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PREFACE 1

Dear Readers,

Since the inception of our journal, we have been privileged to present numerous research articles for your benefit. Now, it is with great pleasure that I introduce the first special issue of the Journal of Economics, Business and Finance Research, featuring articles from the "Green Deal, Sustainable Trade and Turkey's Integration" project. This project, supported by the Turkish National Agency under the Erasmus-Jean Monnet Module, has produced a wealth of valuable research, six articles of which are included in this special issue, presented to you as Volume 6, Special Issue 1. We take pride in publishing these meticulously reviewed articles under the theme of this special issue. I would like to extend my sincere gratitude to Prof. Dr. Rana Atabay Kuşçu, the project coordinator, and Gülsena Samsunlu, the project assistant, for their unwavering support throughout the publication process. I hope this special issue will serve as a valuable resource for the scientific, academic, and policy-making communities.

Best regards,

Assist. Prof. İrfan Ersin

Editor-in-Chief

PREFACE 2

Dear Readers, Academicians, and Researchers,

Within the scope of the EUTRADE Jean Monnet Module, supported by the European Commission, we have prepared a special issue: "Green Deal, Sustainable Trade, and Türkiye's Integration." The framework established by the European Union (EU) to combat the climate crisis and ensure sustainable development is increasingly impacting our lives. This framework, known as the European Green Deal, operates on three fundamental principles: environmental protection, economic growth, and social equality. As one of the EU's most significant trade partners, Türkiye is at the heart of this transformation process. While the EU is resolutely moving toward its goal of becoming the world's first carbon-neutral continent, Türkiye is positioning itself as a key stakeholder in this process. Efforts and initiatives toward green transformation and decarbonization are being implemented simultaneously.

Our project offers a comprehensive research platform to understand how these dynamics of change are reflected in the relations between Türkiye and the EU. The trade relations between the EU and Türkiye are examined through the lens of sustainability, and the impacts of the Green Deal on trade are evaluated. We hope that this issue, which we are publishing as an academic output of the project, will serve not only as an academic resource but also as a guide for policymakers, business leaders, and civil society organizations. The practical and current reflections of Türkiye's alignment process with the Green Deal in its trade with the EU are evaluated within this context. The articles in our journal address the direct and indirect effects of the European Green Deal on EU-Türkiye relations from various perspectives. The innovations brought by the Green Deal, sectoral changes, and the impacts of this transformation on the Turkish economy are among the focal points of this issue. As the project coordinator, I extend my sincere thanks to the esteemed authors, academicians, and researchers who have worked diligently at every stage of this special issue. I would also like to express my gratitude to the European Commission and the Journal of Economics, Business and Finance Research (EKİMAD) for their support in bringing this issue to life. I believe that our collaborative efforts will strengthen the cooperation between the EU and Türkiye and contribute to a sustainable future.

All our efforts are for a sustainable world; for the future of our country and our children…

Sincerely

Prof.Dr. Rana ATABAY KUŞÇU

EUTRADE Jean Monnet Module Project Coordinator

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REPowerEU As a Crisis Response: Immediate Diversification and Green Transition

Anıl Ömer Taydaş*

Abstract

The EU has been facing an energy crisis on behalf of Russia's invasion of Ukraine in February 2022. To substitute Russian fossil fuels, the EU has built its response on the European Green Deal (EGD), the REPowerEU plan. The plan has three main pillars: diversification of energy supplies, green energy investments, and promoting energy saving. The article focuses on the performance of the REPowerEU Plan by analyzing it both internally and externally. The article provides a background for how the REPowerEU Plan is built upon the EGD by examining the links between these two strategies. Then, the article focuses on these three pillars. First, the article provides an insight into the diversification policy by referencing LNG and pipeline agreements and critical raw material agreements for renewables. Second, the article provides an overview of the EU's green energy investments since the initiation of the REPowerEU Plan. Third, energy saving is analyzed through the internal practices of the EU. The article emphasizes that the REPowerEU plan entails a combination of short-term and long-term measures in the energy crisis response. Though the plan has contributed to the EGD's overarching goals in a broader context, its primary focus seems to secure the EU's energy demand. In this sense, the article draws a conclusion that underlines the imbalance between the green transition and the immediate needs.

Keywords: *REPowerEU, European Green Deal, Energy Geopolitics, The EU Climate Policy*

JEL Classification: *F5, Q01, N44, N74*

* Master's Degree (Graduate), Middle East Technical University, Institute of Social Sciences, International Relations, taydasanil@gmail.com , ORCID NO: 0009-0002-1031-8752

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Bir Kriz Yanıtı Olarak REPowerEU: Acil Çeşitlendirme ve Yeşil Geçiş

Öz

AB, Rusya'nın Şubat 2022'de Ukrayna'yı işgal etmesi nedeniyle bir enerji kriziyle karşı karşıya kalmıştır. AB, Rusya'nın fosil yakıtlarını ikame etmek için politik yanıtını REPowerEU Planı'nı oluşturarak Avrupa Yeşil Mutabakatı (AYM)) üzerine kurmuştur. Planın üç ana ayağı bulunmaktadır; enerji arzının çeşitlendirilmesi, yeşil enerji yatırımları ve enerji tasarrufunun teşvik edilmesi. Makale, REPowerEU Planı'nın hem dahili hem de harici olarak analiz ederek, planın performansına odaklanmaktadır. Makale, bu iki strateji arasındaki bağlantıları inceleyerek REPowerEU Planı'nın AYM üzerine nasıl inşa edildiğine dair bir arka plan sunmaktadır. Daha sonra makale planın üç ana sütuna odaklanmaktadır. İlk olarak, LNG ve boru hattı anlaşmalarına ve yenilenebilir enerji kaynaklarına yönelik kritik hammadde anlaşmalarına atıfta bulunarak çeşitlendirme politikasına dair bir perspektif sağlanmaktadır. İkinci olarak makale, REPowerEU Planı'nın başlatılmasından bu yana AB'nin yeşil enerji yatırımlarına genel bir bakış sunmaktadır. Son olarak, enerji tasarrufu AB'nin iç pratikleri üzerinden analiz edilmektedir. Makale, Planı'nın enerji krizine müdahalede kısa vadeli ve uzun vadeli önlemlerin bir kombinasyonunu içerdiğini vurgulamaktadır. Plan, AYM'nin kapsayıcı hedeflerine daha geniş bir bağlamda katkıda bulunsa da öncelikli odak noktasının AB'nin enerji talebini güvence altına almak olduğunu vurgulamaktadır. Bu anlamda makale, yeşil geçiş ile acil ihtiyaçlar arasında bir dengesizlik bulunduğu sonucuna varmaktadır.

Anahtar Kelimeler: *REPowerEU, Avrupa Yeşil Mutabakatı, Enerji Jeopolitiği, AB İklim Politikası*

JEL Sınıflandırması: *F5, Q01, N44, N74*

1. Introduction

The European Union (EU) has long been an active in environmental and climate change policy. Historically, the EU's involvement in environmental policy dates back to the 1972 Stockholm Conference, which caused the development of the EU's own Environmental Action Programmes (EAPs) through the years (Gravey et al., 2022). There have been seven successive EAPs that the EU has initiated over the years (Selin & VanDeveer, 2015), and the current 8th EAP has built upon the EGD and entered into force in 2022 (European Commission, 2022). Besides the EAPs, the EU has made consecutive changes and amendments in the EU Treaties in order to provide legal competency for environmental action, and climate change policies later on (Jordan et al., 2021). In time, with the increasing impact of scientific research and global public response, climate change has become a global issue in world politics. The EU has extended its environmental policy in a way that comprises climate change, in particular regarding the urgency of climate change issues. Since the initiation of the United Nations Framework Convention on Climate Change (UNFCC) in the 1992 Rio Conference, the EU has initiated ambitious policies, strategies, and norms and is often called as an exemplary climate leader through the years (Dupont et al., 2023). Initial policy of greenhouse gases (GHG) reductions under the UNFCC, and later the Kyoto Protocol, has extended an overarching target-setting and policy-making comprising a number of different sectors. In addition, the EU's environment and climate change policy has become compatible with the UN's Sustainable Development Goals (SDGs) and its predecessors. Thus, environment and climate change have become serious political concerns of the EU, both domestically and externally With the election of the Von der Leyen Commission in 2019, this political tendency has become a top policy priority. President Von der Leyen declared her agenda that the EGD is the top priority, with the ultimate goal of becoming the first climate-neutral continent by 2050 (Von der Leyen, 2019). In parallel to that, the EGD declared on 11 December 2019 with a European Commission (EC) Communication that outlines the EU's new growth strategy under four main goals towards at least 55% GHG emissions reduction by 2030 and becoming climate-neutral by 2050, compared to the 1990 GHG emissions levels (European Commission, 2019). These main pillars of the EGD are reaching net-zero GHG emissions gradually (1), decoupling the EU's economy from resource use (2), leaving no one behind through a

just transition (3), and leading global green transition via setting credible examples for others (4) (European Commission 2019). In other words, the EGD has environmental, economic, social and external dimensions. In this aspect, it could be argued that the EGD is compatible with the EU's environmental policy dynamics, which are Europeanization, internationalization, and policy integration (Gravey et al., 2022) and the UN SDGs (European Commission, 2019). The EGD has brought a large variety of cross-sectoral policies and legislative measures that aim to make the EGD targets legally binding. The most prominent example of this approach is the Fit for 55 Package proposal. Through this extensive package, the EC has proposed various cross-sectoral measures and a European Climate Law, which originally had a target of 50% (increased to 55% by the EC later on) GG emission reductions by 2030 and achieving climate neutrality by 2050 (European Commission, 2020). In addition, the EGD has its own financing mechanisms to make the strategy financially sustainable and feasible. The cross-sectoral policies, on the other hand, are extensive and diverse, from trade, industry, agriculture, biodiversity, chemicals, transport, urban mobility, circular economy, just transition, and social inclusion (European Commission, 2019). The EU mobilized its budget to meet these targets and initiated new finance mechanisms such as the Just Transition Mechanism and Fund (European Commission, 2019). Under this intensity of policies and strategies, green energy transformation is considered one of the pivotal policy options, according to the EC. In the original EGD Communication, the EC emphasized the central role of clean and affordable energy supply with the notion of "smart integration" and combined this integration with a broader energy security perspective (European Commission, 2019). In addition, the EC underlined energy efficiency, particularly for industrial energy use and buildings (European Commission, 2019). However, the original EGD Communication does not include any measures or mention of energy saving. Yet, it must be noted that this approach is mainly derived from the EGD's main characteristic of making economic growth greener and sustainable rather than employing a degrowth perspective through emission reduction policies. On behalf of this brief introduction, it might be argued that the Russian invasion of Ukraine in February 2022 is a turning point and a challenge for the survival and resilience of the whole EGD strategy. Russia has long been the EU's top energy provider, which caused an EU dependency on Russian fossil fuel supplies (European Council, 2023). The EU has explicitly opposed the Russian invasion and developed an active political stance with Ukraine since February 2022. This political opposition and explicit support to Ukraine inevitably caused an immediate reaction of disruption of the Russian fossil fuels supplies. Though the EU, via the EGD, has a strategy to reduce fossil fuels dependency gradually, the Russian invasion of Ukraine has made this phase-out a top priority and urgent. Hence, the EU immediately initiated the REPowerEU Plan in May 2022, which is built upon the EU's new growth strategy, the European Green Deal, to provide a response to this emerging energy crisis (European Commission, 2022a). The next section provides a qualitative analysis of the REPowerEU Plan and discussions in the existing literature by identifying its three main dimensions in detail. It also draws a perspective on the crisis response and green transition in a broader context.

2. The REPowerEU Plan

As mentioned earlier, the Russian invasion of Ukraine in February 2022 has affected the EU's green transition plans severely, mainly due to the EU's dependency on the Russian fossil fuels of gas, oil, and coal. According to the EC, this dependency equals 57-60% of the EU's total energy consumption between 2017-2022 (European Commission, 2022b). In more detail, before 2022, the EU was 45% in the gas sector, 40% in crude oil, and 27% in hard coal, dependent on Russia on an annual basis (European Commission, 2022b). The interruption in energy supplies from Russia has forced the EU to develop an urgent phase-out from Russian supplies against the emerging energy crisis. Accordingly, the EU initiated the REPowerEU Plan to diversify energy sources with the motto of "affordable, secure, and sustainable energy for Europe" in March 2022 (European Commission, 2022c). The final version of the REPowerEU Plan was published in May 2022, in which energy

saving was mentioned for the first time as a dimension of the strategy (European Commission, 2022a). According to the final version of the REPowerEU Plan, there are three main dimensions: diversification of energy supplies, improvement of green energy investments, and empowering EU citizens for energy saving (European Commission, 2022a). Besides, with the REPowerEU, the EU aimed to stabilize and provide various financial supports for energy prices, improve energy storage for the 2022-2023 winter season, and promote smart investments through National and European-level Energy Plans (European Commission, 2022a). These measures are estimated to be approximately €210 billion by 2027 under the EU's Recover and Resilience Facility (RRF) (Karda, 2023). To provide a more comprehensive outlook, the three dimensions of the REPowerEU Plan are discussed in detail in the following sub-sections.

2.1. Diversification of Energy Supplies

As mentioned earlier in this paper, the EU aims to end Russian dependency on fossil fuels and the overarching goal of phase-out from fossil fuels. In the REPowerEU context, diversification refers to varying the type and sources of energy import. Namely, the EU has aimed to import Liquified Natural Gas (LNG), biomethane, and renewable hydrogen from countries such as Qatar, the US, Egypt, Israel, UAE, Namibia, and Kazakhstan (Kardas, 2023). With this strategy, the EU aimed to keep its industry functioning and meet other sectoral energy demands, such as transportation and household energy. Also, the EU has formed an EU Energy Platform to coordinate collective gas, LNG, and hydrogen purchases for its member states through international outreach (European Commission, 2022d). In accordance with this approach, more than 130 energy agreements have been concluded at both the bilateral and the EU levels, including LNG, hydrogen, and natural gas other than Russian sources, since January 2022 (Dennison et al., 2023). Moreover, the EU aimed to provide nuclear fuel from non-Russian sources for the Member States are Bulgaria, Czechia, Finland, Hungary, Slovakia, and Poland, where such atomic power plants are used for either power generation or scientific research (European Commission, 2022a). Besides these measures, domestic natural gas production, where possible, has been promoted in the Plan's diversification section. (European Commission, 2022a). As a result of this diversification strategy, the EU claims that there is a reduction from 41% to 9% in Russian pipeline gas imports within the total EU imports between August 2021 and August 2022 (European Commission, 2022e). On the other hand, although it is not directly an energy source, critical raw materials (CRMs) are key in the green energy transition, in particular their use in renewable energy infrastructure and energy production processes. It means that there is a dependency on CRMs, and this dependency is perceived as a subject matter of the EU's diversification strategy. In this context, the EU has intended to conclude CRM agreements with foreign partners to secure its supply. For example, in June 2023, the EU initiated a strategic partnership with Brazil, including the CRM supplies as a part of a broader green transition and trade framework (European Commission, 2023). Therefore, it might be argued that energy diversification in terms of source and energy type is also a geopolitical security concern that involves various forms of negotiation, alliance-forming, and the ability to sustain partnerships abroad for the EU. Yet, this dimension of the REPowerEU is the short-term response to the energy crisis, as well as energy saving. In this context, the following section provides an insight into a more sustainable and long-term response, the green energy transformation of the EU.

2.2. Green Energy Investments

The second dimension, scaling up green energy investments, is the central and sustainable strategy toward the ultimate fossil fuels phase-out goal of the REPowerEU Plan. It is obvious that to execute such a transition, there has to be a viable, affordable, and sustainable alternative. In this context, the REPowerEU employs boosting renewables (including solar photovoltaics, wind energy, and heat pumps), promoting hydrogen imports and domestic production, and increasing sustainable biomethane production and use across the EU (European Commission, 2022a). In more detail, the

EU aims to increase its capacity to 1236 GW in renewables by 2030, 10 million tonnes of domestic production and 10 million tonnes of imports in hydrogen by 2030, and improve its production to 35 billion cubic meters (bcm) in biomethane by 2030 (European Commission, 2022a). Besides, via the plan, the EU aimed to improve electrification in the transport sector through legislative initiatives for zero-emission vehicles, promoting alternative fuels, and greening freight transport (European Commission, 2022a). As mentioned earlier in this paper, the leading energy consumer sectors of the EU are industry, households, and transport. While transport covers a large amount of energy consumption, fossil fuels in particular, it requires a complex, well-designed, all-encompassing transition. On the other hand, such an energy transition requires a prioritized investment strategy. The REPowerEU Plan titles this as a "smart investment" that entails €210 billion by 2027, as mentioned earlier. This estimated investment is composed of €113 billion for renewables, €56 billion for energy efficiency and heat pumps, €41 billion for phase-out in industry, €37 billion to increase biomethane production, €29 billion in the power grids to increase electricity use, €10 billion in LNG and pipeline gas imports, and €1.5-2 billion for oil supply security (European Commission, 2022f). Unlike diversification, "smart" investment has more long- and, at least, medium-term characteristics. Moreover, to sustain such a strategy, there has to be any external energy supply or CRM import shortages, future budget cuts, and shifts in the political will. Saving time and money for the necessary transition brings the discussion to one of the controversial aspects of the REPowerEU Plan, promoting energy saving, which is discussed in the next section.

2.3. Energy Saving

When the EGD Communication was released on 11 December 2019, one of the main goals was to reach climate neutrality gradually without causing economic damage to EU citizens. In other words, the EGD claimed that it is not a degrowth strategy. When the EGD is examined, it is seen that the strategy provides various well-designed responses for possible economic and social impacts. Yet, the energy crisis has also tested the EGD's sustainable growth approach. As mentioned in this article, energy saving has become a third dimension of the REPowerEU in its final version. Similar to diversification, energy saving is a short-term response. It is also called as "the quickest and cheapest way" to address the energy crisis (European Commission, 2022a). Similar to the whole plan, an urgent and long-term distinction is made for energy saving. In the short run, the EU aimed to reduce energy use by affecting consumer behaviors while employing energy efficiency measures in the long run (European Commission, 2022a). In energy saving, the EU, in cooperation with the International Energy Agency (IEA), has advocated a bunch of individual measures called "Playing My Part" as follows: turning down heating and using less air air-conditioning, adjusting boiler settings, working from home, reducing speed on highways, leaving individual cars at home on Sundays in large cities, walking or using bike for short journeys rather than driving car, using public transport, using train instead of plane (International Energy Agency, 2022). In energy efficiency, the EU pledged to increase its energy efficiency target to 13%, as declared in the Energy Efficiency Directive (European Commission, 2022a). On the other hand, the sustainability of energy saving policy is quite doubtful, depending on the possibility of a rise in public concerns and the diminishing willingness of EU citizens to save as time passes. Also, promoting energy saving could bring adverse effects on the economy, such as job losses and degrowth, which are also aimed to be prevented by the EGD strategy. A backlash in energy saving approach might be expected in time, which depends on the improvement of energy efficiency and the success of the fossil fuels phase-out.

3. Conclusion

The article has examined the three dimensions of the REPowerEU Plan by identifying to what extent they are politically, economically, and environmentally sustainable. At that point, it will be more plausible to perceive the REPowerEU as a transitional strategy towards not only green transition but also a broader geopolitical shift. As Siddi and Prandin (2023) underline, the EU's recent energy crisis

response was a geopolitical turn, which signifies developing narrower strategic partnerships with "like-minded" states rather than forming multilateral coalitions for collective action and prioritizing the EU's energy security. Besides, this shift is also visible in the official documents of the EU regarding the REPowerEU to the extent that around 40% percent coverage of security issues, whereas green transition covers around 27% (Wendler, 2023). In other words, climate action has become a component of the EU's geopolitical autonomy, as Wendler (2023) underlines. The EU's approach to diversification and securing supplies may even affect the existing power structures of the EU's foreign partners, such as in North Africa and the Middle Eastern countries (Engström, 2023). Yet, it must be noted that, unlike the 2009 and 2014 energy crises, the EU provided a response that encompasses climate objectives hand in hand with energy security (Giuli & Oberthür, 2023). While climate was being securitized, the evolving energy crisis also has a potential for carbon lock-in derived from high energy prices and relatively slow progress in green energy infrastructure (Homeyer et al., 2022). Such a lock-in may delay the transition and force the EU to continue energy and CRM imports from foreign partners (Siddi &Prandin, 2023). It is evident that as long as the Russia-Ukraine war continues, the EU may not be likely to shift its political stance against Russia. This means that the phase-out of fossil fuels, both from Russian sources and the whole, is the only viable policy option for the EU. The EU has already developed its climate framework through the EGD and made it a legally binding policy for the Union. Also, the REPowerEU provided cohesion in funding green transition and improved the fiscal capacity of the EU in the crisis response (Fama, 2023). In that sense, the EU is expected to sustain and fortify its green transition. Still, the Plan has limitations regarding short-term versus long-term dichotomy among its targets towards the fossil fuels phase-out. First, as emphasized throughout this article, diversification and energy saving are short-term policy instruments, and their political, economic, and social sustainability seem unlikely; in particular, upcoming elections are taken into consideration. As this article outlines, these two measures are employed to address the immediate needs of the EU. Second, improving and promoting green energy investments becomes the only long-term policy option, which is also coherent with the broader EU climate framework. On the other hand, it might be argued that the three dimensions of the REPowerEU are complementary and also contribute to the resilience of the EGD against the energy crisis from their own perspectives. Also, the REPowerEU signifies the flexibility and adaptability of the EGD, particularly the ability to shift policy priorities in response to geopolitical challenges.

