ Recovery of annual water needs of 6.8 thousand people

** Economic gain calculations provide net gains calculated after deducting ten years of operating costs.*

4.3. Blue Opportunities

Sector / Field		Intervention	10-Year Gains			Total Cost
			Economic	Environmental	Social	
PORTS	**Revitalization of TCDD İzmir (Alsancak) Port**	Strengthening the capacity of TCDD İzmir Port	▸ $1,307 million increase in port revenues		▸ Employment of 700 people at the port ▸ Employment of 1.2 thousand people in non-port sectors	▸ $269.8 million infrastructure investment cost
		Realization of Kemalpaşa Logistics Center superstructure investment	▸ $200 million operating income		▸ Employment of 1.5 thousand people	▸ $67.7 million superstructure investment cost
		Establishment of the railway connection between TCDD Izmir Port and KLC	▸ 2 million TEU port handling capacity increase			▸ $162.5 million investment cost
	Restructuring of the North Aegean (Çandarlı) Port	Development of Çandarlı Port on the basis of wind energy	▸ $610 million increase in port revenues ▸ Increased wind equipment export revenues of $1,099 million ▸ Increased income tax revenues of $64.5 million		▸ Employment of 700 people at the port ▸ Employment of 8.5 thousand people in the wind energy equipment production sector	▸ $118 million investment cost
		Construction of the highway connection				▸ $13.5 million investment cost
		Clean Energy Specialized Organized Industrial Zone Investment	▸ Increase in wind equipment export revenues of $1,062 million ▸ Increase in income tax revenues of $64.5 million			▸ $66 million investment cost
		Construction of the railway connection				▸ $49.5 million investment cost
SHIP RECYCLING	**Development of the Rehabilitation Program**	Replacing the oxy-propane gas cutting method with waterjet cutting	▸ $2.9 million reduction in oxygen consumption cost ▸ $9.9 million reduction in acetylene consumption cost	▸ 139 thousand tons of reduction in CO_2 emissions ▸ 69 thousand tons of reduction in acetylene consumption	▸ Emission reduction of 70 thousand people ▸ Keeping 1400 people away from fire risk	▸ $450 thousand investment cost
		Reducing the volume of wastewater collected by the grids on the coastline and preventing overflow on rainy days	▸ $884 thousand reduction in transportation cost	▸ 11 tons of reduction in CO_2 emissions ▸ 396 thousand m^3 reduction in wastewater amount		▸ $220 thousand investment cost
		Establishment of a camera system that continuously monitors certain points in the coastal region	▸ $75 million reduction in petroleum contaminated shoreline cleanup cost	▸ Preventing 10 cases of petroleum marine pollution		▸ $12 thousand investment cost
AQUACULTURE AND FISHING	**Identifying Opportunity Areas**	Development of coastal logistics facility infrastructure				
		Carrying out R&D activities for alternative feed use				
		Breeding of new species				
		Supporting blue biotechnology studies				

Under the main heading of *Blue Opportunities*, two scenarios have been studied in the context of the port services sector and the goal of developing regional logistics infrastructure. In the first scenario, the restructuring of the Northern Aegean Port, of which construction activities are unfinished based on the export of wind energy equipment, and in the second scenario, the revitalization of Alsancak Port, the completion of the superstructure investment of the Kemalpaşa Logistics Center and the establishment of the railway connection between them are discussed including their benefit and cost analyses. It is observed that, in case the development scenario focusing on the North Aegean Port is realized, it will be possible to gain around $3.2 billion at a cost of $247 million over a ten-year period. As a result of the examinations and evaluations made for the ship recycling sector, measures to reduce the environmental risks created by the sector's activities are given priority. These measures are also associated with the improvement of occupational health and safety. As another mature sector in İzmir, meeting the needs of coastal logistics facilities and structures, conducting R&D activities for alternative feed use, breeding new species and supporting blue biotechnology studies have been identified as priority intervention areas in the aquaculture and fishing sector.



Aliağa

CHAPTER 5.

