

**UNDER THE SWORD OF DAMOCLES IN TECHNOLOGY POLICY MAKING: THE CASES OF TURKISH HEALTH BIOTECHNOLOGY AND RENEWABLE ENERGY SECTORS**

Teknoloji Politikası Yapımında Demokles'in Kılıcı Altında Olmak: Türkiye'de Sağlık Biyoteknolojisi ve Yenilenebilir Enerji Sektörlerinin İncelenmesi

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**ABSTRACT**

Health biotechnology (HEB) and renewable energy (RES) are emerging and promising research areas for developing countries and Turkey. Science and Technology (S&T) policies can potentially be exploited to eradicate the unbalances in S&T capacity building for developed and developing countries. Nonetheless, policy-making in these sectors is seen as ambiguous and unsettled in Turkey due to the developing nature of the technologies, the dynamic environment in which technologies are used and changing circumstances depending on the actors' problems and needs. Policies in HEB are loose compared to policies in RES. Nonetheless, these two sectors are distinct and unique in their peculiarities; responses to the policy problems are converging due to the common motivation of political intervention, namely uncertainty in decision-making. This joint structural response makes them search for illegal or auxiliary solutions for their sectoral problems and needs. Therefore, here the main examination unit is the 'uncertainty' in policy-makers' actions that make the actors behave in parallel despite structural differences. In this context, we discuss the socioeconomic impacts of the political intervention of the Turkish policy-makers in HEB and RES. For this purpose, two qualitative data sets are elaborated, and the joint and separate patterns behind the policy-making were examined with interview data from HEB and RES. In other words, we discussed the "character" sitting under the sword of Damocles. Is it a "policy-maker", "researcher", or the "firm owner"? Or are they inseparable, and so are they feeling the same fear?

**Keywords:** Health Biotechnology, Renewable Energy, S&T Policy, Technological Innovation System

**ÖZET**

Sağlık biyoteknolojisi (SAB) ve yenilenebilir enerji (YES), Türkiye'nin yanı sıra gelişmekte olan ülkeler için de yeni ortaya çıkan ve gelecek vaat eden araştırma alanlarıdır. Bilim ve Teknoloji (BT) politikaları, gelişmiş ve gelişmekte olan ülkeler için BT kapasitesi oluşturmada dengeszlikleri ortadan kaldırmak için potansiyel olarak kullanılabilir. Bununla birlikte, teknolojilerin gelişen doğası, teknolojilerin kullanıldığı dinamik ortam ve aktörlerin sorun ve ihtiyaçlarına bağlı olarak değişen koşulların Türkiye'de bu sektörler için politika oluşturma sürecini belirsiz ve huzursuz kıldığı görülmektedir. Sağlık biyoteknolojisi sektörüne yönelik hükümet politikaları, yenilenebilir enerji sektörüne yönelik titiz hükümet politikalarına kıyasla gevşektir. Politika oluşturmada bu yapısal farklılıklara rağmen, "siyasi müdahaleler ve prosedürlerdeki belirsizlik" güdüsü her iki sektördeki aktörlerin karar alma sürecinde standarttır. Bu güdü onları ulusal ve/veya uluslararası piyasalarda hayatta kalabilmek için yasadışı veya kayıt dışı çözümler aramaya zorlamaktadır. Bu nedenle, bu makalede, politika yapıcılarının eylemlerindeki "belirsizliğin" bu birbirinden farklı iki sektördeki aktörleri aynı tepkiye yönlendiren kaynakları incelenmiştir. Bu amaçla, Türkiye Cumhuriyeti Hükümeti'nin sağlık biyoteknolojisi sektörü ve yenilenebilir enerji sektörüne siyasi müdahalesinin sosyo-ekonomik etkileri tartışılmıştır. Bu çalışmada iki nitel veri seti ele alınmış, politika yapımının ardındaki ortak ve birbirinden farklı örüntüler SAB ve YES'ten elde edilen mülakat verileriyle incelenmiştir. Bir başka deyişle, Demokles'in kılıcı altında oturan "karakter" tartışılmıştır. Bu karakter "politika yapıcı" mı, "araştırmacı" mı, yoksa "firma sahibi" midir? Yoksa bunlar birbirinden ayrılmaz olduğu için hepsi birlikte aynı korkuyu mu hissediyorlar?