CONTRIBUTION OF AUTHORS

This study was entirely conducted by Anıl Ömer Taydaş.

CONFLICT OF INTEREST DECLARATION

There is no financial conflict of interest with any institution, organization or person and there is no conflict of interest among the authors

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Research Article

The Effect of the European Green Deal on Turkish Maritime Transport Sector from a Legal Perspective

Halil Çeçen*

Abstract

The aim of the research is to review the contributions of the European Green Deal (EGD) and the acquis communautaire to the decarbonization targets of Turkish maritime transport sector. As the methodology of the research, a detailed and comparative analysis was followed by reviewing the legal documents both in the European Union (EU) law and Turkish law, international agreements and official statistical data. The main question of the research is to review how the compliance works of Türkiye with the acquis communautaire at the field of the decarbonization of Turkish maritime sector shapes the Turkish law based on EGD and Türkiye Green Deal Action Plan (TGDAP). Therefore, the paper is considered by the author, will contribute to the literature by delving into the recent developments. The decarbonization targets for the maritime transportation sector mentioned in the EGD have a significant impact on the decarbonization targets in the Turkish maritime which constitutes a significant field in TGDAP. It is concluded that the European Commission's Financing Agreement, which determines actions such as donating existing ships with renewable energy technologies, building new ships, and supplying alternative fuel infrastructure in port activities in Türkiye, shall also make significant contributions to the realization of the commitments given by Türkiye at the international agreements for the decarbonisation of maritime activities in the Mediterranean and Black Sea regions, respectively and shall increase the close cooperation between the Turkish authorities and the EU in combating climate change.

Keywords: *Greenhouse Gas Emissions, Decarbonisation of Maritime Activities, European Green Deal, Türkiye Green Deal Action Plan, Financing Agreement.*

JEL Classification: *K23, K32, K33.*

* Assoc. Prof. Dr., Nuh Naci Yazgan University, Faculty of Law, Department of Law, hcecen@nny.edu.tr ORCID NO: 0000-0001-5569-4511

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Avrupa Yeşil Mutabakatı'nın Türk Deniz Taşımacılığı Sektörüne Hukuki Açıdan Etkisi

Öz

Bu araştırmanın amacı, Avrupa Yeşil Mutabakatının (AYM) ve Avrupa Birliği müktesebatının Türk deniz ulaşım sektörünün karbonsuzlaştırma hedeflerine katkısının incelenmesidir. Araştırmanın metodolojisi olarak hem Avrupa Birliği hukuku hem de Türk hukukundaki yasal metinler, uluslararası anlaşmalar ve resmi istatistiki veriler incelenerek detaylı ve kapsamlı bir araştırma gerçekleştirilmiştir. Araştırmanın asıl sorusu, AYM ve Türkiye Yeşil Mutabakat Eylem Planı (TYMEP) temelinde Türk denizcilik sektörünün karbonsuzlaştırılmasına ilişkin olarak AB müktesebatına uyum çalışmalarının bu alanda Türk hukukunu nasıl şekillendirdiğini araştırmaktır. Bu sebeple yazar tarafından, güncel gelişmeler detaylı incelenerek, metnin literatüre katkı sağlaması hedeflenmektedir. AYM'de bahsedilen deniz ulaşım sektörü için karbonsuzlaştırma hedefleri, TYMEP'de önemli bir alanı oluşturan Türk denizciliğinde karbonsuzlaştırma hedeflerine önemli etkisi bulunmaktadır. Mevcut gemilerin yenilenebilir enerji teknolojileri ile donatılması, yeni gemilerin inşa edilmesi ve Türkiye'deki liman faaliyetlerinde alternatif yakıt altyapısı tedarikinin sağlanması gibi eylemleri belirleyen Avrupa Komisyonu'nun Finans Anlaşması, Türkiye tarafından ayrı ayrı hem Akdeniz hem de Karadeniz bölgelerindeki denizcilik faaliyetlerinin karbonsuzlaştırılması için uluslararası anlaşmalarda verilen taahhütlerin gerçekleştirilmesine önemli katkı sağlayacak ve iklim değişikliğiyle mücadelede Türk makamları ile AB arasındaki yakın işbirliğini de artıracaktır.

Anahtar Kelimeler: *Sera Gazı Emisyonları, Denizcilik Faaliyetlerinin Karbonsuzlaştırılması, Avrupa Yeşil Mutabakatı, Türkiye Yeşil Mutabakat Eylem Planı, Finans Anlaşması*

JEL Sınıflandırılması: *K23, K32, K33.*

1. Introduction

The European Green Deal (EGD), as a result of the works of the European Union (EU) to achieve the targets in the Paris Agreement, has been set out a clear vision for achieving the target of climate neutrality by 2050 (European Commission, 2019). On this basis, the European Climate Law (Regulation 2021/1119) has been adopted to ensure that all EU policies contribute to the goal of climate neutrality and that all sectors provide their contribution. In accordance with the European Climate Law, climate neutrality goal has been set in the EU by 2050 following the long-term temperature target specified in paragraph (a) of the Article 2(1) of the Paris Agreement. Action fields have also been determined in the transportation sector in the EGD, as all sectors will contribute to achieving the goals in the Paris Agreement.

Considering the current situation in the maritime sector in the EU, maritime transport constitutes 75% of the Union's foreign trade and 31% of its domestic trade (European Commission, 2023a). It was found out that there was a 36% increase in emissions from fossil fuels sold within the Union on voyages from one Member State to another Member State or to a third country since 1990 (Directive 2023/959, Recital 17). In addition, carbon dioxide emissions from maritime transportation constitute 3-4% of the Union's total emissions (Directive 2023/959, Recital 20). If this rate increases, the Union's goal of climate neutrality by 2050 will be jeopardized (European Commission, 2019). Thus, within the scope of the Paris Agreement and the EGD, the maritime sector has also taken a place among the sectors included in achieving the targets to decrease greenhouse gas (GHG) emissions (Ghoneim, et al., 2023; Bhattacharyya, et al., 2023).

Türkiye, which is a candidate country for the EU, also published a Turkish Green Deal Action Plan (TGDAP) compatible with the EDP within the framework of its efforts to harmonize with the a*cquis communautaire*. The relevant plan was prepared by the Ministry of Commerce and announced in 2021 (Ministry of Commerce, 2021). In this context, in line with the EGD, it is aimed to reduce emissions in transport sector at a level 90% in Türkiye by 2050. As an important development, it should be stated here that Türkiye, which were criticized for a long time for not signing the Paris Agreement (Alan, 2021), became a party to the Agreement and the Paris Agreement came into force in Turkish law by being published in the Official Journal of the Republic of Türkiye (OJRT) dated 7

October 2021 and numbered 31621. Therefore, the temperature targets in the Paris Agreement, which requires reducing GHG emissions, thus became a part of Turkish law. Attaining the targets of the Paris Agreement also requires the decarbonisation of all sectors, including maritime as stated in the TGDAP (Ministry of Commerce, 2021).

Based on the above-mentioned explanations, this research will examine the actions and targets carried out within the framework of the EGD and TGDAP on the decarbonization of the maritime sector in the EU and Türkiye, and in this context, the effects and contributions of the EGD on the decarbonization of the Turkish maritime will be reviewed.

2. Methodology

As this research delves into a comparative legal issue directed to find out the compatibility of Turkish law with the *acquis communautaire* regarding the decarbonization of maritime sector in terms of legal perspective, the effective documents in the EU law and Turkish law are reviewed in detail for this aim. And the studies in the field of law which covers the actions for decarbonising the maritime sector are analyzed.

3. Literature Review

In his research, Cecen analyzes the last legislation in the EU law regarding the decarbonization of maritime sector and their effect on Turkish law. In accordance with his research, in order to decarbonize the maritime sector in the EU, a series of different legislative documents were adopted. Among these legislative documents, the Regulation 2023/957 includes the maritime activities into the EU Emissions Trading System (ETS) which is a cornerstone mechanism for reducing the GHG emissions in most sectors in economy as Wang and the others, and Baştuğ and the others stated in their articles (Wang and the others, 2024:1; Baştuğ and the others, 2024:8). Another legislative document adopted to reduce GHG in maritime sector is the Directive 2023/959. The said Directive also includes important provisions regarding the inclusion of the maritime activities into the EU ETS. Not just the voyages of the ships and vessels between the ports located in the EU are included into the EU ETS in order to reduce the GHGs from their activities but also the voyages of the ships and vessels between the ports located in the EU and the ports located out of the EU are subject to "the allocation of allowances and the application of surrender requirements in respect of fifty percent of the emissions" from these voyages. And as an other important development in the EU law regarding the decarbonization of maritime sector is the adoption of the Regulation 2023/1805 as the formal version of FuelEU Maritime Initiative which limit the "GHG intensity of the energy used on board by a ship" during its voyage, from/to the ports located in the EU. These provisions have also effects on the ships and vessels in Turkish maritime sector which carry out activities to the ports located in the EU (Cecen, 2024:132). It would cost higher for shipping companies, including Turkish shipping companies, once they integrate their maritime transport activities into the EU ETS (Baştuğ and the others, 2024:8).

Malmborg is of the opinion that "the FuelEU Maritime is a way for the EU to gain first mover advantage in the transitioning of the maritime sector to carbon neutrality by 2050" (Malmborg, 2023:7). And according to Grzelakowski and the others, the FuelEU Maritime will "accelerate the production and implementation of new low-carbon fuels as soon as possible" (Grzelakowski and the others, 2022:6).

Yolcu also reviews the green implementation of EGD in logistics and claims that the EU, as a global actor in logistics, follows a strategy to trigger all the countries in the world to take action in green transformation of logistics and it will be very costly for Türkiye to realize green conversion in this field (Yolcu, 2023:141). But as Ozerdem assert in Customs Union will be an opportunity for Turkish companies comparing to the other trade partners of the EU such as Mexico and Vietnam in case that Türkiye follows a roadmap compatible with the EGD (Ozerdem, 2024:60-61).

Tunahan and the others make a research on the compatibility of Turkish logistics with the EU's "Fit for 55" (Tunahan and the others, 2023). As the researchers also stress in their article, the EU included the maritime activities into the EU ETS which also have effect on the voyages of the ships and vessels between the ports located in the EU and the ports located in third countries (Tunahan and the others, 2023:235). Tunahan and the others also allege that the second most affected country from the EU legislation in decarbonising the maritime sector among the trade partners of the EU would be Türkiye (Tunahan and the others, 2023:237) as a result of the fact that most of Turkish ships, which make voyages to the ports located in the EU, are part of ro-ro transport, the most GHGs emitting type in maritime transportation (Tunahan and the others, 2023:240). As the finding of their research on Turkish companies in logistic sector, their professional organisations and the related Turkish public authorities, the research reveals that the infrastructure lacks sufficiency and the roadmap is uncertain (Tunahan and the others, 2023:249). The similar findings may be read at the research of Kanberoglu and the others. They observed that "more than 60% of Turkish-fleet ships do not comply with the terms and conditions of the required reference line for the present" and "additional measures would also be taken such as energy saving devices or using of alternative fuels by shipowners, otherwise, the shipowners have no choice but to sell the vessel" (Kanberoglu and the others, 2023:726). Baştuğ and the others also find out in their research that "the availability of finance and of financial sources poses a significant barrier to the transformative journey towards a green shipping industry"and "funds are essential for financing the transition to cleaner technologies and infrastructure, while incentives provide motivation and rewards for shipowners and operators to enable them to make sustainable choices." (Baştuğ and the others; 2024:17).

4. Decarbonisation targets of Turkish maritime sector within the framework of Türkiye's Green Deal Action Plan

The maritime trade of Türkiye was approximately doubled from 2005 to 2015. Annual growth rate is 6,27%. This is because Turkish ports constitute important pillars in international trade. However, Turkish ports are also at an early stage in the sector's green conversion. Since fossil fuels are used as a power source in Turkish maritime activities, energy efficiency measures are also important to reduce CO_2 emissions from maritime activities (European Commission, 2021a).

In the EGD, it was stated that all sub-branches of the transportation sector, namely road, rail, aviation and maritime transportation, should contribute to the reduction in order to "*reduce emissions from transportation by 90% by 2050*" for the EU's climate neutrality target (Grzelakowski and the others, 2022:6). In this context, ending fossil fuel subsidies in maritime sector, expanding the EU Emissions Trading System (ETS) to the maritime sector and coordinating action at the global level with the International Maritime Organization (IMO) were counted among the priority actions. These priority actions aim to regulate the access of the most polluting ships to EU ports (European Commission, 2019; Adamowicz, 2022). And carbon revenues from shipping are also deemed as an effective tool to "support investments in zero-GHG bunker fuel infrastructure and vessels" additionally (Dominioni, 2023:4).

Sustainable and Smart Transport Strategy (SSTS) has been declared by the European Commission to decrease GHG emissions in the transportation sector, which is included in the EGD (Grzelakowski and the others, 2022:6). In the SSTS, the importance of the FuelEU Maritime initiative to increase sustainable maritime fuels was mentioned and it was also stated that the EU would work together with the IMO to determine concrete measures to achieve science-based global emission reduction targets in line with the Paris Agreement (European Commission, 2020).

In this context, in order to comply with the EGD, the policy to enhance the use of green vehicles has been included within the framework of TGDAP on the basis of the SSTS announced by the European Commission. It is noticed that, to achieve this goal, "the introduction of zero-emission vehicles in maritime transport, developing electric vehicle infrastructure, increasing the production/use of

sustainable and alternative fuels, pricing of transportation by taking into account its effects on the environment" are included. In addition, it was set in the TGDAP, as a goal, "to reduce GHG emissions in transportation by 90% by 2050 through creating an environmentally friendly, smart, competitive, safe, accessible and affordable transportation system" in line with the EGD (Ministry of Commerce, 2021).

Another important action field in TGDAP is the work on the development of green port practices. Green port practices are a project being practiced in Türkiye for a while by the General Directorate of Maritime Affairs under the Ministry of Transport and Infrastructure (MTI). After the practice principles regarding the Green Port project were announced in 2012, they were updated in accordance with the Green Port/Eco Port Cooperation Protocol signed with the Turkish Standards Institute on 16 December 2014 (Directorate General of Maritime Commerce, 2015). It was required for the port operator to obtain an operating permit or temporary operating permit in accordance with the "Regulation on Procedures and Principles for Granting Operating Permits to Coastal Facilities" dated 18 February 2007 and numbered 26438.

The relevant regulation has been updated and the "Regulation on the Issuance of Green Port Certificates for Coastal Facilities", which includes the principles of green port practices, came into force by being published in the OJRT dated 18 November 2023 and numbered 32373. By the adoption of the mentioned Regulation, it is aimed to extend and support the efforts to increase energy efficiency by reducing the environmental damage caused by ship and cargo operations of coastal facilities, and an important step has been taken to realize the strategy included TGDAP for putting the framework regarding the establishment of environmentally friendly, sustainable and competitive port facilities on a legal basis by promulgating the national legislation for green port certificate program.

Coastal facilities wishing to apply for a green port certificate within the scope of the relevant Regulation must submit the documents specified in Annex-4 to the competent administration. Among the documents specified in Annex-4, there are also additional documents that are important in terms of the strategies specified in the EGD and the TGDAP. In this context, the Renewable Energy Sources Guarantee Certificate (YEK-G) or International Green Energy Certificate (I-REC) provided by the supplier to prove that at least 5% of the energy consumption of the coastal facility is covered by electricity produced from renewable energy sources (RES) are among the mandatory documents.

In addition, the action fields include making exhaust emission measurements of vehicles using fossil fuels within the facility every year and not allowing vehicles without valid measurements to enter the facility. Necessary steps must be taken to reduce GHG emissions, ensuring that at least 50% of the energy consumed by the total main handling equipment of the facility is covered by electrical energy, carrying out the necessary infrastructure and superstructure work to provide electrical connection from the port to ships, establishing a Zero Waste Management System within the scope of the Regulation on Zero Waste and obtaining a Zero Waste Certificate.

Together with the green port practices, it is also followed to "establish a financial support mechanism for innovative technologies that will be used for environmentally friendly, sustainable and safe transportation in the ships and ports", as well as the establishment of relevant infrastructures, the construction of new ships which will work with low-emission alternative fuels or the conversion of existing ships in this way and "cold ironing" in port facilities (Ministry of Commerce, 2021; Baştuğ et al., 2024:9).

In line with the targets established in the TGDAP, the "Regulation on the Promotion of the Construction of New Ships to Replace Scrapped Turkish Flag Ships" was published in the OJRT dated 28 April 2021 and numbered 31468. According to the said Regulation, "a grant of 25% of the conversion cost is provided to ship owners who converts the power for the main engines of existing ships from fossil fuel to an alternative environmentally friendly energy source" (Ministry of Commerce, 2022).

Other important documents, which are supposed to be mentioned regarding the decarbonization of the Turkish maritime, are the Türkiye's Development Plans. In the Eleventh Development Plan (2019-2023), it was stated that Türkiye would "follow the green growth policy and transform the vessels used in long-distance passenger and vehicle transportation into environmentally and energy-friendly electric ships" and would "expand the sustainable green port practices" (Presidency of Strategy and Budget [PSB], 2019). The Twelfth Development Plan for the years 2024-2028, which includes the policies of Türkiye towards supporting the green conversion of Turkish maritime (PSB, 2023), are mentioned below:

- Increasing the number of green ports on the basis of digitalization and energy efficiency by developing the Turkish maritime merchant fleet (277)
- Continuing to support green port practices by encouraging the use of low-emission/non-emission-producing machinery and equipment to minimize environmental impacts by increasing energy efficiency in port operations (606.3.)
- Encouraging R&D studies for the dissemination of environmentally friendly, new generation sea and air vehicles (606.4.)

One last development, which should be stated at this point, is the preparation of a climate law in Turkish legal system. In its 2023 Türkiye Progress Report, the European Commission stated that Türkiye was about to adopt a climate law (European Commission, 2023b). The law mentioned by the European Commission is the Climate Change Bill.

Although there were several attempts to draft a climate law by the Ministry of Environment, Urbanization and Climate Change (MEUCC), the text of the draft law has not been officially promulgated or submitted to the Turkish Parliamentary yet. In spite of this, a draft text was revealed. In the draft text of the Climate Change Bill, it seems that the Bill includes the "reduction of GHG emissions in combating and adaptation to climate change and planning and implementation tools for these issues in line with the green development vision and net zero emission target", and important provisions regarding activities in the maritime transport are also included in the mentioned Bill. In particular, the MTI is delegated important powers and duties: In this context, with the provisions set out in the Bill, the MTI shall have the authority to "develop and extend the use of low or zero emission, energy efficient and alternative clean fuels in international and intercity passenger and freight transport by sea". The MTI also shall be responsible to "work towards decarbonising ports, maritime transport activities and all elements in the shipping value chain, developing zero-emission refueling and charging capabilities, deploying low- or zero-emission ships, creating green shipping corridors and taking the necessary measures for the adaptation of these sectors to climate change by determining the negative impacts of climate change on the transport and maritime sectors" (MEUCC, 2023). Particularly, creation of green shipping corridors, among one of the possible future task of the Turkish MTI in accordance with the draft text of Climate Change Bill of Türkiye, has become an important issue in decarbonisation of international maritime. The Clydebank Declaration at the 26th Conference of Parties in Glasgow in 2021 stresses the need to reduce the GHG emissions from international shipping also by decarbonising the logistics chain (Song et al., 2023:2). So, besides committing the creation of green shipping corridors at the Climate Change Bill, the MTI is delegated important duties in taking actions and putting these actions into effect in order to achieve green conversion and decarbonization of the Turkish maritime sector in line with the EGD (MEUCC, 2023) and Clydebank Declaration.