Regional Agenda On Implementation And Scope Expansion

In the perspective study, which was designed for a period of ten years, the sectors where the prominent problems and opportunities in the fields of waste, water and energy are connected and the places where they are accumulated are determined, and the priority interventions that will contribute to the achievement of the goals determined within the scope of the study and the benefits that will arise if these interventions are to be realized for these focal points, including their costs, are presented. In this way, it is aimed to present a practical framework for İzmir for the problems it needs to solve and the opportunities it needs to benefit from on the basis of the green and blue growth approach.

Taking action in accordance with the perspective put forward is possible with the management of a multi-dimensional, multi-layered and multi-actor process. The study presents an intervention framework that is open to improvement in strategic priority areas that are considered to be highly applicable and effective. However, there are different activities needed to be carried out with the high interest of the regional actors in order to realize these interventions and to ensure the green transformation at the regional level, and to benefit from the blue opportunities – in line the main purpose of the study. One of the main objectives of the study is to develop the agenda for further and in-depth studies, as well as programming the developed intervention perspective. In this context;

A) In order to put into practice the intervention framework put forward by the Green Transformation and Blue Opportunities Perspective for İzmir, studies of a different nature should be carried out.

Within the scope of the study, various interventions are developed for priority sectors, and the gains to be achieved if the interventions are to be implemented are determined. Due to data limitations, the interventions have been prepared within the framework of certain approaches and assumptions, and there may be positive or negative deviations from the targeted gains during the implementation phase. For this reason, it is critical to make pilot-scale implementations in every sector and monitor the gains during the implementation of the interventions. It is necessary to revise the potential gains according to the results obtained in the pilot-scale implementations, prioritize them according to the level of gain and return on investment, carry out studies, analysis, feasibility studies if necessary, and finally, generalization actions towards holistic transformation should be started. Focusing on interventions with a short response time during the prioritization phase will accelerate the generalization process by creating examples of success.

In line with the Port City İzmir theme, large-scale investments proposed for transportation and logistics infrastructures at the regional level are also prioritized in terms of realizing the perspective. Adopting and advancing research, feasibility and lobbying activities on these investment issues as a regional vision priority will play a strategic role in accelerating the transformation.

It is important for businesses to disseminate clean production actions and life cycle analysis studies, which will include measures in waste management, technology selection, resource efficiency, in order to implement the transformation immediately and in all relevant dimensions at the enterprise scale. On the other hand, for an effective waste management, waste strategies including appropriate methods and technologies for different types of wastes should be developed by considering the waste hierarchy according to the existing waste composition specific to İzmir.

While some of the interventions developed are for the investments by enterprises or producers, others require public investment. It is known that there will be a significant financing need during the generalization phase. In this context, besides making use of existing opportunities such as European Union funds, it will be necessary to ensure that other funding institutions and organizations focus their support on these interventions, and to develop green financing mechanisms.

The fight against climate change, as a policy framework, has started to take place in the basis of recovery plans for many countries, especially **after**

the Covid-19 pandemic, and significant funds have been created to achieve such goals. In order to realize İzmir's green transformation and blue opportunities targets, it is necessary to search for appropriate funding sources and develop resource utilization strategies. Within the scope of Horizon Europe Program Cluster: 6.9 billion Euros of support will be provided in the fields of Food, Bioeconomy, Natural Resources, Agriculture and Environment. The Program, which aims to ensure sustainability in the food chain, prevent environmental degradation, protect biodiversity, ensure water security and an economy in which natural resources are better managed, has the potential to create an important resource for the implementation of perspective interventions.

Interventions in the fields of energy and waste in different sectors provide both economic and environmental gains. However, the economic gain potential of the interventions in the water field is observed to be at a quite low level and likewise the return on investment is very long. This situation, which arises from the pricing policy of water, may result in the fact that the interventions developed in the field of water are not primarily preferred by producers or businesses. Therefore, interventions in the water field should be considered in the context of water's role as an asset management element in ensuring the continuity of economic activities, rather than prioritizing the short-term economic benefits of water recovery. In line with the prediction that the perspective of producers or businesses regarding interventions in the water field will be largely shaped by economic gains, the role of incentives in interventions at such point will be very critical. In this respect, financing mechanisms for the water field will need to be handled differently than for the energy and waste field, and these investments will need to be made more attractive. In the longer term, there is a need to measure and record the amount of water used by businesses and producers, to prevent unregistered uses, and to revise water pricing policies with an approach that increases the economic potential of investments in this area and shortens the return period. The realization of this revision in a manner that will significantly increase the competitiveness of businesses or producers providing water efficiency will contribute greatly to the protection of water resources.