**Anahtar Kelimeler :** Sağlık Biyoteknolojisi, Yenilenebilir Enerji, BT Politikası, Teknoloji Yenilik Sistemi

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## GENİŞLETİLMİŞ ÖZET

Sağlık Biyoteknolojisi (SAB) ve Yenilenebilir Enerji Sektörleri (YES), Türkiye'nin yanı sıra gelişmekte olan ülkeler için de yeni ortaya çıkan ve gelecek vaat eden iki araştırma alanıdır. Ancak, gelişmekte olan ülke girişimcileri, sektör için geliştirilen politikalardan yatırım için sermaye ve teşviklere ulaşmaya kadar pek çok açıdan dezavantajlı durumdadırlar. Bu sektörlerle yönelik Bilim ve Teknoloji (BT) politikaları, gelişmiş ve gelişmekte olan ülkeler arasındaki BT kapasite birikimindeki farklılıkları ve eşitsizlikleri ortadan kaldırmak için güçlü araçlar olarak kullanılabilir. Ancak bu iki sektör, Türkiye'de BT politikalarının oluşturulmasında sorunlu araştırma alanları olarak ortaya çıkmaktadırlar. Sağlık biyoteknolojisi sektörüne yönelik hükümet politikaları, yenilenebilir enerji sektörüne yönelik titiz hükümet politikalarına kıyasla daha gevşek görünmektedir. Politika oluşturmadaki bu yapısal farklılıklara rağmen, "siyasi müdahaleler ve prosedürlerdeki belirsizlik" faktörü her iki sektördeki aktörlerin karar alma süreçlerinde önemli rol oynamaktadır. Bu faktör onları ulusal ve/veya uluslararası piyasalarda hayatta kalabilmek için yasadışı veya kayıt dışı çözümler aramaya zorlamaktadır. Bu nedenle, makalede, politika yapıcıların eylemlerindeki "belirsizliğin" bu birbirinden farklı iki sektördeki aktörleri aynı tepkiye yönlendiren birincil kaynak olduğu önermesi sorgulanmıştır.

Giriş bölümünden sonraki, "Türkiye Sağlık Biyoteknolojisi ve Yenilenebilir Enerji Sektörlerinde Demokles'in Kılıcı" başlığı altında, bir efsaneye atıf yapılmaktadır. Buna göre; Siraküza Kralı Dionysius, kral olmanın çok rahat ve güzel olduğunu savunan Demokles'e ders vermek için onu yemeğe davet eder. Onu önce varlık ve bolluk içinde sarhoş eder ama sonrasında ince bir sicimle tavana bağlanmış ağır bir kılıcın altındaki koltuğa oturtur. Diğer bir deyişle ona kral olmanın ve iktidarda bulunmanın aslında ne kadar zor olduğunu gösterir. Bu çalışmada söz konusu efsane ile Türkiye'deki gelişmekte olan teknolojilere ilişkin politika yapma süreçlerine bir gönderme yapılmıştır. Demokles söz konusu teknolojilerdeki aktörleri; Dionysius ise gücü elinde bulundurduğu için aslında rahat ve mutlak iktidar sahibi olarak görülen, her türlü sorunun çözümünde elindeki "politika" aracı ile mühadele edip sorunu ortadan kaldırmaktan sorumlu olan, çözülmemiş sorunlarda da suçlu bulunan politika yapıcıları, temel olarak da hükümetleri temsil etmektedir. İktidar sahibi olduğu için sorunlara çözüm bulmak konusunda mutlak bir güce sahip olduğu gibi, aynı zamanda bolluk ve rahat içinde olduğu düşünülen Dionysius, Demokles'e aslında bunun bir yanılsama olduğunu ve bu bolluk ve iktidarın aslında sürekli keskin bir kılıç altında oturmak zorunda olunan zor bir sorumluluk olduğunu göstermek istemiştir. Peki Türkiye'de SABYES Sektöründeki Demokles kimdir? Aslında iktidar sahibinin, tüm sorunları çözmekte muktedir olan hükümet olduğunu düşünen yani kılıcın altında duran "aktör" kimdir? Bu aktör "politika yapıcı" mı, "araştırmacı" mı yoksa "firma sahibi" midir? Yoksa bunlar birbirinden ayrılamaz olduğu için korkuyu kendileri yaratıp, yine kendileri mi hissetmektedirler?