In addition, in case that the ETS in the draft law is established, one of the sectors which will be included in the system within the framework of compliance with the *acquis communautaire*, may be the maritime sector. The EU has already included the maritime activities into its ETS and has adopted the Regulation 2023/957 which regulates the inclusion of maritime activities into EU ETS. In this

context, including the Turkish maritime activities into the ETS, which is considered to be established in Türkiye, shall also contribute to fully comply with the related directives and regulations of the EU.

In the first part, it is concluded that in order to comply with the decarbonization targets in the maritime within the scope of the EGD, importance is given to decarbonization of the maritime in the TGDAP. The expansion of green port practices, which have been implemented in Türkiye for a while, constitutes one of the strategic goals expressed in both the TGDAP and the Twelfth Development Plan of Türkiye.

In the second part, the effects of the European Commission's decision titled "Implementing Decision on the financing of the annual action plan in favor of Türkiye for 2021", which will help decarbonize the Turkish maritime sector and its adaptation to the EGD, will be reviewed.

5. Decarbonisation targets of Turkish maritime sector within the framework of the "Implementing Decision on the financing of the annual action plan in favor of Türkiye for 2021"

Another important instrument regarding the decarbonization of Turkish maritime sector is the European Commission's "Implementing Decision of 16.12.2021 on the financing of the annual action plan in favour of Türkiye for 2021". The "Implementing Decision of 16.12.2021 on the financing of the annual action plan in favour of Türkiye for 2021" was regulated by the Commission on the basis of the "Implementing Decision of 10.12.2021 adopting the Instrument for Pre-Accession Assistance (IPA III) Programming Framework for the period 2021-2027" prepared based on the Article 9(1) of the "Regulation (EU) 2021/1529 of 15 September 2021 establishing the Instrument for Pre-Accession assistance (IPA III)".[1]

The section titled "Window 3: Green Agenda and Sustainable Connectivity" of the Implementing Decision of 10.12.2021 regulates the green conversion of the transportation sector, and prevention of marine pollution (European Commission, 2021b).[2] The financial framework of this section was set under the "Implementing Decision of 16.12.2021 on the financing of the annual action plan in favor of Türkiye for 2021". The fifth annex titled "Sustainable Green Energy and Transport" section of the "Implementing Decision of 16.12.2021 on the financing of the annual action plan in favor of Türkiye for 2021", includes important actions regarding the green conversion of the Turkish maritime sector and the financing of these actions (European Commission, 2021a).

One of the prominent actions stated in the Commission's Implementing Decision dated 16.12.2021, "Maritime Decarbonisation and Green Shipping Program", is the "retrofitting of old vessels and the construction of new vessels in order to own environmentally friendly, low-emission, energy-efficient maritime fleet". Another prominent action stipulated in the Commission's Implementing Decision is to "improve the supply of alternative fuel infrastructure to power port activities". In this context, strategies for decarbonization of Turkish maritime sector include reducing GHG emissions, deploying RES, and supporting climate resilient investments to promote energy efficiency and circular economy (European Commission, 2021a).

In its "Implementing Decision on the financing of the annual action plan in favor of Türkiye for 2021", the European Commission arranges the actions and fund allocation to be carried out for the green conversion of and decarbonization in the Turkish maritime in detail. This decision of the Commission, which contributes to the EGD in addition to the legal regulations in Turkish law, shall have an impact on the practices in Turkish maritime.

[1] The aim of the Regulation 2021/1529 is to "provide political, institutional, legal, administrative, social and economic support to the candidate countries, including Türkiye, in order to comply with the Union values" and "to progressively align to Union rules, standards, policies and practices in terms of future Union membership".
[2] It was stated by the Commission that this decision would also contribute to the European Green Deal due to its content.

Another contribution of the Commission's Implementing Decision is to the modernization of Turkish fleet. A significant part of the vessels in Turkish fleet is more than 20 years old in line with the research of Kanberoglu et al. (Kanberoglu et al., 2023:726) and of Tunahan et al. (Tunahan et al., 2023:240). In addition, vessels in the Turkish commercial fleet also need to be modernized by including new sustainable technologies. However, the "Turkish maritime industry has a key role for economic growth and acts as a catalyst for global trade" (European Commission, 2021a). At the same time, the transportation sector constituted 22.6% of the total GHG emissions in Türkiye in accordance with the National Inventory Report submitted to the UNFCCC in 2021 (Turkish Statistical Institute, 2021). And the maritime industry is considered to grow in the long term due to the increase in economic growth of Türkiye. Additionally, many seaports in Türkiye are vulnerable to climate change risks and lack energy efficiency (European Commission, 2021a).

Within the framework of the program, the required financial sources are provided as grants and loans by the European Bank for Reconstruction and Development (EBRD). Additionally, technical support and capacity development is also provided within the framework of the program. It is necessary here to express the contributions of the EBRD. The EBRD invested in Türkiye more than €17.3 billion (Sari, 2023). "Accelerating Türkiye's Green Economy Transformation and Regional Energy Connectivity" is also among EBRD's operational priorities. In addition to the 20 million Euro as an IPA contribution, it is expected to get a supplementary investment of 50 million Euros from the EBRD and the other funders. The projects on "the development of the bunkering of alternative fuel infrastructure with LNG, Bio-LNG, hydrogen and ammonia, the use of renewable equipment such as solar panels in port operations, and the use of zero or low emission vehicles in the coastal part of the port" will be supported with the funds provided by the EBRD. The "retrofitting of existing vessels and the construction of new green vessels" are also intended to realize the green conversion of maritime fleet and to create a sustainable marine environment. The EBRD also stated that the projects, which do not target to implement green transformation measures, would not be supported (European Commission, 2021a).

The contribution of the Commission's Implementing Decision to the policies of Türkiye in this context is also important. Firstly, Türkiye committed to decrease GHG emissions resulting from maritime activities at the international level. Türkiye approved IMO's MARPOL Annex VI in 2013, titled "Regulations for the Prevention of Air Pollution from Ships" (European Commission, 2021a). The IMO's GHG emissions reduction strategy in 2023 set the indicative checkpoints as "to reduce the total annual GHG emissions from international shipping by at least 20%, striving for 30%, by 2030, compared to 2008; and to reduce the total annual GHG emissions from international shipping by at least 70%, striving for 80%, by 2040, compared to 2008" (IMO, 2023; Grzelakowski et al., 2022:5). Türkiye also signed "the Ministerial Declaration of the Union for the Mediterranean on sustainable blue economy" (Union for the Mediterranean, 2021) and "the Bucharest Ministerial Declaration on the Common Maritime Agenda for the Black Sea" (Common Maritime Agenda for the Black Sea, 2019) to support the policies for "ensuring sustainable, climate-neutral and zero-pollution maritime transportation" in both the Mediterranean and the Black Sea. By signing the relevant declarations, Türkiye undertakes important commitments regarding the decarbonization of maritime in both the Mediterranean and the Black Sea. For instance, in order to promote the transformation of ship vessels and ports in the Mediterranean towards carbon-neutrality and zero pollution, the Ministers calls for "the specific needs and priorities of Mediterranean countries, including investments in the provision of Onshore Power Supply" and "the development of alternative fuels for ships, as well as investments in energy-saving technologies for port activities and an increase in infrastructure investments". The Ministers envisage "encouraging Mediterranean countries to actively cooperate and contribute to the implementation of joint projects in the provision of clean energy and technology" (Union for the Mediterranean, 2021).

Achieving the objectives within the framework of the Commission's Implementing Decision is only possible with the cooperation between the EU and Türkiye and the financial support of the EU, which Baştuğ et al. also believe that the availability of finance poses a significant barrier before a green shipping industry (Baştuğ et al.; 2024:17). The projects to be implemented will contribute to the creation of Turkish fleet of green ships and the management of the private sector in a climate-related manner. And it will gradually contribute to the environmentally friendly conversion of Turkish maritime activities and significantly improve the environmental performance of the region. Performing the Commission's Implementing Decision will take the relations between the EU and Türkiye further in maritime by ensuring progressively compliance of the Turkish regulations with the EU transportation policies and increase the sustainability and efficiency of Turkish maritime transportation.

The support provided to Turkish seaports, which considered an important pillar in international trade, by the Commission's "Implementing Decision of 16.12.2021 on the financing of the annual action plan in favour of Türkiye for 2021" within the framework of the IPA III program, shall not only ensure the decarbonization of the Turkish maritime transportation, but shall also enable the performance of the targets in the Twelfth Development Plan for the years 2024-2028 of Türkiye. The mentioned decision of the Commission will also contribute to the Paris Agreement targets and IMO strategies by reducing GHG emissions. Via the funds provided by EBRD under IPA III program, the compliance of the Turkish maritime transportation with the *acquis communautaire* will also be monitored.

6. Conclusion

In this research, the effects of the EGD on reducing GHG emissions from activities in the Turkish maritime were evaluated, taking into account the harmonization efforts with the *acquis communautaire*. In line with the targets of EGD, the inclusion of activities in transportation in the target of reducing total GHG emissions has also been accepted in TGDAP. Thus, it is aimed to decarbonize the Turkish maritime through actions such as the retrofitting of existing ships, the use of renewable energy in ports, and the dissemination of green port practices. In this regard, it was decided to provide support for the decarbonization of the Turkish maritime within the framework of the European Commission's "Implementing Decision of 16.12.2021 on the financing of the annual action plan in favour of Türkiye for 2021". The relevant fund will not only contribute to the targets of the EGD and TGDAP regarding the decarbonization of the maritime sectors in the EU and in Türkiye but will also ensure that Türkiye's international commitments regarding maritime activities in the Black Sea and the Mediterranean are fulfilled.

AUTHORS' CONTRIBUTION

All parts of this study are written by a single author.

STATEMENT OF CONFLICT OF INTEREST

I hereby confirm that there is no financial conflict of interest with any institution, organization or person, and there is no conflict of interest between the authors.

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Research Article

Green Transformation of the Real Sector in Türkiye: A priority Evaluation with DEMATEL Methodology

Kader Ulakçı[*] Serhat Yüksel[**] Hasan Dinçer[***] Serkan Eti[****] Hakan Kalkavan[*****]

Abstract

Increasing awareness of global changes in the natural environment, such as climate change and increasing biodiversity loss, has led to the concept of green transformation. Green transformation is a broad concept that includes objectives such as environmental sustainability, conservation of natural resources, combating climate change and ensuring energy efficiency. This study aims to examine the green transformation of the real sector in Türkiye and to rank the most effective strategies for transition to green transformation. It is aimed to rank the criteria that play the most role in the transition to green transformation and to offer solutions to the criteria. The critical success factors of the green transformation of the real sector in Türkiye are evaluated in line with the answers given by three expert opinions. The data obtained from the expert opinions were analyzed by DEMATEL method, which is one of the multi-criteria decision-making methods. In the study, the eight most frequently mentioned criteria in the literature were identified. In the study, the criteria for the green transformation of the real sector in Türkiye; increasing legal regulations for green transformation, increasing green financing opportunities, consumer preferences and behaviors, qualified workforce / green collars specialized in environmental issues, use of recyclable materials, increasing environmental social responsibility projects, combating air and environmental pollution, increasing investment in environmentally friendly energy resources factors were evaluated. As a result of the analysis, it was found that the most important criterion for the green transformation of the real sector in Türkiye is the need to increase legal regulations for green transformation. The second most important criterion for the green transformation of the real sector in Türkiye is to increase green financing opportunities for green transformation. Türkiye needs to achieve a more stable legal framework and more supportive financing opportunities to transition to green transformation.

Keywords: *Green Transformation, Real Sector, DEMATEL, Türkiye, Multi-Criteria Decision Making*

JEL Classification: *C19, Q59, O11*

[*] Master's Degree (Graduate), İstanbul Medipol University, Institute of Social Sciences, kader.ukalci@medipol.edu.tr ORCID NO: 0009-0003-7216-3714
[**] Prof.Dr., Istanbul Medipol University, Faculty of Business and Management Sciences, serhatyuksel@medipol.edu.tr ORCID NO: 0000-0002-9858-1266
[***] Prof.Dr., Istanbul Medipol University, Faculty of Business and Management Sciences, hdincer@medipol.edu.tr ORCID NO: 0000-0002-8072-031X
[****] Assoc. Prof. Dr., Istanbul Medipol University, IMU Vocational School, seti@medipol.edu.tr ORCID NO: 0000-0002-4791-4091
[*****] Assoc. Prof. Dr., Istanbul Medeniyet University, Faculty of Political Sciences, hakan.kalkavan@medeniyet.edu.tr ORCID NO: 0000-0003-4482-0505

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Türkiye'de Reel Sektörün Yeşil Dönüşümü: DEMATEL Metodolojisi ile Öncelikli Bir Değerlendirme

Öz

İklim değişikliği ve artan biyolojik çeşitlilik kaybı gibi doğal çevredeki küresel değişimlere ilişkin farkındalığın artması, yeşil dönüşüm kavramının ortaya çıkmasına neden olmuştur. Yeşil dönüşüm, çevresel sürdürülebilirlik, doğal kaynakların korunması, iklim değişikliğiyle mücadele ve enerji verimliliğinin sağlanması gibi hedefleri içeren geniş bir kavramdır. Sürdürülebilir bir yeşil dönüşüm, bu zorlukları azaltmak ve faydaları en üst düzeye çıkarmak için dengeli ve kapsamlı politikalar gerektirir. Bu çalışma, Türkiye'de reel sektörün yeşil dönüşümünü incelemeyi ve yeşil dönüşüme geçiş için en etkili stratejileri sıralamayı amaçlamaktadır. Yeşil dönüşüme geçişte en fazla rol oynayan kriterleri sıralamak ve kriterlere yönelik çözüm önerileri sunmak amaçlanmaktadır. Türkiye'de reel sektörün yeşil dönüşümünün kritik başarı faktörleri, üç uzman görüşünün verdiği yanıtlar doğrultusunda değerlendirilmiştir. Uzman görüşlerinden elde edilen veriler, çok kriterli karar alma yöntemlerinden biri olan DEMATEL yöntemi ile analiz edilmiştir. Çalışmada, literatürde en sık belirtilen sekiz kriter belirlenmiştir. Çalışmada, Türkiye'de reel sektörün yeşil dönüşümü için kriterler; Yeşil dönüşüm için yasal düzenlemelerin artırılması, yeşil finansman olanaklarının artırılması, tüketici tercihleri ve davranışları, çevre konularında uzmanlaşmış nitelikli işgücü/yeşil yakalılar, geri dönüştürülebilir malzeme kullanımı, çevresel sosyal sorumluluk projelerinin artırılması, hava ve çevre kirliliğiyle mücadele, çevre dostu enerji kaynaklarına yatırımın artırılması faktörleri değerlendirilmiştir. Yapılan analiz sonucunda Türkiye'de reel sektörün yeşil dönüşümü için en önemli kriterin yeşil dönüşüm için yasal düzenlemelerin artırılması gerekliliği olduğu görülmüştür. Türkiye'de reel sektörün yeşil dönüşümü için ikinci en önemli kriter ise yeşil dönüşüm için yeşil finansman olanaklarının artırılmasıdır. Türkiye'nin yeşil dönüşüme geçiş yapabilmesi için daha istikrarlı bir yasal çerçeveye ve daha destekleyici finansman olanaklarına kavuşması gerekmektedir.

Anahtar Kelimeler: *Green Transformation, Real Sector, DEMATEL, Türkiye, Multi-Criteria Decision Making*

JEL Sınıflandırması: *C19, Q59, O11*

1. Introduction

The concept of green transformation is a concept that emphasizes environmental sustainability and ecological balance and states that industrial and economic activities should be carried out in harmony with nature. Green transformation is a broad concept that generally includes objectives such as environmental sustainability, protection of natural resources, combating climate change and ensuring energy efficiency, and it refers to the development of the economy or society in a nature-friendly and sustainable direction. Environmental problems experienced in the 1970s and 1980s laid the foundation of the concept of green transformation. In this period when environmental problems such as industrial waste, air pollution and water pollution increase, societies and governments have begun to attach more importance to the protection of the environment. Green transformation is necessary to ensure environmental sustainability, combat climate change, access reliable and clean energy, prevent unnecessary use of natural resources and increase social welfare. Green transformation represents a global goal that requires the participation of people at different levels, from individuals to organizations, from local governments to global policy makers (Sheng and Liu, 2023).

Green transformation has many benefits, and these benefits appear in many areas. Green transformation reduces the carbon footprint by reducing greenhouse gases caused by fossil fuels. Green transformation contributes to human health by minimizing environmental impacts. Green transformation aims to increase energy efficiency and provides long-term economic benefits by reducing energy costs for businesses and individuals. Green transformation can reduce dependence on natural resources that increase carbon emissions by encouraging the use of clean energy sources such as wind, solar and hydroelectric energy (Yang et al., 2023; Ersin, 2023). Thanks to green transformation, access to clean air, food and water resources increases the quality of life of the society. Green transformation creates new business opportunities and new industries. The renewable energy sector offers developing economic potential in areas such as green technology and sustainable agriculture.

Green transformation has advantages as well as disadvantages. The high initial investment costs of green transformation projects may pose an obstacle for businesses. Installing renewable energy infrastructure, adopting energy efficient technologies and implementing sustainable practices are costly for businesses. Undeveloped or unoptimized technologies hinder the feasibility of green transformation. The variable nature of renewable energy sources may cause problems in energy storage. Since resources such as wind and sun are not continuous and predictable, energy storage technologies are needed and impose extra costs on businesses (Kostis et al., 2023). Green transformation may lead to a decrease in job opportunities or sector changes in some sectors. For example, a transition from the fossil fuel sector to the renewable energy sector may require some employees to acquire new skills. Some green energy projects, especially hydroelectric power plants, may have a negative impact on nature due to their environmental impacts. This situation carries the risk of damage to ecosystems (Wang et al., 2023). Considering the disadvantages of green transformation, it is important to pay attention to policies and strategies to overcome these challenges. A sustainable green transformation must pursue balanced and comprehensive policies to reduce these challenges and maximize their benefits.

The aim of green transformation is to enable business and society to adopt sustainable and environmentally friendly practices and reduce their environmental impact. Business world and society must take action for green transformation. Legal regulations that support green transformation can be introduced in order to achieve the sustainability goals of businesses and to encourage environmental responsibilities. A strong legal framework supporting green transformation will help businesses lead environmental sustainability and meet society's expectations. Green financing mechanisms should be encouraged for renewable energy and environmentally friendly infrastructure projects (Sarpong et al., 2023). By making it easier for businesses to invest in green projects, suitable loan conditions and advantages can be introduced. To encourage sustainable production and consumption models, the use of local and durable products should be increased. In order to support green transformation, educational campaigns should be organized to raise awareness of large segments of society on this issue. Businesses, factories, and homeowners can take various steps to become more energy efficient. This may include the use of energy-efficient lighting, insulation, and energy-efficient equipment and processes. Businesses and individuals need to adopt waste management strategies to reduce waste generation and encourage recycling. To promote sustainable transportation, it is necessary to support public transportation, increase the use of bicycles, and increase the use of electric vehicles (Ge et al., 2023).

In this study, the most frequently mentioned criteria in the literature for the real sector to transition to green transformation have been determined, and it is aimed to contribute to the literature by determining which criteria should be focused on by developing evaluations and suggestions specifically for Türkiye. As a result of our study, the analysis and evaluation of critical success factors in the green transformation of the real sector in Türkiye were examined. The critical success factors of the green transformation of the real sector in Türkiye were evaluated in line with the answers given by three expert opinions. The data obtained from expert opinion was analyzed with the DEMATEL method, which is one of the multi-criteria decision-making methods. In the study, eight criteria that were most frequently mentioned in the literature were determined. In the study, the criteria for the green transformation of the real sector in Türkiye are; increasing legal regulations for green transformation, increasing green financing opportunities, consumer preferences and behaviors, qualified workforce/green collar specialized in the environment, use of recyclable materials, increasing environmental social responsibility projects, combating air and environmental pollution, increasing investment in environmentally friendly energy resources factors were evaluated.