The fact that the taxes levied on the unit price of electricity and fuel do not successfully serve to achieve the transformation targets and cannot be transferred to environmental support mechanisms in the current economic system is observed as an important constraint. The current taxation policy does not distinguish between taxpayers who contribute to green transformation goals and those who are energy intensive, have low resource efficiency and produce more waste. At this point, it is important to develop tools for taxation based on criteria and standards such as energy efficiency, water recovery, waste separation efficiency at source, and use of recycled materials.

Another important issue is the establishment of an administrative, technical and financial infrastructure for an inclusive industrial symbiosis network system that will operate institutionally and systematically for many years, in which businesses share their idle resources. The İzmir Resource Efficiency Program, carried out by our Agency in cooperation with UNDP, in order to develop an industrial symbiosis model unique to İzmir is an important step in this field. The center, which is planned to be implemented at the end of the program, is expected to play an accelerating role in the transition to green transformation by supporting the resource efficiency practices of businesses.

Green transformation and blue opportunities are expected to have significant impacts on the local labor market. In the transition to green growth, the decrease in labor demand, the conversion of job profiles and the necessity of new skills come to the fore with the effect of technological developments. However, with the emergence of new technologies and products, new jobs are being created and existing jobs are turning into greener jobs. Perspective study sectoral gain calculations give clues that interventions such as transition to innovative technology, recycling and productivity practices improve the skills of the current employment, but the employment creation effect is low. The effects of the dynamics that will

emerge in the labor market with the transformation, the qualifications, skills and sectors of the workforce, and the effects of the transition process on the social structure and employment should be analyzed**.**

Regarding the mentioned issues, it seems possible to list the activity titles that can be carried out by our Agency in the context of implementing and guiding the Green Transformation and Blue Opportunities Perspective for İzmir, as follows;

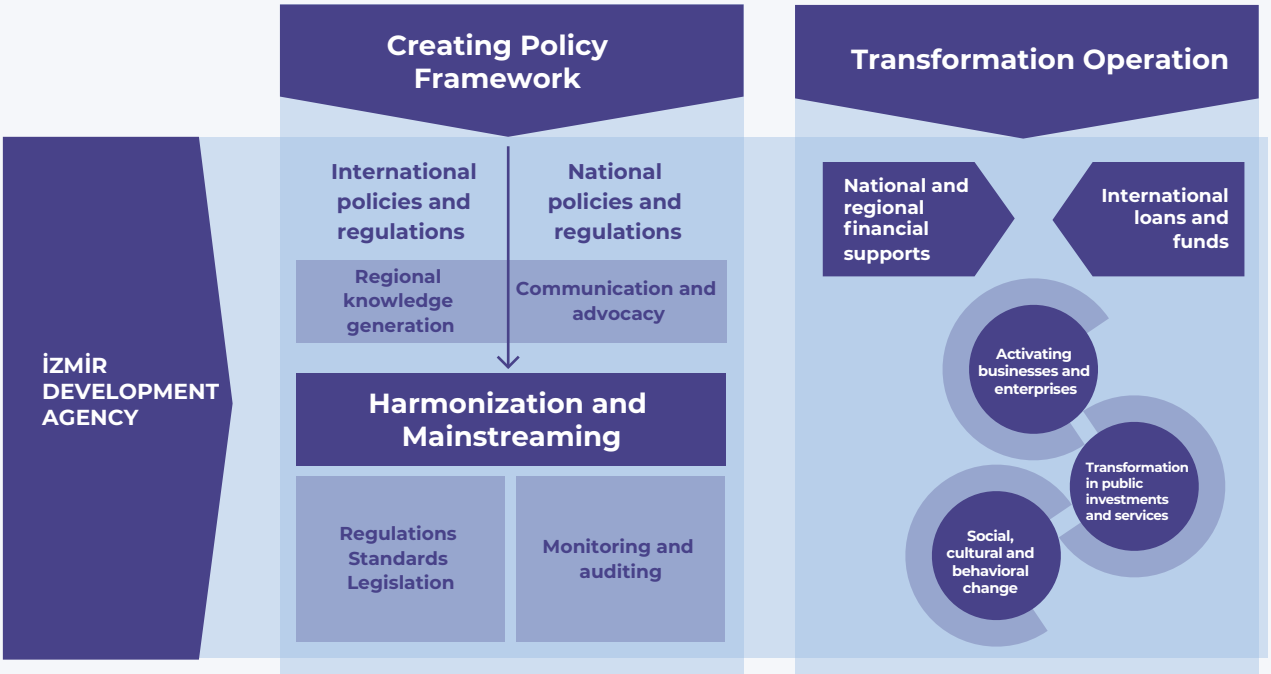
- Strategic investment projects (common infrastructures, pilots, etc.),
- Knowledge production (analysis, planning, study, feasibility),
- Carrying out preparatory studies for loan and fund opportunities,
- Developing cooperation models and ensuring coordination between the public, private sector and civil society (governance of transformation),