Bu soruları aydınlatılabilmek için araştırmacılar, görüşmelerinde nitel araştırma yöntemini kullanmışlardır. "Sağlık Biyoteknolojisi ve Yenilenebilir Enerji Sektörlerinde Politika Oluşturma: Teknoloji İnovasyon Sistemi Yaklaşımı" bölümünde dünyadan alınan bazı örnekler üzerinden neden bu sektörlerde başarılı olunabilmesi için Teknoloji İnovasyon Sistemi Yaklaşımının kullanılması gerektiğini anlatmaktadırlar.

İki farklı sektörle ilgili bilgiyi tartıştığından bu çalışma, iki farklı saha deneyimi ve yöntem bilgisini ve alan verisini içermektedir. Dolayısıyla "a. Ampirik Analiz 1: Yenilenebilir Enerji Sektörü" ve "b. Ampirik Analiz 2: Sağlık Biyoteknolojisi Sektörü" olmak üzere iki alt bölümden oluşmaktadır. Birinci bölümde yenilenebilir enerji sektörünün ileri gelen elektrik üreticisi firma ve kurum temsilcileri ile, ikinci bölümde ise sağlık biyoteknolojisi sektör temsilcileri olarak üremeye yardımcı tüp bebek merkezlerinde sorumlu kişi olarak çalışan bireylerle yapılan yüzyüze mülakat verilerine yer verilmiştir.

Çalışmada "Health Biotechnology and Renewable Energy Sectors" yerine kısaca, bu sektörlerin baş harflerinden oluşan HEBRES kullanılmıştır. Türkçe özetle ise benzer şekilde oluşturulmuş (Sağlık Biyoteknolojisi ve Yenilenebilir Enerji Sektörleri) SABYES kullanılmıştır.

Bu makalede, Türkiye Cumhuriyeti Hükümeti'nin sağlık biyoteknolojisi sektörü ve yenilenebilir enerji sektörüne siyasi müdahalesinin sosyo-ekonomik etkileri tartışılmıştır. Sektörlerde yaşanan sorunların bu sektörlerle içkin olup olmadığı ve sektörlerin yapısal özellikleri tarafından mı yeniden üretildiği yoksa sektörlerle dışsal mı olduğu

incelenmiştir. Yarı yapılandırılmış görüşmeler yoluyla bu sektörlerdeki politika oluşturma yaklaşımları arasındaki karşılıklı ilişkilerin, benzerliklerin ve farklılıkların ampirik analizleri yapılmıştır. Türkiye'de gelişmekte olan bir yenilenebilir enerji sistemi için, kurumsal ve yasal belirsizliklerin sektörün gelişimini engelleyebileceği sonucuna varılmıştır.

Türkiye'de gelişmekte olan sağlık biyoteknolojisi sisteminin ampirik analizine baktığımızda ise, piyasada var olan birçok kurumsal ve yasal zayıflık bulunduğu görülmektedir. Enerji sektöründe görüldüğü gibi, bu kısıtlamalara ve yasaklara rağmen kısıtlı hizmetleri almak isteyen insanlar ve sağlık biyoteknolojisi uzmanları tarafından bulunan birçok alternatif yol vardır.