2. Literature Review

There are many different studies in the literature on the green transformation of the real sector. Green transformation is the climate crisis caused by excessive consumption of fossil fuels after the industrial revolution, air pollution and depletion of natural resources, etc. It is seen as a strategy to solve environmental problems. The green transformation initially appears to be a major challenge for the real sector (Martínez et al., 2023). Issues such as planning the necessary infrastructure investments, creating alternative funds, recruiting qualified personnel for the sector, and meeting bureaucratic requirements may pose short-term difficulties for the sector (Eti et al., 2023). However, when the economic, ecological and social costs of ignoring environmental problems are weighed against the opportunities and benefits of green transformation, it is clear that it makes more sense to cover short-term costs for long-term benefits (Zhong et al., 2023). The reluctance and slowness of the real sector to transition to green transformation further increases the damage to the environment and makes it difficult to use natural resources efficiently. External pressures such as national regulations, international agreements, and concerns about losing market power are now forcing companies to invest in green transformation (Xu et al., 2023). Businesses that undertake green transformation need guidance and support from the state. For governments to facilitate the transition to green transformation; Increasing renewable energy investment projects to encourage the production of green energies, providing subsidies to industries that want to install energy-efficient technologies, introducing interest-free loans to promote environmentally friendly trade, ensuring competition in financial markets and the active participation of domestic and international investors to promote financial development (Ran et al., 2023). Additionally, it should provide incentives to the financial sector to invest in renewable and environmentally friendly projects to promote sustainability (Hoxha et al., 2023).

Diversifying financing opportunities for green transformation has increasing strategic importance in combating the global climate crisis and transitioning to a low-carbon economy. Green finance policy, which encourages the green transformation of polluting enterprises, has become an effective tool for countries to overcome environmental problems (Meng et al., 2023). When implementing green loan policies, the green loan interest rate should be determined according to the actual status of the project. Green credit control measures also need to be strengthened to prevent companies from illegal borrowing (Cui et al., 2022). In the literature, it has been determined that green finance provides environmental improvement, protects natural resources, increases energy efficiency and has a positive impact on economic growth. One of the important issues in the literature on the green transformation of the real sector has been energy supply security (Li et al., 2023). The increase in energy costs due to the sudden change in energy supply and demand due to the pandemic and the recent Ukrainian-Russian war have exacerbated existing problems. Economic development and sustainability depend on supplying the energy we need in sufficient quantities, at low cost, in a reliable way and in a way that does not pollute the environment (Chen et al., 2023). Behind the idea of green transformation lies the idea of limiting the use of fossil fuels or switching to renewable energy sources instead of fossil fuels (Wu et al., 2023). Since the intensive use of traditional fossil fuels such as oil and coal causes environmental damage, it is necessary to switch to alternative energy sources. Renewable energy sources form the basis of the energy of the future because they cause very little greenhouse gas and pollutant emissions (Hacioglu et al., 2023).

Circular economy, one of the important pillars of green transformation in the literature, aims to reduce the level of toxic chemical use, increase the use of clean, reliable energy and fundamentally solve the waste problem (Sun et al., 2023). Circular economy, as part of the green transformation approach, helps to reduce the use of natural resources and reduce costs in sectors that rely on imported raw materials by recycling waste into the economy (Dinçer et al., 2023). Following the industrial revolution, changes in production and consumption patterns have created difficulties in sustainable development due to the decrease in natural resources over time (Zeng et al., 2023). It is stated that

concepts such as green economy and circular economy were put forward by participants from different segments of society, such as United Nations members, heads of government, and non-governmental organizations, to overcome difficulties (Fang et al., 2023). In the literature, the first step of circular economy is the implementation of zero waste. In this way, in addition to recycling waste, it will be possible to use it as much as necessary and to use resources "better and more efficiently" instead of "less".

3. An Evaluation on the Green Transformation of the Real Sector in Türkiye with DEMATEL Methodology

In this study, it is aimed to examine the green transformation of the real sector in Türkiye and list the most effective strategies for the transition to green transformation. The impact of the real sector on the damage caused to the environment around the world is at a level that cannot be ignored. If there is to be success in green transformation, it is not possible to achieve this without the participation of the real sector. Therefore, it is important for policy makers to determine the current environmental perceptions of the real sector, the measures they take and the factors that encourage/support them to take action. It is aimed to list the criteria that play the most role in the transition to green transformation and to offer solutions to the criteria. By ranking the importance of the criteria, the priority criteria in the green transformation of the real sector in Türkiye will be determined and the path to be followed for the transformation of the identified criteria will be determined. The biggest contribution of this study to the literature is that the real sector will determine the correct criteria for green transformation and the results will help the real sector make the right decisions. Firstly, 8 different criteria are selected that have an impact on the performance of green transformation of the real sector. These factors are defined in Table 1.

Table 1: Criteria List

Criteria	Codes
Increasing legal regulations for green transformation	K1
Increasing green financing opportunities	K2
Consumer preferences and behaviors	K3
Qualified workforce specializing in the environment/Green collar	K4
Use of recyclable materials	K5
Increasing environmental social responsibility projects	K6
Combating air and environmental pollution	K7
Increasing investment in environmentally friendly energy sources	K8

After that, an expert team is constructed with three people. These people consist of the academicians who have significant publications in this area. The evaluations regarding these criteria are obtained from these people. Moreover, the steps of DEMATEL are implemented (Özdemirci et al., 2023; Kou et al., 2023; Rawat et al., 2023; Yapar and Keskin, 2023). Finally, the weights of the indicators are computed. Table 2 gives information about these results.

Table 2: Weights

Criteria	Weights	Rankings
Increasing legal regulations for green transformation	0,1723	1
Increasing green financing opportunities	0,1705	2
Consumer preferences and behaviors	0,1204	3
Qualified workforce specializing in the environment/Green collar	0,1099	4
Use of recyclable materials	0,104	8
Increasing environmental social responsibility projects	0,1096	5
Combating air and environmental pollution	0,1066	7
Increasing investment in environmentally friendly energy sources	0,1068	6

It is determined that the most important factor affecting the green transformation performance of the real sector in Türkiye was the increase in legal regulations for green transformation (K1), and the least important factor was the use of recyclable materials (K5).

4. Conclusion

Since green transformation is a long-term and challenging process, it is necessary to support and strengthen the real sector, which is the main factor of the transformation, with an inclusive approach. Adapting to green transformation by implementing environmentally friendly activities in a systematic and planned manner has become an extremely important issue for every business, regardless of sector and company size. In the long term, green transformation will become inevitable for all sectors. If the real sector acts with awareness of this, it makes green transformation easier and more cost-effective. Conscious and timely adaptation of the sector to the green transformation will significantly accelerate Türkiye's sustainable economic development efforts.

As a result of our study, the analysis and evaluation of critical success factors in the green transformation of the real sector in Türkiye were examined. The critical success factors of the green transformation of the real sector in Türkiye were evaluated in line with the answers given by three expert opinions. The data obtained from expert opinion was analyzed with the DEMATEL method, which is one of the multi-criteria decision-making methods. In the study, the criteria for the green transformation of the real sector in Türkiye are increasing legal regulations for green transformation, increasing green financing opportunities, consumer preferences and behaviors, qualified workforce/green collar specialized in the environment, use of recyclable materials, increasing environmental social responsibility projects, air and environment. The factors of combating pollution and increasing investment in environmentally friendly energy sources were evaluated.

The most important criterion in the green transformation of the real sector in Türkiye is to increase the legal regulations for green transformation. Legal regulations are made in which a government or an authority creates regulations, standards and rules on a certain subject, in order to control and direct the security, order, economy and welfare of the society in the long term, even though it may bring different difficulties in the short term. Legal regulations provide assurance to businesses that transition to green transformation, encouraging businesses to determine their environmental responsibilities and act in accordance with these responsibilities. Legal regulations ensure that all businesses comply with the same environmental standards, ensuring equal competition and facilitating the spread of the transition to green transformation. In this regard, according to the findings obtained from the study, suggestions can be made to create legal regulations for the real sector in Türkiye to transition to green transformation.

An official carbon tax is not yet implemented in Türkiye. A carbon tax is the taxation of a specific activity or product in a country or region based on its greenhouse gas emissions. The main goal is to reduce greenhouse gas emissions through a carbon tax and facilitate the transition to green transformation. A carbon tax can be introduced as a legal regulation tool to reduce greenhouse gas emissions in Türkiye. Carbon tax in Türkiye should initially be applied in sectors with high carbon dioxide emissions, and the scope of the tax should be expanded over time. To ensure the effectiveness of the carbon tax, it is also important in which area the revenue obtained from this tax is used. Carbon tax revenues should be collected in a fund to be used to compensate for possible environmental damage. If used in this way, the potential yield expected from the tax may be higher.

AUTHORS' CONTRIBUTIONS

Authors have contributed equally.

CONFLICT OF INTEREST STATEMENT

There is no financial conflict of interest with any institution, organization or person and there is no conflict of interest between the authors

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Research Article

Transformative Trends: Exploring the Nexus of Innovation, Technology, Blockchain, and Islamic Social Finance for Global Sustainability

Damar Osman*

Abdus Salam Muharam**

Abstract

Global sustainability is a growing concern, with the Islamic finance system playing a pivotal role in addressing this issue. The integration of blockchain technology, which enhances transparency, efficiency, and security, is being explored in the context of Islamic social finance. The study, combining literature review, case studies, and interviews with industry experts, highlights the potential of blockchain to revolutionize zakat management, waqf, and sadaqa processes. This can contribute to global sustainability by promoting fair transactions, wealth distribution, and socioeconomic empowerment. The case study of iBantu's collaboration with the Hidayatullah organization in Indonesia exemplifies the practical application of blockchain in digital philanthropy. The study emphasizes the importance of user-friendly, scalable, and interoperable blockchain solutions for widespread adoption and sustainability. The findings offer valuable insights for policymakers, businesses, and practitioners, suggesting strategic interventions to foster sustainable innovation. By integrating blockchain technology into regulatory frameworks and operations, Islamic social finance institutions can significantly contribute to achieving the Sustainable Development Goals while promoting environmental responsibility and socioeconomic development.

Keywords: *Innovation, Technology, Blockchain, Islamic Social Finance, Sustainability*

JEL Classification: *O31, G23, Q56*

* Expert, Academy iBantu - iBantu Pte. Ltd Singapore, damarosmansg@gmail.com ORCID NO: 0009-0006-7260-7348
** Master's Degree, Academy iBantu – PT. iBantu Solusi Syariah Indonesia, salamuharam@gmail.com ORCID NO: 0009-0006-3475-4427

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Dönüştürücü Trendler: Küresel Sürdürülebilirlik için Yenilik, Teknoloji, Blockchain ve İslami Sosyal Finansın Bağlantısını Keşfetmek

Öz

Küresel sürdürülebilirlik, İslami finans sisteminin bu sorunu ele almada önemli bir rol oynamasıyla büyüyen bir endişedir. Şeffaflığı, verimliliği ve güvenliği artıran blok zinciri teknolojisinin entegrasyonu, İslami sosyal finans bağlamında araştırılmaktadır. Literatür incelemesini, vaka çalışmalarını ve sektör uzmanlarıyla yapılan görüşmeleri birleştiren çalışma, blok zincirinin zekat yönetimi, vakıf ve sadaka süreçlerinde devrim yaratma potansiyelini vurgulamaktadır. Bu, adil işlemleri, servet dağıtımını ve sosyoekonomik güçlendirmeyi teşvik ederek küresel sürdürülebilirliğe katkıda bulunabilir. iBantu'nun Endonezya'daki Hidayatullah örgütüyle iş birliğinin vaka çalışması, blok zincirinin dijital hayırseverlikte pratik uygulamasını örneklemektedir. Çalışma, yaygın benimsenme ve sürdürülebilirlik için kullanıcı dostu, ölçeklenebilir ve birlikte çalışabilir blok zinciri çözümlerinin önemini vurgulamaktadır. Bulgular, politika yapıcılar, işletmeler ve uygulayıcılar için değerli içgörüler sunarak sürdürülebilir inovasyonu teşvik etmek için stratejik müdahaleler önermektedir. Blok zinciri teknolojisini düzenleyici çerçevelere ve operasyonlara entegre ederek İslami sosyal finans kurumları, çevresel sorumluluğu ve sosyoekonomik kalkınmayı teşvik ederken Sürdürülebilir Kalkınma Hedeflerine ulaşılmasına önemli ölçüde katkıda bulunabilir.

Anahtar Kelimeler: *Innovation, Technology, Blockchain, Islamic Social Finance, Sustainability*

JEL Sınıflandırması: *O31, G23, Q56*

1. Introduction

Innovation and technology have been identified as pivotal drivers of Islamic social finance and sustainability efforts worldwide. It is crucial to understand the importance of these elements in creating solutions that meet the needs of the present without compromising the ability of future generations to meet their own needs. Moreover, the presence of Fintech (Financial Technology) nowadays is an interesting form of technological innovation and development. One of the trends and innovations that has been utilized in the fintech sector is blockchain (Chang et al., 2020). In theory, blockchain technology is pivotal for establishing such a system. The immutable nature of blockchain ensures that data cannot be altered or erased, thereby offering transparency, anonymity, and enhanced security for transactions. Given the current valuation of cryptocurrencies and decentralized finance assets at over $40 billion, the rapid growth of Ethereum and Bitcoin in 2021 is evident. This trend has significant macroeconomic implications (Sheremetov, 2023).

As advancements in technology progress, blockchain has the opportunity to contribute to the development of Islamic social finance. In short, Islamic social finance is a crucial aspect of the broader Islamic finance system, aiming to enhance social justice by promoting fair transactions and wealth distribution. This system is deeply rooted in the teachings of the Quran and Sunnah, which form the basis for Islamic charity, philanthropy, and social justice (Kunhibava et al., 2023).

Islamic social finance is always essential to discuss, and it would be beneficial to also explore global sustainability as one of its objectives. By adhering to Shariah principles, a Muslim can lead a sustainable life, like how a financial system ensures the sustainability of the ecosystem by pursuing the final objectives (maqāṣid). It is crucial to focus on 'istidāma as a fundamental component of a Muslim's life, influencing daily decisions in economics, society, and the environment, to achieve the goals of Shariah (Cattelan, 2020). Emphasizing the social aspects of Islamic finance, which are in line with global sustainability, can guide practitioners towards Islamic social finance, which is essential for fulfilling the objectives of Shariah. Therefore, the significance of Islamic social finance mechanisms in accomplishing sustainability and resolving societal issues globally has recently attracted a lot of academic interest (Tok et al., 2022a, 2022b).

This research aims to explore the intricate relationship between innovation, technology, blockchain, and Islamic social finance, focusing on their correlation with global sustainability. It seeks to understand how these elements intersect and influence each other to drive global sustainability. The study will explore the role of innovation and technology through blockchain implementation in Islamic social finance in promoting sustainable practices within the Islamic finance system.

The significance of this research lies in its potential to provide a comprehensive understanding of the transformative potential of blockchain and Islamic social finance in achieving global sustainability. This study aims to contribute to the discourse on sustainable finance and development. It offers insights that could guide policymakers, businesses, and practitioners in leveraging these technologies to foster a more sustainable and equitable financial ecosystem. Furthermore, the findings could inspire future research in the field, encouraging further exploration of the intersection between technology and Islamic social finance in the pursuit of global sustainability.

This paper is structured into two main parts. The first part provides a literature review, presenting a comprehensive overview of blockchain in fintech and Islamic social finance, and global sustainability. The second part delves into discussions with industry experts about the role of blockchain in Islamic social finance and the contribution of Islamic social finance through blockchain implementation in achieving global sustainability. It will discuss the application of blockchain technology in digital philanthropy, focusing on its potential to enhance the security and transparency of transaction records in the collection and distribution of funds. The paper will also explore case studies on blockchain implementation in Islamic social finance. Finally, the last section concludes the paper by summarizing the findings and their implications for the fusion of Islamic social finance with blockchain in the global sustainability landscape.

2. Literature Review

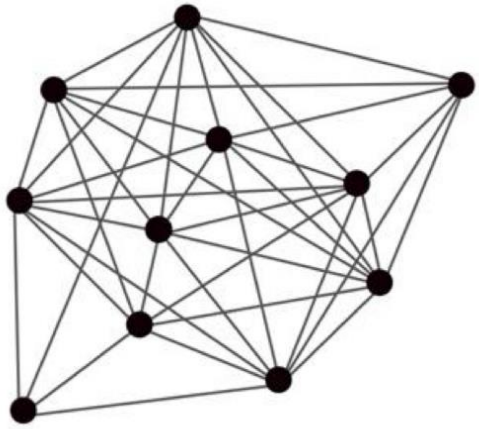
2.1 Blockchain in Fintech

Blockchain technology, particularly within the fintech sector, has appeared as a transformative force in the financial industry. This technology has been particularly relevant in the context of Islamic finance which we will shortly elaborate in Islamic social finance sector in the findings section. It can provide a decentralized and transparent platform for transactions, thereby aligning with the principles of Islamic law (Qudah et al., 2023).

2.1.1 Overview of Blockchain

Blockchain is a decentralized digital ledger that records transactions in a secure and immutable manner, without the need for a central authority like a bank or government. It runs on a network of computers, where each transaction is grouped into blocks, ensuring that the information is secure and cannot be altered once recorded (Tapscott & Tapscott, 2018). A study by Khairi et al., (2023) introduces blockchain as a network of nodes, which can be servers, laptops, or computers, that are part of the blockchain. These nodes verify, record, and store data blocks that are linked together in a chain. Each block holds multiple transaction records, and each record is named by a unique hash, a string generated by a mathematical function from a set of characters. This hash includes details about the transaction, such as the sender, recipient, other participants, date, time, and other relevant information encoded into the blockchain algorithm. Once a block is created, it is also hashed, linking it to the previous block, forming the chain. This hash also contains the transaction hashes recorded within the block. A block is only added to the chain after it has been verified by the network's participants as authentic, using a consensus mechanism. This process is ongoing without an end, and in theory, there is no upper limit to the number of blocks that can be added to the network.

Figure 1: Decentralized and distributed network of blockchain nodes



Source: (Khairi et al., 2023)

2.1.2 Blockchain Types (Consensus Algorithms)

The challenge of scalability in blockchain technology is a growing concern as more users join the network. However, by employing appropriate consensus algorithms, these scalability issues can be mitigated to a manageable level. There are several consensus algorithms recognized, including Proof-of-Work (PoW), Proof-of-Stake (PoS), Proof-of-Activity (PoA), and Proof-of-Vote (PoV). Each consensus algorithm has unique characteristics, making it difficult to determine which is superior in terms of specific criteria. Bitcoin for instance, the most renowned and influential cryptocurrency, initially introduced the Proof-of-Work consensus algorithm (Fahim et al., 2023).

However, in the case study on the finding section, we will use PoA as a censensus alghorithmm. Proof of Authority (PoA) is a consensus algorithm that ensures the security of private blockchains by requiring machines to undergo a thorough vetting process before creating new blocks. This process involves pre-approved participants verifying blocks and transactions, ensuring only trustworthy validators can protect PoA blockchains. PoA is less decentralized, requires low energy consumption, and has no technical rivalry between validators. It allows for more simultaneous transactions and consumes less computational power than PoW and PoS. PoA also guarantees defense against 51% of network attacks, making it a significant initiative for private blockchain networks (Fahim et al., 2023).

2.2 Understanding Islamic Social Finance

Islamic social finance is a critical component of the broader Islamic finance system, aiming to enhance social justice by promoting fair transactions and wealth distribution. Islamic social finance also promotes socioeconomic empowerment through social tools like Zakat (almsgiving), Sadaqa (voluntary), and Waqf (endowment), which have been adopted and applied even outside the Islamic world (Kunhibava et al., 2023).

Zakat is a third pillar and very crucial for the welfare of the impoverished. It is obligatory for Muslims, especially those who are wealthy, and involves a fixed rate and beneficiaries. Zakat serves as a meaningful and sustainable social security scheme by providing material support to the poor, needy, and destitute within society, enabling them to meet their basic needs and become self-reliant. It also helps those facing unemployment, insufficient medical expenses, and other hardships, including the elderly, disabled, and those in need of financial support to maintain their lives (Kuanova et al., 2021).