B) There are also issues that need to be taken into consideration regarding the dimensions that are excluded from the scope or focus of the perspective study and are not addressed in depth due to the limitations of the study or its strategic choices.

These are areas that will facilitate the realization of the intervention perspective put forward, increase its impact and expand the scope of transformation. Each of them are elements that should be considered in the integrity of research, analysis, planning and implementation, and can be considered as an agenda to strengthen the foundations of transformation and expand its scope together with both national and regional actors.

- Adaptation and mainstreaming:
  i. Developing proposals for regulations, standards, legislative arrangements
  ii. Developing recommendations for monitoring and evaluation structure and supervision, penalty and reward mechanisms

FIGURE 33. Structure for the implementation of the perspective



- Developing green financing mechanisms
- Developing green jobs and ensuring harmonization
- Determining the green and blue technologies that will be given priority to be developed in our region and programming such development
- Effective management of ecosystem services
- Conservation and development of biodiversity
- Developing sustainable mobility
- Development of sustainable food systems
- Studies to be conducted for social, cultural and behavioral changes (public, private, civil society-stakeholder governance)

In line with this basic approach in two separate but complementary activities, we, as İzmir Development Agency, position ourselves as to be responsible for both contributing to the production of knowledge, making financial contribution to the realization of strategic investments within the framework of possibilities, facilitating the benefit of the region from other loan and funding opportunities, and designing and coordinating the governance of this multi-actor process. When the implementation of the developed Green Transformation and Blue Opportunities Perspective and the other issues mentioned under (B) are taken into consideration together with their reflections in our region, certain responsibilities emerge at both central and local level. When considered together with the Agency's mission in this context, there may be a distribution of scope and responsibilities as outlined below at local and central levels. Hoping to increase our collaborations and carry our works further in the breakthrough that İzmir will realize in line with its green and blue growth approach...

AGENCY	LOCAL ACTORS	CENTRAL ADMINISTRATION
▸ Knowledge generation (analysis, planning, study, feasibility)	▸ Regulation, standard and legislation development studies at local level	▸ Regulation, standard and legislation development studies at national level
▸ Supporting pilots and joint infrastructure investments	▸ Compliance reviews	▸ Establishment of national measurement-monitoring, inspection, penalty/reward (pricing, taxation etc.) mechanisms
▸ Developing regional capacity to benefit from loan and funding opportunities and supporting preparatory studies	▸ Establishment of regional (İzmir) measurement-monitoring, inspection, penalty/reward (pricing, taxation etc.) mechanisms	▸ Realization of strategic joint infrastructure (transport & logistics, irrigation etc.) investments
▸ Mission on local-central cooperation and coordination	▸ Realization of joint infrastructure investments in resource efficiency and sustainable waste management	▸ Development of green financing infrastructure and mechanisms
	▸ Sustainable mobility planning and practices	▸ Information, awareness and diplomacy studies
	▸ Developing sustainable food systems	

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İZMİR DEVELOPMENT AGENCY

Megapol Çarşı Kule, Halkapınar Mahallesi,
1203/11. Sk. No: 5-7, Kat: 19, 35170 Konak/İzmir

T. +90 232 489 81 81 **F.** +90 232 489 85 05

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