Waqf (Wakaf) refers to a voluntary act of charity that falls under the broader categories of Sadaqah and Infaq, which involve giving without expecting a return. This can include both tangible and

financial contributions, all of which are dedicated to specific purposes. The utilization of waqf is strictly limited to the objectives set by the donors (Global Islamic Finance, 2017).

Sadaqa is a form of Islamic Social Finance that plays a crucial role in mitigating poverty and supporting those in need. The Quran encourages giving to the poor, stating, "Who among you is willing to lend to Allah?" (Chapter 57, Verse 11), indicating that all are considered poor and that giving to the poor is equivalent to giving to Allah. This act is voluntary and can be done in any amount (no limit), unlike Zakat, which is obligatory and limited to 2.5 percent of one's wealth. This distinction allows for Sadaqa to be given without limit, making it a significant act of generosity for committed Muslims (Abdul Razak et al., 2021).

2.3 Global Sustainability

To achieve global sustainability, the United Nations (UN) has established a framework known as The Sustainable Development Goals (SDGs), which are integral to the UN Agenda 2030 and serve as the primary objectives for global socioeconomic development. The UN encourages all nations, regardless of their economic status, to strive for the betterment of humanity and the environment, combat climate change, and preserve biodiversity. Both developed and developing countries are urged to contribute to the achievement of the SDGs. The SDGs were established by the UN in 2015 with the aim of enhancing various regions worldwide. The 17 distinct goals, collectively referred to as the development goals or global goals, are mandatory for UN members to achieve by 2030 (United Nations, 2015).

The 17 SDGs represent a global call to action to eradicate poverty, safeguard the planet, and ensure peace and prosperity for all. These goals encompass ending hunger and malnutrition, achieving gender equality, providing quality education, reducing inequality, promoting economic growth, protecting the environment, ensuring access to clean water and sanitation, building resilient infrastructure, promoting peaceful and inclusive societies, and fostering partnerships for sustainable development. The SDGs are a universal call to action by all countries, regardless of their wealth, to address the world's most pressing challenges and create a better future for all while preserving the environment (Dirie et al., 2023).

Currently, there is a concerted effort by scholars, practitioners, and other intellectuals to align Islamic (social) finance with the SDGs, as well as Environmental, Social, and Governance (ESG) considerations. It is widely recognized that Islamic social finance along with Islamic finance generally, have the potential to make a significant contribution to the SDGs (Center of Islamic and Middle Eastern Law & SOAS University of London, 2020) while also by considering the ESG framework.

Despite the recognized potential of blockchain technology in the fintech sector and its alignment with Islamic finance principles, there is a notable gap in the literature regarding its practical implementation in Islamic social finance, particularly within the context of zakat management systems. While blockchain offers promising features such as transparency, security, and efficiency, its application in Islamic social finance remains underexplored. Specifically, there is a lack of comprehensive studies examining how blockchain can be effectively integrated into zakat institutions to enhance the collection, distribution, and overall management of zakat funds.

This research addresses this gap by employing an exploratory approach to investigate the practical implementation of blockchain technology in Islamic social finance. This study will provide insights into the integration of blockchain within zakat management systems in Malaysia and Indonesia. By focusing on real-world applications and outcomes, this research aims to contribute valuable knowledge to the literature, highlighting the potential of blockchain to improve the effectiveness and transparency of zakat institutions, thereby supporting global sustainability.

3. Methodology

Since blockchain technology is relatively new and still actively being studied, exploratory research is the preferred method for analyzing its application in Islamic social finance. Due to the inquisitive nature of qualitative research, Nazeri et al. (2023) utilized an exploratory research design to investigate this phenomenon, as recommended by Creswell (2009). Thus, a comprehensive exploratory approach, with interviews as the primary tool, is essential to implement blockchain in Islamic social finance.

This research uses in-depth interviews to thoroughly observe and analyze the implementation of blockchain technology in Islamic social finance, specifically within the zakat management system. Additionally, it employs an exploratory approach in a case study of iBantu and Hidayatullah in Indonesia to examine how blockchain technology has been integrated into zakat management and how it enhances zakat collection and distribution.

By overcoming the limitations of prior research methodologies, this approach enhances the reliability of the findings on how the implementation of blockchain technology in Islamic social finance can contribute to achieve global sustainability.

In conducting the interview sessions with the industry experts related to the study, we will provide several questions that can contribute to the findings as follows:

Question 1: How does blockchain technology enhance the efficiency and transparency of transactions within the Islamic social finance sector?

Question 2: Based on your experience in the industry, what are the key factors that determine the success of blockchain implementation in Islamic social finance, and how can these factors be leveraged to achieve global sustainability?

4. Findings and Discussions

4.1. The Role of Blockchain in Islamic Social Finance

Islamic social finance is a form of finance that complies with Islamic principles. E1 from Singapore believe that blockchain technology can enhance Islamic social finance by offering secure and transparent platforms for transactions, reducing costs, intermediaries, and etcetera.

> "Blockchain has the potential to enhance efficiency and transparency of transactions within the Islamic social finance sector in several ways. First one is to enhance transparency. Blockchain enables transparent and immutable record keeping of transactions on a decentralized ledger. This transparency aligns with the principles of Islamic finance, which emphasizes fairness, justice, accountability, which is why we look into transparency. Our stakeholders also can access real-time information about transactions, and this can ensure greater transparency and trust within the financial system when it is used in its application. Number two, reduce intermediaries. That means less middlemen Blockchain eliminates the need for middlemen or intermediaries such as banks or financial institutions to facilitate transactions. It can go directly to the counterparty or peer-to-peer, as we say. This reduces transaction cost. It streamlines the process. Because it streamlines the process, it makes the process flow much shorter and faster, and it also increases efficiency in Islamic social finance applications. Additionally, the decentralized nature of blockchain reduces the dependency on centralized authorities to enhance financial inclusion and accessibility. Thirdly and lastly is the improved traceability. Blockchain allows you to trace the funds throughout the transaction life cycle. This is beneficial to Islamic social finance and as well to other financial transactions, not only in Islamic social finance, because when you are moving funds from one place to another, it is good to be able to trace it

so that the receiver of the funds is accountable to where the money ends up. With blockchain, stakeholders can trace the flow of funds from donors to beneficiaries, ensuring compliance with Sharia guidelines."

(E1- Singapore)

This argument is also supported by E2 from Australia.

"The benefits of blockchain technology for finance, generally, will also apply to the Islamic finance sector. The main benefits are that blockchain technologies or distributed ledger have a number of core properties, and they lead to outcomes that are more dependable and which are also more robust. So, it enhances data integrity. And the reason it does that is because the information that is updated onto a distributed ledger must be updated in accordance with a set of rules. And those rules are operated across a network of different computers. The rules can not be changed by one player acting by themselves."

(E2 – Australia)

4.2. The Contribution of Islamic Social Finance through Blockchain Implementation in achieving Global Sustainability

Blockchain technology's ability to provide transparency, security, and efficiency makes it a powerful tool for sustainable development. By combining blockchain with Islamic social financing mechanisms, such as Zakat, Infaq (Sadaqa) in voluntary charity, Wakaf (charitable endowment), can help accomplish the sustainability because they aim to improve communal or individual well-being by giving monetary assistance (Dirie et al., 2023).

E1 highlighted that to be sustainable, it must be very useful, it also must be able to scale and be interoperable to be a system that is completely sustainable globally.

"In order for anything to be sustainable. It must be very useful. It is like in the startup world, we call it traction. So, in order for you to get more users, it must be useful. It must be easy to use. It must be, make sense to them user friendly and all that. So, once you have achieved all of that, you will get a lot more people using it. When a lot more people using it, the system becomes very sustainable because everybody is using it. So, for me, it will be user friendliness, and then logic, and easy to use. Not efficiency, cost reduction, those kinds of things, but it must be a link to an app blockchain, like a depth decentralized application which is built on top of the blockchain with AI features and then you can make it into an app. So, if you know, everybody's know using apps, if you can build in an app which is integrated to blockchain and AI and is user friendly, it looks attractive, the page movements, the buttons make sense where it's supposed to be easy to find, it has all the features and functions that the customers are you looking for the users are looking for. Then we gain a lot of traction, and it will become sustainable, then there is the most important first part. Second part is it must be able to scale and be interoperable. So that means when you build something so secure on the blockchain. One of Blockchain's most useful features is in scalability. But to be scalable, that means all other systems need to be able to connect to this particular blockchain. So, as you know, there are different blockchain protocols. There is ethereum, there is so many, right? Different ledgers are the decentralized ledger system we call it, and so many different systems. So, how do we make it scalable? We make it interoperable. How do you make it interoperable in the software will we use? That what we call as API (Application Programmable Interface). So, when you have

> two enterprise systems, they are built on different protocols or different programming languages, python, or C++ (C plus plus), or whatever whatsoever. But what makes the two enterprises system that is built differently be able to communicate with each other is the API. So, API is to put it simply, like when you travel, you have that adapter plug to for your electricity. So, in Indonesia you may have the 2 PIN plug, in Singapore we have the 3 PIN plug, and all that. So, it is like a multiple plug that allows you to communicate between the different systems. So, the second more important one is the interoperability so that you can leverage on the scalability. Once you get traction, everybody is using it, then you try to integrate more services built by other people so that you don not have to rebuild it, then it becomes interoperable and scalable. Then you will be a system that is completely sustainable globally, because everyone will be wanting to use it because it is easy to use and user friendly."
>
> (E1- Singapore)

E2 added the key succuss to enable its implementation, he believes:

> "The key to success with introducing anything new is to be able to, firstly, explain it clearly. But secondly, to also be able to listen to the users within a community and understand what their objectives are and what their challenges are, and then together design a solution that makes the most out of the technology. So, just like any other change process, introducing anything new, it must be done with a clear purpose. So, our experience is trying to help people to be ready for change so that if they are forced to change, they can do it. But also, if they are not forced to change, they can take the proactive steps to begin their own digitalization and innovation journeys using these technology tools to improve services, to improve transparency, and to improve data integrity."
>
> (E2 – Australia)

In addition to be sustainable, beside Islamic finance itself, E1 added that there is a need to level up and develop Islamic principles and implications into modern applications.

> "They are kinds of trying to give you a broad understanding of what sustainability is from an Islamic perspective with what the conventional has already done. I think that is another besides Fintech. Finance is lagging, and we need to level up and get to it. Because we have two groups of people that you have the non-Muslims who already understand sustainability from the conventional segment. And then we are trying to understand what Islamic sustainability is. Okay, so there is one group to address, and then the other group is the Muslims. Who thing that, "Oh, Islam already covers sustainability." But they do not understand net zero target goals, they do not understand NDC (Nationally Determine Contributions), they do not understand what the conventional world is using as metrics to reach the sustainable goal and all that. So, because they say, "Islam already covered this, we have Zakat-Wakaf, we know this one will cover everything. But we know Zakat and Wakaf is social institutions. But when you talk about sustainability, you have ESG as this is globally everybody agrees on the ESG framework. Environment, Social, and Governance. "S" social, we have covered with Wakaf and Zakat. "G" Governance we cover with our sharia guidelines, Sharia principles and Sharia compliant procedures and everything. But what about "E" environment? So, we need to develop that we cannot just this means by saying, "Oh, Islam has everything." Yes, Islam has everything. But just like Islamic finance. We did not approach Islamic finance by saying, "Oh, yeah, Islam, cover this finance." Islam is that we did not mean we took the time to develop financial system, economic system, financial tools, great piece of Islamic law contracts, we learn about

> debt, we learn about speculation, we learn about derivatives, that what is halal, what is not halal, and then we learn about definition of money. So, it takes time to develop. We cannot just say that "Oh, Islam has everything." Yes, Islam is everything, but it is up to us as Muslims to understand what Islam is. What do you call this, develop (Islamic) principles and implications that is grounded by what Islam says into modern applications."
>
> (E1- Singapore)

4.3. Case Study of Blockchain in Islamic Social Finance: Finalising the Work in Progress - iBantu with Hidayatullah and Blockchain Implementation for Digital Philanthropy in Indonesia

This exploration of the nexus between innovation, technology, blockchain, and Islamic social finance is supported by our own case study in iBantu. This case study has revealed the practical application of blockchain in the Islamic social finance sector, it could be as the implementation of the world's first blockchain in digital philanthropy in Indonesia.

iBantu is a specialist in Islamic finance and a technology partner for Web3.0 Blockchain, providing training and consultancy, and solutions to corporations and individuals. Recently, iBantu is actively engaging with Baitul Mal Hidayatullah (BMH) and Baitul Wakaf under the Hidayatullah organization to pioneer the use of blockchain technology in zakat management in Indonesia. This initiative aims to revolutionize the recording on the collection and the distribution of zakat, facilitating transactions through the use of tokens for zakat, waqf, and infaq (sadaqa) payment as well as reducing their operational cost, enhance transparency, security and efficiency for both donors and Hidayatullah organization. The enthusiastic response from BMH Hidayatullah underscores a growing interest and readiness to embrace blockchain technology in zakat management.

To give a better understanding for the case study, we will explain further the transaction scheme. The donor begins the donation process by using the iBantu platform or customize platform as for Hidayatullah, either creating an account or logging in. Next, the donor chooses the donation project(s) and specifies the donation amount. The donation, in the form of fiat money, is then transferred to the registered bank account of Hidayatullah or an authorized payment gateway. This action triggers the Wakalah (agent) contract, which includes its Terms and Conditions (T&C) and is encoded into a smart contract.

Following the transfer, the donated amount is converted into tokens through a process known as tokenization. This conversion takes place on a blockchain that operates on the Proof-of-Authority (PoA) consensus mechanism. For each fiat money donation, an equivalent number of donation tokens are issued to a dedicated digital wallet and a multi-signature (multi-sig) signer. These tokens are ERC20 tokens, custom tokens on the Ethereum blockchain or any Ethereum-compatible blockchain, such as Polygon.

In the PoA-based blockchain (figure 2 and 3), authorized verifiers or committees manage the tokens in the digital wallet and organize the distribution of tokens to the donation targets. The Wakalah contract is executed at this stage, with the committee acting as the wakil and adhering to the assigned T&C. The donation tokens are distributed to three categories:

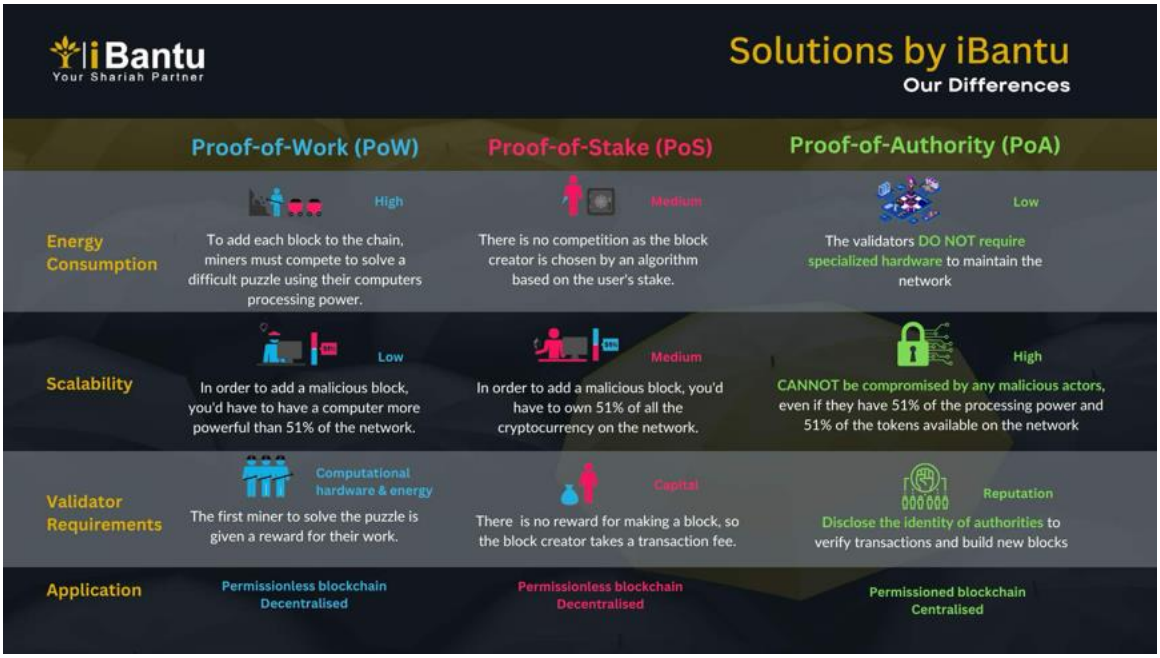
1. Zakat beneficiaries, who are individuals represented by charity organizations or foundations, without involving vendors or suppliers.

2. Project financing, which includes vendors or suppliers for projects such as schools or scholarships, disaster relief, construction, and medical expenses for hospitalized individuals.

3. Operations expenses of the Charity Organization.

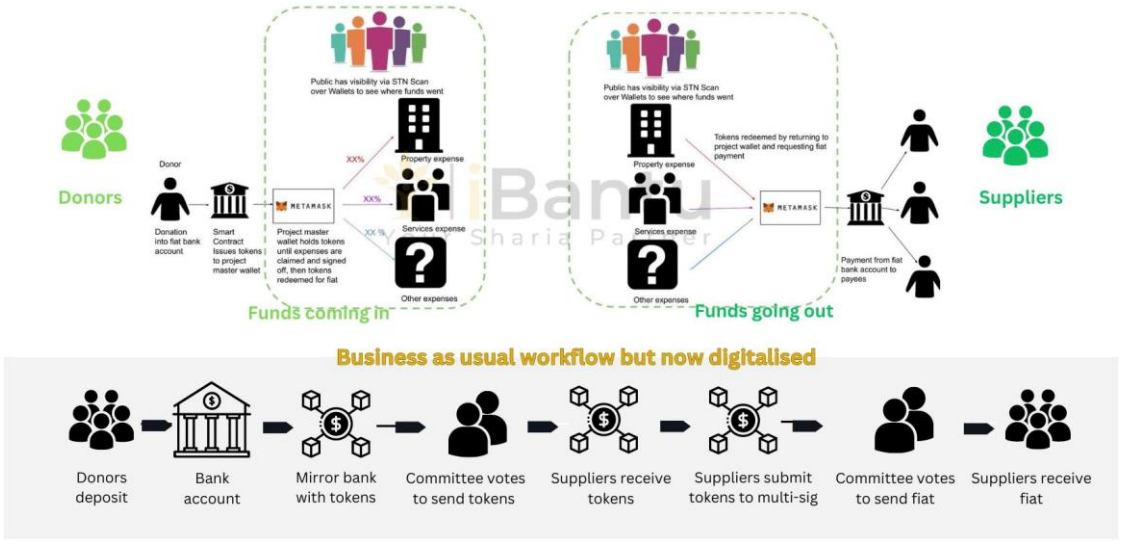
Suppliers or individuals represented by organizations submit tokens to multi-sig signers, where the committee votes to release the fiat money. Finally, suppliers or individuals receive the fiat money (figure 4).

Figure 2: iBantu choose PoA (Proof-of-Authority)



Source: Author's own (iBantu)

Figure 3: Transaction Scheme (Donation Journey) with Multi-sig Signer Verification



Source: Author's own (iBantu)

This case study demonstrates the feasibility of integrating Islamic social finance with blockchain technology. Initially, it shifts trust from human-operated entities to machine-operated ones, eliminating the risk of deception in transactions. Additionally, the smart contract, which encodes the contract terms and is stored on the blockchain, automatically settles transactions upon the occurrence

of a specified event. Finally, the immutable nature of the blockchain allows for the verification of transaction details at any time, ensuring that once a transaction is recorded, it can not be hacked by human intervention (Kunhibava et al., 2023).

5. Conclusion and Recommendation

The integration of blockchain technology within the Islamic social finance sector represents a transformative trend with significant implications for global sustainability. By leveraging the inherent characteristics of blockchain, such as decentralization, immutability, and transparency, Islamic social finance institutions can enhance the efficiency, security, and accountability of their operations. This not only aligns with the Islamic principles but also contributes to the broader objectives of the Sustainable Development Goals (SDGs) by promoting fair transactions, wealth distribution, and socioeconomic empowerment. The case study of iBantu's collaboration with the Hidayatullah organization in Indonesia exemplifies the practical application of blockchain in digital philanthropy, demonstrating the potential for blockchain to revolutionize zakat management, waqf, and infaq processes.

The insights gained from this exploration have profound implications for policymakers, businesses, and society at large. Although, our contribution remains within the limits of existing literature analysis, case study and discussions with two industry experts only. There is a clear need for strategic interventions to foster sustainable innovation. Policymakers should consider incorporating blockchain technology into regulatory frameworks to support Islamic social finance initiatives. Businesses as Islamic social finance institutions, on the other hand, should explore the implementation of blockchain in their operations to improve transparency, security, and efficiency, thereby contributing to global sustainability.

AUTHORS' CONTRIBUTION

The contributions of the authors to this article are equal.

CONFLICT OF INTEREST DECLARATION

There is no financial conflict of interest with any institutions, organization or person, and there is no conflict of interest between the authors.

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APPENDIX 1

Table 1: A Brief Background of the Participants

Experts	Institutions and Backgrounds
	Singapore
Expert 1	He is the Managing Director of Stellar Group in Singapore, where he has provided Islamic Finance, Fintech and Sustainability implementation consulting services to businesses and national offices, including multi-lateral organizations such as the ASEAN Secretariat and the UNCDF. He also runs IBF-funded Fintech and Digital Transformation courses in Singapore and is the author of three internationally renowned books: "Beyond Fintech: Technology Applications for the Islamic Economy" (World Scientific, 2021), "Blockchain, Fintech, and Islamic Finance: Building the Future in the New Islamic Digital Economy" (De|G Press, 2019; 2d Edition, 2022). He holds a BSc in Engineering, a MSc in Finance and received his PhD in Islamic Finance from INCEIF.
	Australia
Expert 2	He is a Chairman at Smart Trade Networks, Author of China, Trust & Digital Supply Chains and Research Leader in Value Flows. His specialties including in Economic digitalisation & 4th Industrial Revolution, Decentralised or distributed ledger technologies, blockchain, digital assets design and implementation & Blockchain-enabled supply chain integration, Internet of Things, Big Data, China and international political economy, social impact analysis, Industry and community development innovation and finance, Regional Development, Public policy impact analysis, international affairs, trade, and political economy.

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Research Article

Carbon Leakage Concept after Carbon Pricing & Green Deal Policies

Abdulkadir Bektaş[*]
Eyüp Kaan Moralı[**]
Aygün Aktaş[***]

Abstract

As part of the European Green Deal, EU nations are required to decrease their carbon emissions by 55% by 2030 and reach carbon neutrality by 2050. The EU's emissions trading system is the cornerstone of this goal. In theory, rising carbon prices may cause carbon leakage, or the transfer of economic activity and related emissions from high-carbon economies to low-carbon economies. Losing market share to rivals in international rivalry might result in short-term international carbon leakage. In the long term, it can be accomplished by moving domestic businesses abroad. To date, a variety of tools, including offsets and free allowances granted under the ETS, have been used to support the carbon leakage risk of high-risk industries. This paper develops an international technique, the EU Emissions Trading Scheme (ETS) Phase IV consultation, to produce a sector-level risk assessment of carbon leakage in Türkiye. This methodology combines emissions intensity and trading intensity, two important indicators for assessing carbon leakage risk. Although the former is commonly employed as a measure of a company's exposure to carbon costs, the latter indicates its ability to pass on costs to customers without losing market share. According to the carbon risk study carried out in Türkiye for the aluminium, cement, paper, fertilizer, iron-steel, and ceramics sectors, cement has the highest risk, while paper carries the lowest risk. For Türkiye, it is important to consider the risk of carbon leakage, in particular emission intensity and trade intensity, in order to accelerate and facilitate low-carbon development.

Keywords: *European Green Deal, CBAM, Carbon Leakage, Carbon Pricing, ETS, EU ETS*

JEL Classification: *Q54, Q56, E27*

[*] Assoc. Prof. Dr., Çimentaş Group- Cementir Holding, kadirbektas35@gmail.com , ORCID NO: 0000-0003-0199-2251
[**] Expert, Republıc Of Türkiye Mınıstry Of Envıronment, Urbanızatıon And Clımate Change (Presidency Of Climate Change), ekaan.morali@csb.gov.tr ORCID NO: 0000-0002-0070-7087
[***] Master's Degree, Republıc Of Türkiye Mınıstry Of Envıronment, Urbanızatıon And Clımate Change (Presidency Of Climate Change), aygunakts@gmail.com ORCID NO: 0000-0002-7378-1608

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Karbon Fiyatlandırmasından Sonra Karbon Sızıntısı Kavramı & Yeşil Anlaşma Politikaları

Öz

Avrupa Yeşil Mutabakat kapsamında, AB ülkeleri karbon emisyonlarını 2030 yılına kadar %55 oranında azaltmaları ve 2050 yılına kadar karbon nötrlüğüne ulaşmaları gerekmektedir. AB'nin emisyon ticaret sistemi bu hedefin temel taşıdır. Teorik olarak, artan karbon fiyatları karbon kaçağına veya ekonomik faaliyetlerin ve ilgili emisyonların yüksek karbonlu ekonomilerden düşük karbonlu ekonomilere aktarılmasına neden olabilir. Uluslararası rekabette pazar payının rakiplere kaptırılması, kısa vadede uluslararası karbon kaçağına neden olabilir. Uzun vadede ise bu durum yerli işletmelerin yurtdışına taşınmasıyla gerçekleşebilir. Bugüne kadar, yüksek riskli endüstrilerin karbon kaçağı riskini desteklemek için denkleştirmeler ve ETS kapsamında verilen ücretsiz tahsisatlar da dahil olmak üzere çeşitli araçlar kullanılmıştır. Bu çalışma, Türkiye'de karbon kaçağına ilişkin sektör düzeyinde bir risk değerlendirmesi oluşturmak için uluslararası bir teknik olan AB Emisyon Ticareti Programı (ETS) Faz IV istişaresini geliştirmektedir. Bu metodoloji, karbon kaçağı riskini değerlendirmek için iki önemli gösterge olan emisyon yoğunluğu ve ticaret yoğunluğunu birleştirmektedir. Bunlardan ilki genellikle bir şirketin karbon maliyetlerine maruz kalmasının bir ölçüsü olarak kullanılırken, ikincisi şirketin pazar payını kaybetmeden maliyetleri müşterilere aktarma kabiliyetini göstermektedir. Türkiye'de alüminyum, çimento, kağıt, gübre, demir-çelik ve seramik sektörleri için yapılan karbon kaçağı riski çalışmasına göre, çimento en yüksek riske sahipken, kağıt en düşük riski taşımaktadır. Türkiye için karbon kaçağı riski, özellikle emisyon yoğunluğu ve ticaret yoğunluğu göz önünde bulundurularak hareket edilmelidir, böylece düşük karbonlu kalkınmaya ulaşmak daha hızlı ve kolay olacaktır.

Anahtar Kelimeler: *Avrupa Yeşil Mutabakatı, SKDM, Karbon Kaçağı, Karbon Fiyatlandırması, ETS, AB ETS*

JEL Sınıflandırması: *Q54, Q56, E27*

1. Introduction

In the European Green Deal announced on 11 December 2019, the European Union (EU) set the target of the first climate-neutral continent in 2050. The EU stated that it will adopt a new growth strategy to achieve this goal and reshape all its policies on the axis of climate change (European Commission, 2019). In this regard, the European Commission implemented the "Fit for 55" legislative amendment package, which aims to evaluate the EU's energy, land use, transportation, and taxation policies in order to achieve a 55% decrease in emissions from 1990 levels by 2030. The Carbon Border Adjustment Mechanism (CBAM) is a crucial component of the package that will impact global trade, as it is being applied for the first time ever.

Türkiye has announced that it will decrease its greenhouse gas (GHG) emissions by 41% by 2030 compared to Türkiye's first Nationally Determined Contributions (NDC) Business as Usual (BAU) scenario. In Türkiye's first updated NDC, 2012 is considered the base year (reference year) of the scenario and is economy-wide (Türkiye's NDC, 2023). Türkiye, which has a long-term goal of peaking its emissions by 2038 at the latest and achieving net-zero emissions by 2053, is evaluating the role of carbon pricing in helping it achieve this goal. However, once Türkiye starts to implement carbon pricing, the country's emission-intensive and trade-exposed sectors may be at risk of carbon leakage if their international competitors do not. The term "carbon leakage" describes the scenario that could occur if companies relocate their manufacturing to another nation with less stringent emission regulations because of the expenses associated with climate legislation. The overall amount of emissions may rise as a result (European Commission, 2021). Carbon pricing mechanisms are defined as a cost-effective market-based policy instrument to reduce greenhouse gas emissions and combat climate change. Different carbon pricing mechanisms provide different frameworks and incentives to reduce emissions. Carbon markets impose a limit on emissions on companies in order to meet emission reduction targets set by governments. There are two widely used carbon pricing mechanisms in the world. These are the emissions trading scheme and the carbon tax (ICAP, 2024). So far, 75 global carbon pricing initiatives—36 emission trading systems and 39 carbon taxes—have been put into place or are planned for deployment (World Bank, 2024).

In the literature, there are many studies on carbon leakage risk and considerable progress has been made in investigating carbon leakage problems, especially in terms of leakage level assessment and prevention measures. More thorough and methodical analyses are needed to accelerate research on this important but difficult issue, as most studies are limited to a few specific areas. This paper presents a comprehensive review of the literature on the subject of carbon leakage in the context of differentiated climate policies in Türkiye. It also performs a detailed carbon leakage risk calculation for a number of key industrial sectors, including aluminium, cement, paper, fertiliser, iron-steel and ceramics, for the year 2021. Finally, it offers a number of recommendations for future research on climate policies. To undertake this review, this paper provided answers to the following queries. (1) What are the causes and reasons behind carbon leakage? (2) How can the danger of sectoral carbon leakage be evaluated? And (3) What should be taken into account in future studies to create and assess climate policies more fairly and efficiently? This is how the rest of the paper is structured. The research framework and methodology are presented in Section 2. The method and contributing causes for carbon leakage are explained in Section 3. The sectoral carbon leakage risk computation and interpretation are summed up in Section 4. Conclusions and recommendations for further study are provided in Section 5.

2. Methodology

A quantitative analysis in the form of an evaluation of the risk of carbon leakage at the sector level was used for the selection process. This analysis is based on modelling results for six sectors according to the EU ETS Phase 4 international methodology, which is appropriate for use in the Turkish context. As seen in Table 1, this methodology is determined using the trade intensity and emission intensity measures.

Although there are many carbon leakage risk assessment methodologies, it was preferred to use this method since the currently accepted method in the EU is EU ETS Phase 4. The EU Commission establishes a list of carbon leakage for each period of the ETS; the list of carbon leakage for the fourth period, covering the years 2021-2030, is calculated according to the benchmarks of each installation in a sector or sub-sector. Furthermore, when analysing the formulation in Table 1 below, it is estimated that this method is the most accurate method to understand the realisation rate of green transformation in production in regard to technological infrastructure and capacity and the large number of trading partners that Türkiye has. The level of economic development, industrial structure, level of urbanisation, government interventions, structure of energy consumption and dependence on foreign trade are some of the factors that determine carbon emission intensity (Sun, 2022).

Table 1: EU ETS Phase 4 (2021-2030) method according to the carbon leakage list

Methodology	Measurement	Contents
EU ETS Phase 4	Emission intensity x Trade intensity > 20%	**Trade intensity**: (import + export)/ (import + production) **Emission intensity:** $kgCO_2$/Gross Value Added

Source: (European Commission, 2018)

The study utilises a comprehensive dataset that includes a consistent representation of the identified sectors, as well as production and trade flows for 2021 and detailed calculations of emissions versus gross value added. This mixed dataset is based on data from the Turkish Statistical Institute (TurkStat). The database covers the classification of 6 sectors in Türkiye according to their Scope 1 emissions, and the base year for calculations is 2021.

The four-digit NACE Rev. 2, which corresponds to the sector classification employed by the European Commission in its carbon leakage assessment, is linked to the sector classification. Since

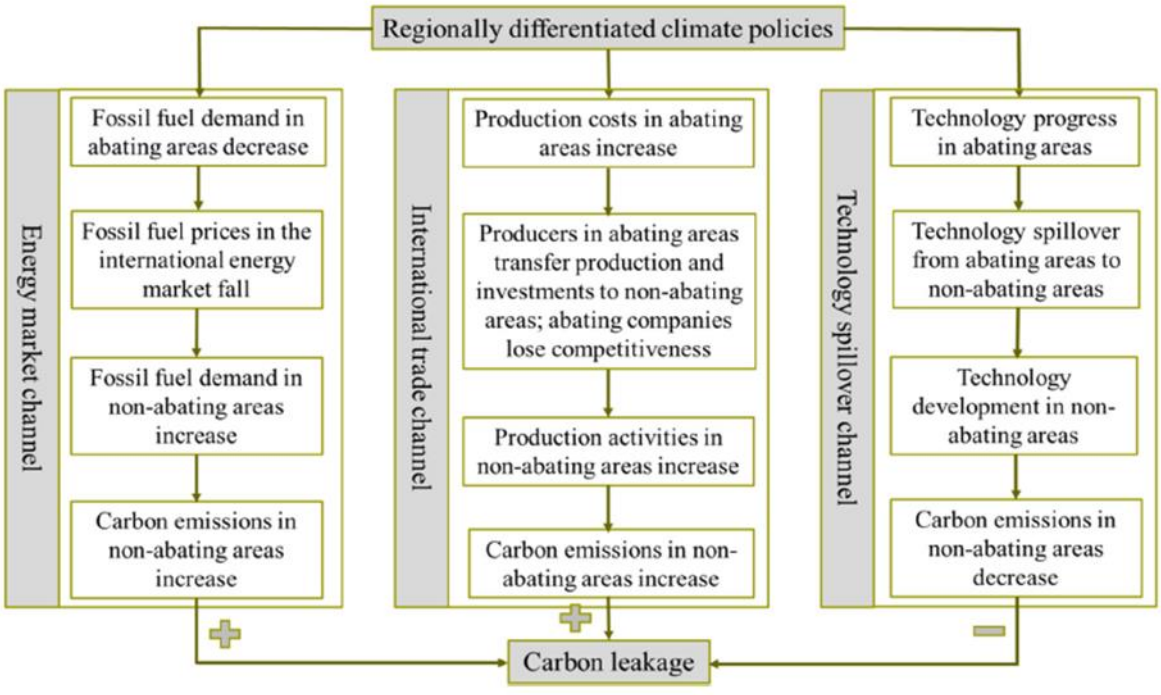
the NACE classification is a hierarchical system, there is a positive correlation between the number of stages and the level of detail.

3. Causes and Affecting Factors of Carbon Leakage

'Carbon leakage' refers to the possibility that businesses would relocate their carbon-intensive operations to nations with more climate-friendly policies and lower production costs than they would have in their original location. Direct and indirect carbon leakage are the two main forms of carbon leakage that can be identified. Despite extensive research on this topic, it is unclear from empirical data how often carbon leakage occurs (Grebe, 2023).

Carbon leakage is one of the primary barriers to taking climate policies further in support of climate governance (Yu et al. 2021). Before measuring carbon leakage, it is necessary to understand how and why carbon leakage occurs and the main factors affecting it. Then, ways to prevent carbon leakage should be sought. Existing research on carbon leakage includes three channels (Tan et al., 2018). As can be seen from Figure 1, the energy market channel and the international trade channel generally reduce the effectiveness of climate policies by creating carbon leakage (expanding carbon leakage) and hurting the economy and the environment. International technology spillovers, on the other hand, are typically thought to lower the danger of carbon leakage (Yu et al. 2021). Given that the primary cause of greenhouse gas emissions is the burning of fossil fuels, there is little question that the energy market plays a significant role in the implementation of climate policy. According to the international energy market channel, when some regions enact policies aimed at reducing emissions, this will decrease demand for fossil fuels in those regions that have done so. This could also result in a drop in the price of fossil fuels on the global energy market, which would then increase demand for fossil fuels in non-mitigating regions and raise emissions.

Figure 1: **Mechanism of Carbon Leakage (Yu et al. 2021).**

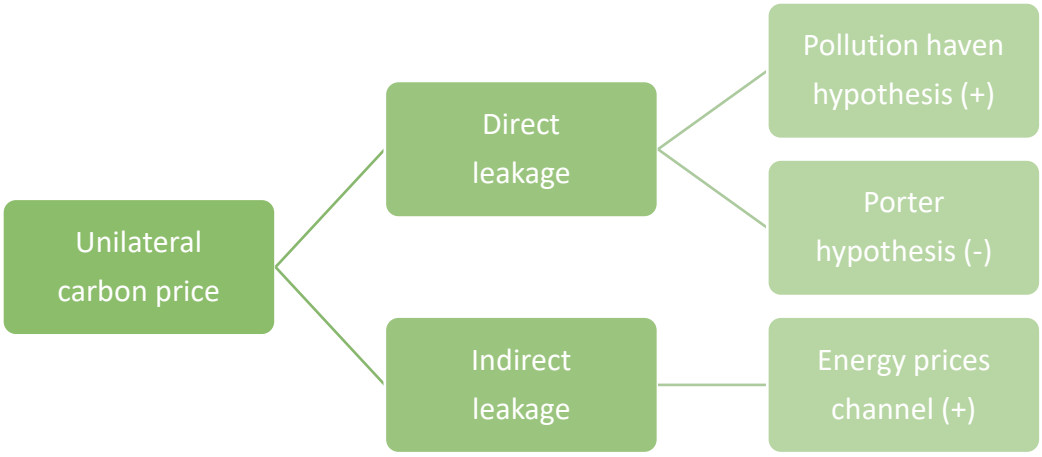


3.1. How and Why Does Carbon Leakage Happen?

The relocation of manufacturing operations to nations with no or reduced greenhouse gas prices is referred to as “direct carbon leakage”. Operational leakage refers to the movement of production shares inside a multinational corporation, while investment leakage refers to the building or acquisition of new production facilities (Zachmann and McWilliams, 2020). Conversely, the

phenomenon of "indirect carbon leakage" is triggered by a decline in domestic demand, which occurs as a consequence of initiatives aimed at curbing the utilisation of fossil fuels in order to mitigate the effects of climate change. The price of these fuels on the global market decreases in tandem with a decline in demand. In nations without CO2 pricing, a lower market price increases demand for fossil fuels, preventing the realization of global emission reductions (Grebe, 2023).

Figure 2: Theoretical pathways of carbon leakage (+/- positive or negative leakage rates)



There is concern that more strict or unilateral climate laws may result in (1) market share loss to foreign competitors who emit greater pollution and (2) increasing emissions in other regions due to carbon leakage (Kartensen et al, 2018).

3.2. How to Solve Carbon Leakage?

There are many recommendations and new mechanisms in the literature and policymakers to prevent and reduce carbon leakage. The EU ETS's strategy to prevent carbon leakage is based on the free allocation of more emission allowances to economic sectors that the European Commission deems more likely to experience carbon leakage than not. Additionally, industries that are vulnerable to carbon leaks are compensated for the expenses of CO2 that are borne by them through electricity rates (Grebe, 2023). On the other hand, the CBAM will minimize the risk of carbon leakage by gradually reducing free allowances and eventually eliminating them. Beginning on October 1, 2023, iron and steel, cement, aluminium, fertilizer, power, and hydrogen products will be included in the first stage of the CBAM reporting procedure. As part of the implementation, carbon emissions from the manufacturing of these products that are imported into the EU as well as (indirect) emissions from the generation of power utilized in industrial processes will be recorded during the transition period until January 1, 2026.

Starting from 1 January 2026, in the actual implementation period, carbon fees will start to be paid for the emissions embedded in imported products by the importers authorised in the EU, taking into account the weekly carbon prices in the EU ETS, and indirect emissions in the cement and fertiliser sectors will also be subject to remuneration. Free allowances provided to European producers in the EU ETS within the scope of the CBAM will also be taken into account in a way to reduce the financial obligation. On the one hand, free allowances in the EU ETS will be cancelled within the framework of a certain reduction schedule in the period 2026-2034, while at the same time, the CBAM financial obligations will increase at the same rate (EU CBAM Regulation, 2023).

Output-based rebating funds (OBR) for emission tax payments and output-based free allocation of permits are two other techniques (Böhringer et al., 2017). The key distinction between CBAM and OBR is centered on financial incentives. OBR encourages domestic manufacturing, while CBAM

limits the foreign supply of commodities exposed to commerce and high emissions to the controlled nation. This is due to the OBR's implicit production subsidy function (Böhringer and Lange, 2005). Put another way, the OBR reduces the incentives for consumers to move from buying items with high emissions to those with lower emissions. The OBR will continue to encourage the manufacture of items that are exposed to trade and have high emissions, even though CBAM will take some time to be implemented internationally.

Another insight is policy-induced carbon leakage. It refers to companies moving their emission-intensive operations abroad to evade regulations, precluding many of the possibilities for mitigation policies in the case of trade-exposed production with high emissions, given that such investments are likely to shift to regions with weaker climate policies (Grubb et al., 2022).

Supporting the low-carbon manufacturing of goods whose manufacture is associated with high-carbon emissions would be a better course of action. First, bolstering long-term competitiveness in sectors that are already high in carbon is possible through governmental support. Secondly, it might give the globe access to the technology required for significant decarbonization. One way to do this is by paying for production that produces less carbon dioxide (Zachmann and McWilliams, 2020). Policymakers could define emissions criteria for disruptive low-carbon alternatives for steel, cement, pulp and paper, aluminium, and other products.

4. Carbon Leakage Measurement and Sectoral Effects

The EU Commission determines a carbon leakage list for each ETS period. The Carbon Leakage List of the 4th period covering 2021-2030, is calculated based on the benchmarks of each facility of a sector or sub-sector. However, it is important to note that free allocations will be phased out gradually until 2030. This is because free allocations have a significant financial value, which gives the Carbon Leakage List an economic value (European Commission, 2018).

The number of free allocations that each of the following rules has been awarded to a (sub-) installation *i* in sector s:

$Allocation_{ist}$ = $benchmark_i$ x historic activity $level_i$ x reduction or correction $factor_{it}$ x carbon leakage exposure $factor_{st}$

Based on quantitative criteria, which comprise two factors: trade intensity and carbon intensity, sectors are frequently classified as hazardous with respect to carbon leakage (Ulmer, 2022). Both factors might be interpreted as estimations of the risk that producers in unregulated areas would lose market share if the increased costs resulting from a national ETS are passed on to the customer. While trade intensity estimates the likelihood that the cost increase will be passed on to consumer prices, carbon intensity measures the amount of potential cost increase (Juergens et al. 2013).

Table 2: Products analysed for carbon leakage risk

NACE Code	Description
1712	Manufacture of paper and paperboard
2015	Manufacture of fertilisers and nitrogen compounds
2331	Manufacture of ceramic tiles and flags
2351	Manufacture of cement
2410	Manufacture of basic iron and steel and of ferro-alloys
2442	Aluminium production

According to EU ETS Phase 4, the carbon leakage list is established in two phases. The NACE-4 degree of discrimination was applied in the first quantitative evaluation level. A sector or subsectors shall be deemed at risk of carbon leakage if the carbon leakage indicator is more than 0.2. As per the updated ETS Directive, a second assessment is conducted if specific sectors and sub-sectors fail to meet the primary carbon leakage criterion for inclusion in the carbon leakage list. When sectors and sub-sectors have emission intensities more than 1.5 and the carbon leakage indicator is between 0.15 and 0.2, a new qualitative or quantitative evaluation is conducted at the disaggregated level (PRODCOM-6 or 8 level) (European Commission, 2018).

4.1. Evaluation-Based Carbon Leakage Measurement

The EU Emissions Trading Scheme (ETS) Phase IV consultation is the basis for the sector-level carbon leakage risk assessment in Türkiye that is presented in this paper. To calculate the carbon leakage risk, this methodology combines two essential metrics: trade intensity and emission intensity. In the carbon risk analysis conducted for aluminium, cement, paper, fertiliser, iron-steel, and ceramics sectors in Türkiye, the riskiest sector is cement, while the lowest risk is observed in the paper sector.

Table 3: Comparison of emission and trade intensity of sectors

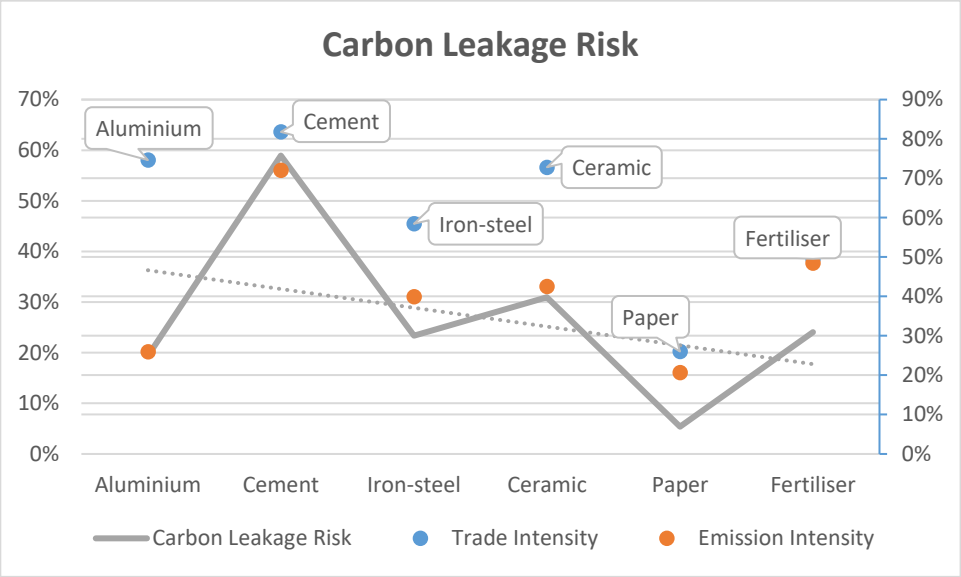
Sectors (2021)	Trade Intensity	Emission Intensity
Aluminium	75%	26%
Cement	82%	72%
Iron-steel	58%	40%
Ceramic	73%	43%
Paper	26%	21%
Fertiliser	50%	49%

When emission intensity and trade intensity are multiplied by each other, if it is more than 20%, it means that the risk of carbon leakage is high. While the risk of carbon leakage is high in the cement, iron-steel, ceramics, and fertiliser sectors, it is anticipated that the paper industry will have a lower risk of carbon leakage.

There are two other main points covered by trade intensity in the assessment of sectoral carbon leakage risk:

The first is the so-called ‘carbon cost effect’, which is the effect of carbon pricing on a certain industry or business. The ability to account for the cost of carbon is the second. The question is whether businesses can pass on the cost of carbon to consumers without losing market share or seeing a decline in profit margins. To measure the carbon cost impact, each production unit can be measured by the volume of emissions arising in revenue, value-added, and profit (PMR Türkiye, 2018). Various factors are important in measuring cost-reflective capacity, including market power, demand elasticities, domestic supply elasticities, and external supply elasticities. A better understanding of the relationship between trade intensity and carbon intensity provides theoretical support for Türkiye to better use its foreign trade activities to achieve low-carbon development (Wang et al., 2021).

Figure 2: **Sectors' Rate of Carbon Leakage Risk**



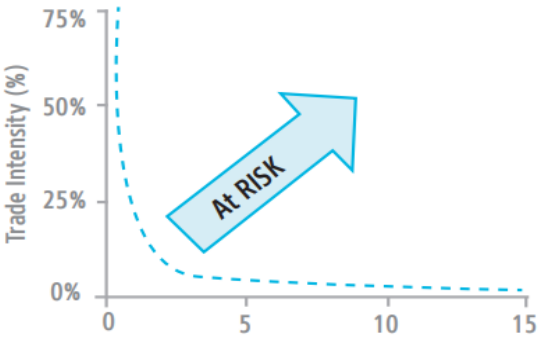
Carbon leakage and investment decisions are influenced by emission intensity details, cost, and emission reduction potential. If a business can reduce its emissions at a low cost, it will be able to reasonably lower the carbon cost it faces and, thus, lower the risk of carbon leakage. This can, however, differ greatly amongst firms.

The risk of carbon leakage, examined sectorally, depends on the emission and trade intensity factors in the country. However, when examined universally, the decisive factor at this point comes from carbon price differences. In contrast, competing countries that implement equivalent carbon pricing policies can reduce the risk of carbon leakage.

Table 4: Risk assessment of sectors

Sectors	**Is there a risk of carbon leakage?**
Aluminum	Yes
Cement	Yes
Iron-steel	Yes
Ceramic	Yes
Paper	No
Fertilizer	Yes

Figure 3 :Trade intensity and emission intensity together to create leakage risk (PMR Türkiye, 2018)



4.2. Effects of Carbon Leakage Risk on The Sectors

Due to their products' high carbon content and exposure to international markets, sectors that are both carbon-intensive and marketable are more vulnerable to leakage. Increased competition and difficulty for businesses to pass on price increases to customers are two effects of high trade volumes. Cement, iron and steel, and ceramic production are the three main industrial sectors known to be prone to carbon leakage risk. Extensive environmental policies have been noted to raise the costs of

environmental and energy regulations and to have minor negative effects on commerce and employment, according to industry consultations and the literature. Furthermore, the necessity for environmental regulations that foster innovation in cleaner technologies has been acknowledged. It is recognised that although green technology investments may be costly in the short term, they will provide positive returns to the sectors in the long term.

The effects of carbon leakage risk on domestic production and net imports for each sector are considered as the 'competitiveness effect'. Customers of commodities like steel and aluminum frequently adjust their consumption to foreign alternatives in response to price fluctuations, but they also take other actions, such as converting to alternative materials that require less energy or consuming less energy (Aldy and Pizer, 2011).

Carbon leakage risk can be evaluated according to sectors as follows:

Paper: Paper is the sector with less emission intensity and the least risk of carbon leakage compared to other sectors. Because the process of making paper produces very little emissions. Most of Türkiye's international competitors in this field apply carbon pricing. At this point, it needs to improve its technology to become more advantageous.

Cement: Cement industry producers have been identified as the most vulnerable sector to the hazard of carbon leakage. However, the sector can benefit from various opportunities for emissions reduction, given its relatively high emissions intensity (PMR Türkiye, 2018). It can also reduce the risk of carbon leakage due to the sector's increased production and current profitability. This shows that the sector is flexible and can quickly adapt to increasing carbon prices.

Ceramics: As a result of quantitative evaluations, it is understood that the sector is at risk. However, the advantage of the ceramics industry is that its trade is largely made to countries that already price industrial emissions or to places where this is implemented at an advanced level. Thus, the sector will have various opportunities to reduce risk.

Iron and steel: The model evaluation suggests a risk to the sector. Nonetheless, many variables lessen the chance of carbon leakage. Electric arc furnaces are widely used, indicating that Türkiye has the potential to become a low-emission steel production hub in the area if the industry moves away from coal and toward on-site production and/or systemic decarbonization. Lastly, nations with sophisticated systems or already charging for industrial emissions represent the sector's principal trading partners. For example, Bektaş (2021) focused on the Europen Green Deal and planned carbon border adjustment mechanism as important developments that will affect trade from the perspective of energy-intensive sectors of Turkey. Possible impacts of implementing the EU's plans and measures that can be taken for the iron-steel industry to be less negatively affected by the EU developments are examined. GDP is found as the most important increasing factor for the differentiation in emissions.

Aluminium: Since aluminium is an energy-storing metal that can be recycled or reused after production without any loss of quality, the emission difference between primary and secondary aluminium is quite high. It is observed that secondary aluminium is preferred in the aluminium trade in Türkiye because it is a form of production that provides lower emissions and higher added value.

5. Conclusions and Future Research

Carbon leakage is unavoidable due to the lack of consistent and resolute international cooperation for the application of diverse climate policies and global climate action. The incidence of carbon leakage underlies how nations divide up the burden of reducing global emissions more equally and has a substantial impact on the environmental efficacy of climate policies as well as the financial costs of attaining emissions reduction targets. At this point, considering the great importance of supporting climate governance, it is observed that detailed studies on carbon leakage are increasing. This article was prepared with the objective of establishing a road map for Türkiye and elucidating the particulars

of policy creation. It was written with the intention of offering suggestions for future climate policies by examining the phenomenon of carbon leakage, its evaluation, and the principal factors influencing the evaluation results. This paper demonstrates that the average carbon leakage risk differs between the EU and other countries due to the selection of Scope 1 emissions and the consideration of Türkiye's trade preferences. It is thought that it would be beneficial to further expand the scope and examine it in other studies.

Based on the experiences gained and the findings from the literature research, three main recommendations are put forward for future research. First, it is essential to create consistent policy metrics to compare climate policies that vary by region, second, it should be handled with standardized measures in calculation methodologies and modeling parameters, and finally, different alternative ways to combat carbon leakage need to be highlighted. Examples of these areas to concentrate on include the policy effects of R&D investments and subsidies for technology aimed at reducing emissions, the diffusion of technology across regions, and the supplementary or substitute outcomes of these areas with other policy instruments. It should be taken into consideration that it is not an issue that can be solved only with CBAM or taxes.

It can be argued that emission pricing together with CBAM are the most appropriate instruments to reduce carbon leakage. It is well recognized that CBAM is a more economical approach than an output-based rebate. However, a different approach that could be comparable to CBAM is the combination of an output-based rebate and a consumption tax on commodities that are exposed to trade and have high emissions. This is due to the fact that a consumption tax of this kind would certainly boost welfare and have greater policy terms.

Türkiye should focus on low-carbon development and reduce emissions. Emissions can be reduced through sectoral energy intensity, sectoral energy mix, and emission factor. In addition, the use of new technologies to improve efficiency, the consideration of green hydrogen and carbon-free gas, the improvement of resource efficiency, and the promotion of the use of renewable resources are recommended.

AUTHORS' CONTRIBUTION

All parts were written by three authors.

CONFLICT OF INTEREST DECLARATION

There is no financial conflict of interest with any institution, organization or person, and there is no conflict of interest between the authors.

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Research Article

Can Türkiye Be a Hub For Closed-Loop Systems in the Textile Industry for the EU?

Nilgün Aytekin*

Abstract

The global textile industry, valued at $414 million, confronts substantial environmental challenges, contributing to waste, pollution, and greenhouse gases. This paper examines Türkiye's potential to drive sustainability in textiles, exploring circular systems that minimize waste and promote eco-friendly practices. The paper consists of seven parts. After introduction, in the second part the importance of sustainability and circularity in textile industry is explained. Third part examines the Türkiye as a major textile player, and the challenges of textile recycling industry. Overwhelming obstacles like insufficient recycling infrastructure require industry initiatives, government regulations, and technological innovations. Following parts explains the main limitations of the textile recycling in EU and questions if Türkiye, with its production capabilities and recycling expertise, could be a key ally for EU to solve the obstacles of current textile recycling challenges. Recommendation and Conclusion parts offer a road map for Türkiye to enhance its capabilities to become a key ally for EU, exemplifying a transformative shift towards a sustainable textile industry.

Keywords : *Circular Economy, Closed-loop, Textile Recycling*

JEL Classification : *Q01, Q32, Q38*

* Expert, Atlas Sustaınabılıty And Change Consultancy, nilgun@atlas-scc.com ORCID NO: 0009-0007-3110-8355

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Türkiye, Avrupa Birliği için Tekstil Endüstrisinde Kapalı Döngü Sistemleri için Bir Merkez Olabilir mi?

Öz

Küresel tekstil endüstrisi, 414 milyon dolarlık değeriyle, atık, kirlilik ve sera gazlarına katkıda bulunan önemli çevresel zorluklarla karşı karşıyadır. Bu çalışma, Türkiye'nin tekstil sektöründe sürdürülebilirliği sağlama potansiyelini inceleyerek, atıkları en aza indiren ve çevre dostu uygulamaları teşvik eden döngüsel sistemleri analiz etmektedir. Makale yedi bölümden oluşmaktadır. Girişten sonra, ikinci bölümde tekstil endüstrisinde sürdürülebilirlik ve döngüselliğin önemi açıklanmaktadır. Üçüncü bölümde, Türkiye'nin önde gelen bir tekstil oyuncusu olarak yeri ve tekstil geri dönüşüm endüstrisinin zorlukları ele alınmaktadır. Yetersiz geri dönüşüm altyapısı gibi büyük engeller, sektör girişimleri, hükümet düzenlemeleri ve teknolojik yenilikler gerektirmektedir. Sonraki bölümler, AB'deki tekstil geri dönüşümünün temel sınırlamalarını açıklamakta ve Türkiye'nin üretim kapasitesi ve geri dönüşüm uzmanlığıyla AB için mevcut tekstil geri dönüşüm zorluklarının aşma yolunda kilit bir müttefik olup olamayacağını sorgulamaktadır. Öneri ve Sonuç bölümleri, Türkiye'nin tekstil geri dönüşüm yeteneklerini artırması için bir yol haritası sunmakta ve sürdürülebilir bir tekstil endüstrisine doğru dönüştürücü bir değişimi örneklemektedir.

Anahtar Kelimeler: *Döngüsel Ekonomi, Kapalı-döngü, Tekstil Geri Dönüşümü*

JEL Sınıflandırması: *Q01, Q32, Q38*

1. Introduction

The global textile industry, while recognized for its pivotal role in fashion and commerce, stands at the intersection of economic progress and environmental challenges. With its extensive supply chains and production processes, the textile industry is both a significant contributor to economic growth and a substantial burden on the environment. The worth of the global textile industry has reached to US$414 million worldwide in 2019, and it contributes 7% to the total world exports (Fernandez-Stark et al, 2022). Labor-intensive apparel production employs millions of workers, particularly in some of the world's least-developed regions (ILO, 2021). The sector's environmental challenges vary from resource consumption to the generation of vast quantities of waste, pollution, and wastewater containing toxic chemicals (Mondal et al., 2016). Every year, the textile sector emits 2-8% of the world’s greenhouse gases, uses the equivalent of 86 million Olympic-sized swimming pools of natural water resources, and is responsible for 9% of microplastic pollution in our oceans (UNEP 2023). In an era characterized by increasing ecological awareness, sustainability transformation is vital for the textile industry through circular economy solutions that address these environmental challenges.

Circularity in the textile industry refers to the concept of creating a closed-loop system where textiles are designed, produced, used, and recycled in a way that minimizes waste, conserves resources, and reduces the industry’s overall environmental footprint. It involves practices to extend the lifespan of textile products and to provide a more sustainable and eco-conscious choice for consumers. The goal is to drop the traditional linear model of "take-make-dispose" and create a circular textile industry that optimizes resources, reduces pollution, and contributes to the principles of circular economy.

This paper is designed to explore Türkiye's potential role as a key player in fostering sustainable and circular practices within the global textile sector. The primary question is the assessment of Türkiye's suitability as a hub for closed-loop systems in the textile industry, examining the strengths and weaknesses of the textile industry in implementing global circularity solutions, analyzing existing initiatives and their impact, understanding challenges and opportunities, and evaluating the role of government policies. The objectives encompass providing a holistic view of Türkiye's prospects, identifying key industry attributes, highlighting sustainability initiatives, proposing strategies for addressing challenges, and gauging the influence of policy and industry infrastructure in Türkiye's journey toward circular textiles.

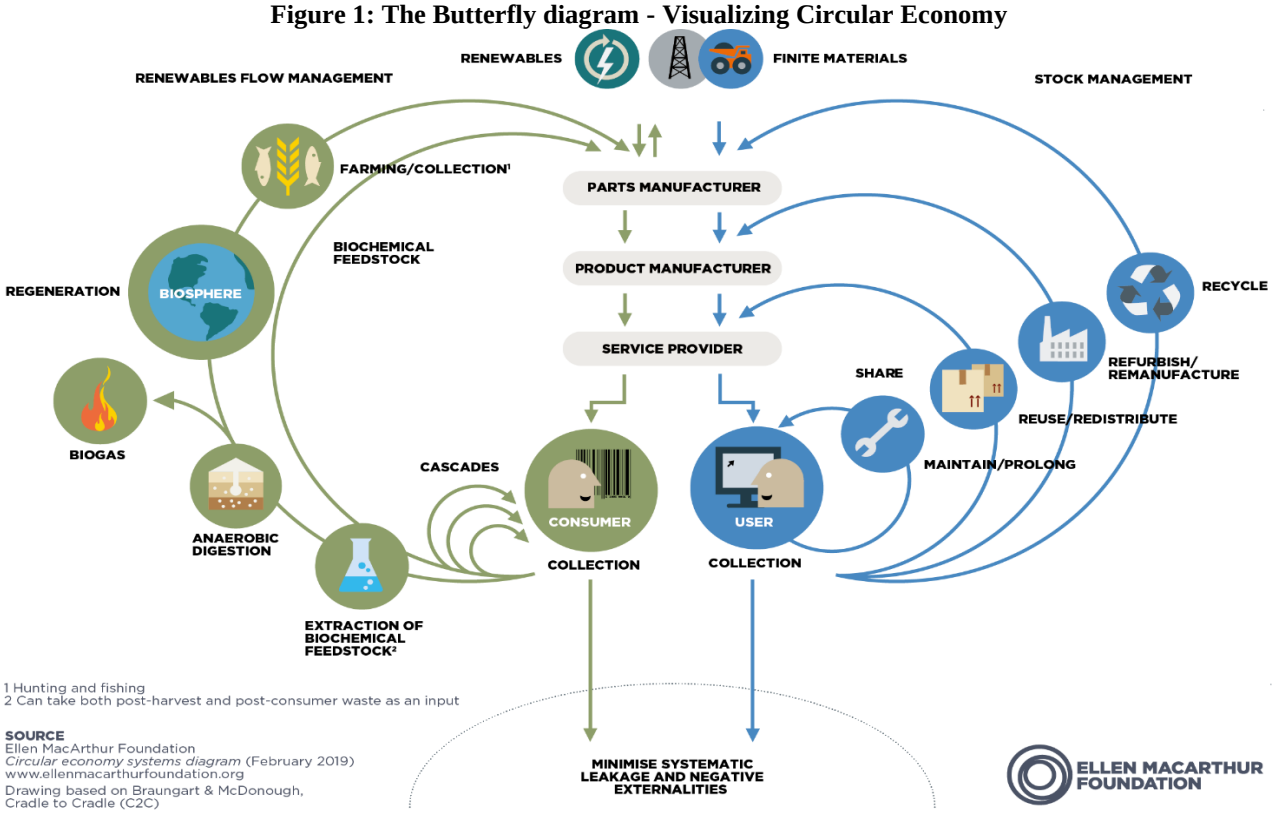
2. Sustainability: The Ultimate Goal for the Textile Industry

The environmental impacts of the textile industry are widespread and significant within its extended supply chain. This industry is well-known for its resource-intensive operations, including the massive consumption of water, energy, and chemicals. One of the most pressing concerns is water usage, with the dyeing and finishing processes demanding vast quantities of water and often resulting in wastewater pollution, accounting for around 20% of industrial water pollution by releasing significant amounts of toxic chemicals into the environment (Ellen MacArthur Foundation, 2017).

Moreover, the textile industry contributes to 8% of the world's greenhouse gas emissions (European Parliament, 2014), primarily through energy consumption and transportation, and is known to be one of the largest water consumers globally, using around 79 billion cubic meters of water annually (European Parliament, 2014). The extensive use of non-renewable resources, such as petroleum-based synthetic fibers, further exacerbates its environmental footprint. This impact is not only due to resource depletion but also contributes significantly to microplastic pollution, one of the main causes of biodiversity loss. Additionally, the industry generates 92 million tons of textile waste yearly, from discarded clothing to off-cuts and unsold inventory (Niinimamp et al., 2020). All these factors underscore the urgent need for a circular and closed-loop system in the textile industry to mitigate its environmental impact and strive for an eco-friendly future.

A closed-loop system in textiles is inspired by the principles of a circular economy, where products, materials, and resources are used efficiently and kept in use for as long as possible. It involves designing products for durability, using eco-friendly materials, and implementing resource-efficient manufacturing processes to keep textile products in circulation as long as possible. The core principles include reducing waste, reusing materials, and recycling textiles at the end of their life cycle. Ellen MacArthur's Butterfly Diagram provides a tremendous visual illustration to understand the principles of a circular economy better as Figure 1. It highlights the implication of closed-loop systems in minimizing waste, conserving resources, and creating a more sustainable economic model.

Figure 1: The Butterfly diagram - Visualizing Circular Economy



Source: Ellen MacArthur, 2019

The diagram is shaped like a butterfly, with two loops. The top loop represents the biological cycle (biological materials returning to the biosphere), while the bottom loop represents the technical cycle (industrial materials staying in a closed-loop system). In the bottom wing of the butterfly, which represents the technical cycle, the emphasis is on keeping materials and products in a closed loop by repairing, remanufacturing, and recycling instead of disposing of them immediately at the end of their life. The goal of the loops is to extend the life cycle of the products as long as possible to decrease their environmental footprint and prevent them from using new sources.

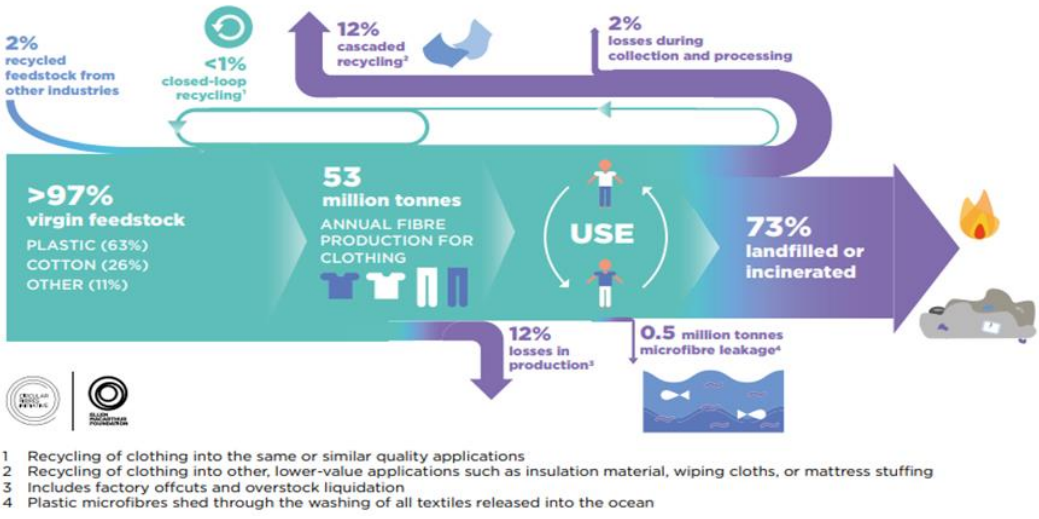
3. Textile in Türkiye: From A Global Perspective

Textile is a vital industry within Türkiye's economy. It stands as one of the largest textile producers and exporters globally, contributing significantly to Türkiye's industrial landscape as specified in the study by Duran and Dinç, 2016. The sector covers many products, including apparel, home, and technical textiles. The textile industry is crucial in Türkiye's employment, providing jobs for thousands of people, particularly in smaller cities and rural areas. (Duran and Dinç, 2016). Türkiye's strategic geographic location, well-established supply chains, and skilled workforce have further cemented its status as a textile hub, making it a key player in the global textile market.

Türkiye’s total garment sector exports reached 19 million US dollars in 2023 having a substantial impact on international trade and commerce according to the data of the Turkish Exporters Assembly (TİM, 2024). The country has 59,000 companies in textile manufacturing, which are mostly small or medium-sized entities, and employ around 1 million (registered) people (T.C. Sanayi ve Teknoloji Bakanlığı, 2021). For the EU, Türkiye ranks as the second largest textile producer, (UNDP 2020) which makes Türkiye an important partner in the textile industry.

Besides, Türkiye’s textile recycling industry played a crucial role in the country's sustainable development efforts in recent years. In particular, the City of Uşak stands out as a significant hub (Altun, 2106; Öner, 2023). Located in western Türkiye, Uşak has become a central spot for textile recycling due to its large number of recycled fiber and yarn manufacturers that process discarded textiles. 85% of Türkiye’s textile waste is recycled in Uşak (Zafer Kalkınma Ajansı, 2019). Moreover, Uşak's expertise in textile production and its access to raw materials make it an ideal location for repurposing and upcycling textiles. As the textile industry in Türkiye continues to grow, Uşak's role as a recycling hub is gaining importance in promoting sustainability and reducing the sector’s environmental footprint.

Figure 2: Global Material Flow for Clothing 2015



Source: Ellen MacArthur, 2017

The opportunity to achieve better waste management in the textile industry lies in recycling blended materials effectively, whether they originate from post-consumer or post-industrial sources. Mechanical recycling is widespread but has its constraints, and chemical recycling remains relatively underdeveloped. Globally, many recyclers identify elastane as a more significant obstacle than any other fiber due to its common use, adding another challenge to the complexity of the recycling process (Fashion for Good, Circle Economy, 2022; Wojciechowska, 2021).

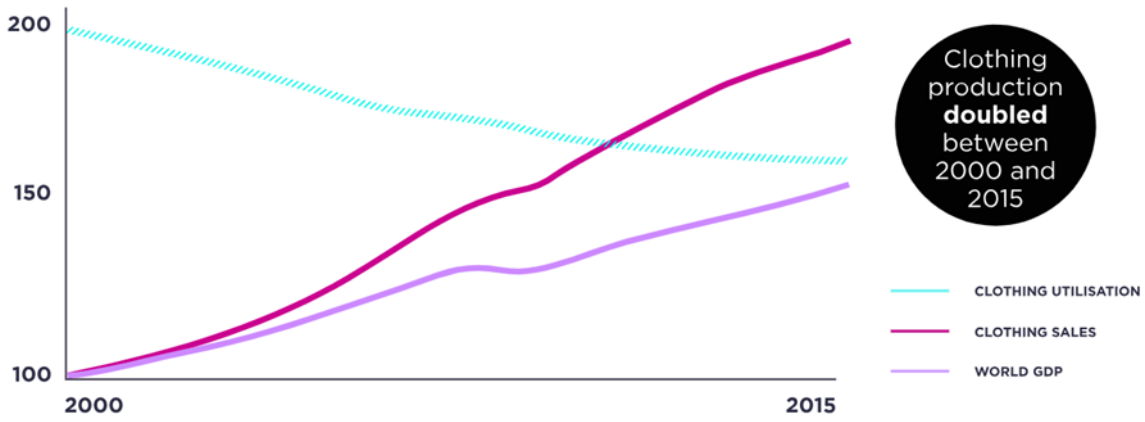
The global nature of the textile industry means that waste can be generated at various points in the supply chain, from production to distribution, complicating waste management efforts. The economics of textile recycling can also be challenging. The costs associated with collecting, transporting, sorting, and processing textiles must be balanced with the potential value of the recycled materials (Watson et al, 2014).

Addressing these challenges requires a combination of industry-wide initiatives, government regulations, consumer education, and the development of innovative recycling technologies to make the textile industry more sustainable and reduce its environmental footprint. The contribution of SMEs in this process cannot be underestimated. As Yorulmaz (2023) highlights in its study, particularly in SMEs, the environmental awareness and innovation of top management are the most influential factors in adopting green strategies. Additionally, creating a green image has been shown to positively impact stakeholder and customer perceptions, contributing to profitability. Furthermore, the study points out that cost efficiency is a weaker motivator for green strategies, likely due to SMEs' limited resources and the high initial investment costs associated with sustainable technologies.

4. Is It Possible to Close the Loop in EU for Textile Products?

Apparel represents just one aspect of the textile industry. The notable global increase in apparel production and consumption over the last 15 years, resulting in a significant rise in waste generation, is one of the many reasons the textile industry is the second polluting among others (See Figure 3). It is no surprise that the EU Strategy for Sustainable and Circular Textiles describes the 2030 vision for the European textiles market as such: “By 2030, textiles on the EU market should be durable and recyclable, largely made of recycled fibres, free of hazardous substances and produced in an environmentally friendly way while respecting social rights. Fast fashion should be ‘out of fashion’ and re-use and repair services would be widely available. Textiles should be collected at the end of their lifetime and their incineration and landfilling reduced to a minimum thanks to innovative fibre-to-fibre recycling” (European Parliament, 2024)

Figure 3: Growth of clothing sales and decline in clothing utilization since 2000



Source: Ellen MacArthur, 2021

Gross textile waste in EU-27 and Europe is expected to grow from 7.0 million to 7.5 million tons in 2022 to 8.5–9.0 million tons in 2030 (Janmark et al, 2022). The separate collection of textile waste

grew from approximately 2 million tons in 2014 to 2.8 million tons in 2019 in Europe. This figure is expected to increase significantly once the EU waste legislation is implemented by the end of 2024 (Euratex, 2020).

European textile companies have been investing for circular solutions to accelerate the shift to circularity. However, most of the recycling methods and circular solutions currently available, whether in the market or in the research and development stage, only make up a tiny part of the overall textile market. Developing high-quality pre-processing at the right cost and scale remains a bottleneck for the sorting and recycling industry to overcome worldwide (Gözet et al, 2021). Even though there is improvement on the sorting phase and there will be enough feedstock to supply the recycling industry, the current yarn-spinning capacity presently is at 1.5 million tons per year in the EU region which is anticipated to challenge the goal of closing the loop fiber to fiber. There is limited capacity in Europe to manage all textile waste streams. According to recent reports, scaling the European textile recycling value chain will likely require a €6 billion to €7 billion investment (Janmark et al, 2022).

Furthermore, the textile industry has established itself in underdeveloped countries in the last decades due to several key factors. First and the most important reason is the fact that labor costs are considerably lower in these regions, making textile production cost-effective for manufacturers. Besides, the availability of raw materials and a large labor force are also crucial, and many underdeveloped countries offer abundant resources and a surplus of skilled and unskilled labor. The relocation of textile industries to these regions has created a competitive advantage for many European brands.

The local production of recycled fibers could play a key role in strengthening the European textile value chain. However, strong barriers are challenging to address individually, and broad collaboration appears to be needed across value chains (Köhler et al, 2021).

5. Türkiye: Future Hub for Closing the Loop

The Turkish textile and clothing industry covers the entire textile value chain and, therefore, a wide range of activities from the processing of natural or synthetic fibers into yarns, the production of woven, knitted, or non-woven fabrics, the treatment of textile materials (finishing, dyeing, coating) up to the production of a great variety of end-products such as high-performance technical textiles for a lot of industrial applications as well as home textiles and apparel. The capability to serve the various stakeholders of the supply chain with high expertise and the nearshoring advantage makes Türkiye a significant partner in circularity for the EU market (Halife, 2020).

Türkiye has developed noteworthy expertise, especially in mechanical textile recycling, positioning itself as a leader in this field. The country's textile recycling industry utilizes advanced machinery and processes to break down and repurpose used textiles efficiently. With a focus on sustainability, Turkish companies have honed their skills in extracting valuable materials from discarded textiles, reducing waste, and conserving resources.

With a yarn-spinning capacity exceeding 7 million tons and a vertically integrated production structure spanning from fiber to fabrics and garments on a regional or country basis, crucial for circular textile infrastructure, Türkiye has emerged as a near-shoring recycling solution for European clothing brands and retailers (Janmark et al, 2022). It could potentially become a critical ally in supplying closed-loop material flows for the EU during its transition to circular textiles.

As per the new EU regulation on waste shipment which was adopted on 11 April 2024 (Regulation (EU) 2024/1157 of the European Parliament and of the Council of 11 April 2024 on shipments of waste), legal restrictions will be imposed on the direct export of textile waste from the EU to non-OECD nations. Furthermore, the shift from used clothing donations to waste disposal is likely to result in a smaller portion of collected items being suitable for resale. (Under the recent regulation on

the shipment of waste, the export of textile waste to non-OECD countries would be allowed only under the condition that such countries notify the Commission of their willingness to import specific types of waste and demonstrate their ability to manage it sustainably.) Establishing Türkiye as a key partner in this endeavor would also mitigate the risks associated with the inability to process textile waste that will be prohibited from trading with underdeveloped countries.

6. Recommendations: Action Plan for Türkiye's Textile Industry

Türkiye stands as a primary candidate to become a central ally in the European Union's closed-loop textile transition. With its well-established textile sector, Türkiye can play a pivotal role in supporting the EU's circularity goals by sharing expertise, technology, and best practices. Collaborative efforts between the EU and Türkiye can further advance the transmission of a circular economy, promoting responsible resource management, reduced waste, and enhanced environmental sustainability. This strategic partnership holds great potential for the mutual benefit of both regions and should be actively pursued.

Besides its advantages, Türkiye also has some improvement areas to consider within the developing recycling industry. Our recommendations are as follows.

- **Increasing the quality of collection and sorting facilities:** Establishing a well-designed textile sorting system in Türkiye to optimize waste for the recycling industry stands as a critical step towards aligning with the EU's Green Deal requirements. By enhancing these facilities to meet higher standards, Türkiye can significantly bolster its recycling infrastructure, aligning it more closely with the sustainability goals outlined by the EU. This improvement not only advances Türkiye's environmental objectives but also strengthens its potential to achieve a balanced collaboration with the EU, facilitating smoother integration into the broader European recycling framework. Upgrading these facilities is fundamental for elevating the nation's environmental stewardship and meeting the precise criteria set forth by the EU's Green Deal, fostering a more sustainable and harmonized closed-loop ecosystem.
- **Change of VAT regulations for discarded textiles:** Revising VAT regulations concerning discarded textiles in Türkiye can significantly contribute to positioning the nation as a closer partner for the EU in building a circular economy. Currently, a significant part of textile waste is still taxed according to VAT regulations. Adjusting VAT policies to encourage recycling initiatives and reutilization of discarded textiles would foster a more sustainable approach to managing these materials. Such changes not only stimulate the proper distribution of textile waste but also align Türkiye's regulations more closely with the circular economy objectives of the EU. This adaptation would enhance Türkiye's role as a partner in the EU's efforts to establish a closed-loop system, promoting resource efficiency and minimizing the environmental impact of textile waste. This alignment signifies Türkiye's commitment to shared sustainability goals, paving the way for a more robust partnership with the EU in realizing a circular economy within the textile industry.
- **Improving the textile waste import procedures to feed raw materials for the recycled yarn manufacturers:** Enabling Türkiye to import textile waste from the EU and establishing close-loop agreements to take back textile waste hold substantial importance in supporting the nation's recycled yarn manufacturers with a consistent supply of raw materials. Improving the procedures for textile waste imports is crucial for advancing the circular economy in Türkiye's textile industry and for supporting EU through its closed-loop targets in the textile industry. This stream of raw materials is fundamental for local manufacturers, serving as a sustainable resource that significantly reduces the reliance on virgin materials. By facilitating the controlled and regulated import of textile waste from the EU, Türkiye not only fosters the growth of its recycled yarn sector but also aligns with the circular economy goals outlined by

the EU. This collaboration promotes resource efficiency, merges textile waste into new products in a cradle-to-cradle approach, and aids in minimizing the environmental impact of textile production, establishing Türkiye as a key player in the closed-loop textile manufacturing landscape.

- **Waste trade system linking EU countries and Türkiye:** One of the key challenges clogging closed-loop systems in the textile industry is the absence of a comprehensive digital solution bridging companies in need of waste as feedstock with those possessing waste to offer (Ministry of Foreign Affairs, 2021). Developing a digital platform that efficiently connects these entities is pivotal in creating a more circular and sustainable textile ecosystem. This platform could serve as a marketplace or network, streamlining the exchange of information, facilitating transactions, and fostering partnerships between waste-producing and waste-consuming companies. By implementing such a digital solution, the industry can optimize resource utilization, minimize waste, and enable a more seamless transition towards a closed-loop system, fostering a more sustainable and interconnected textile industry.

7. Conclusion

In the global textile industry, it's clear that we need to make changes for sustainability. Türkiye holds a significant opportunity to establish itself as a central player in the circular textile movement, offering economic advantages while addressing environmental concerns. While the industry brings economic benefits, its environmental impact is substantial. Shifting to a circular approach in textile production can bring transformative changes. It involves smarter material usage and the development of a digital system connecting companies with surplus materials to those in need. Türkiye, with a strategic assessment of its capabilities and ongoing initiatives, has the potential to lead this transformative change. By doing so, it can not only enhance its textile industry but also serve as a guiding example for the world, particularly for the EU, in the quest for a more eco-friendly and sustainable textile future.

CONTRIBUTION OF AUTHORS

This study was entirely conducted by Nilgün Aytekin.

CONFLICT OF INTEREST DECLARATION

There is no financial conflict of interest with any institution, organization or person and there is no conflict of interest among the authors

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Albert Einstein