Ampirik analizlerin sonucunda görülmektedir ki, karar vericiler, Türkiye'de SABYES gibi yeni ortaya çıkan sektörlerle ilişkin politika kararlarını yeniden ele almalı, bunu yaparken de sektör temsilcilerinin nabzını tutmalıdır. Son söz olarak, Türkiye hükümeti yani Dionysius, Demokles yani SABYES'teki firmalar ve araştırmacılar üzerinde bazı açılardan söz sahibidir. Toplumların sosyal ve ekonomik refahı bilimin her dalı tarafından belirlenmeli ve SABYES gibi yeni gelişen sektörlerin uygulamaları ile ilgili deneme değil nihai kararlar bu konsorsiyum üzerinden verilmelidir. Demokles'in kılıcının altındaki aktör "politika yapıcı", "araştırmacı", "firma sahibi" veya kim olursa olsun, kılıcın vereceği olası zararların bütün toplum aleyhine olacağı unutulmamalıdır.

## INTRODUCTION

Health biotechnology and renewable energy sectors are two promising areas for new types of solutions to welfare-related problems (such as reproductive problems and environmental degradation due to the increasing use of fossil fuels) with emerging technologies. These sectors are chosen as the research objects of this study regarding their science and technology (S&T) policy-making dynamics to understand how S&T policies are designed to solve the problems. However, the examination here needs to include more technical aspects of these two research and development-intensive fields. The main aim is to elaborate on these sectors' societal reflections and policy-making processes. To this aim, we benefited from the sociological imagination as the analysis tool. Using two separate and independent field research data, the relations and analogies between the Health Biotechnology and Renewable Energy Sectors (referred to as HEBRES hereafter) are interpreted from the social science perspective with a focus on political and social aspects.

For this purpose, we analyzed two separate qualitative data collected through semi-structured interviews with the key actor from these sectors. In the empirical analysis, the main discussion is on the social reflections of the recent policy implications in these sectors. The paper is concluded with an analysis of similarities and differences in S&T Policy Making in these two sectors and the main results of the common S&T policy-making patterns for the Health Biotechnology and Renewable Energy Technologies in Turkey. Via these inferences, the target is to reach outcomes as a considerable part of the 'big picture' related to two emerging Turkish sectors.

The main question here is to find out who is under the sword of Damocles in policy-making in the field of S&T in Turkey. When formulating science and technology policies, the social and economic conditions of the country in question and the economic opportunities created by developing and utilizing new technologies should be considered together. In general, developed countries such as the USA, China, the UK or Germany turn this situation into an economic opportunity, and Turkey does not seem to benefit from these advantages.

After the introduction in the first section, in the second section, the literature review was made for 'science and technology policy making as a tool of sociological imagination' to emphasize this study and its objectives. In the third section, after a brief description of the method used and the data collected for the analysis, renewable energy and health biotechnology sectors in Turkey are described, and preliminary results of the empirical analysis are presented. In the final section of the conclusion, we developed the subject argumentations towards the sociological imagination tools and suggested some policy tools in the following versions of the text.

## 1. Theoretical Framework

### 1.1. Sword of Damocles in Turkish Health Biotechnology and Renewable Energy Sectors

When science and technology policy-making is regarded as a question, one could think about the subject country's social and economic conditions on the one hand and the economic opportunities which can be created by developing and using new technologies on the other. These possible economic advantages are attributed to developed countries such as the USA, China, England or Germany. Turkey has yet to benefit from these advantages under cover of self-possession.

Again, we ask what happens if (the actors in) HEBRES puts themselves in place of Damocles:

'...This tyrant, however, showed himself how happy he was; for once, when Damocles was dilating in conversation on his forces, his wealth, the greatness of his power, the plenty he enjoyed, the grandeur of his royal palaces....., "Have you an inclination," said he, "Damocles, as this kind of life pleases you, to have a taste of it yourself, and to make a trial of the good fortune that attends me?" Moreover, when he said that he should like it extremely, Dionysius ordered him to be laid on a bed of gold with the most beautiful covering, ..... tables provided with the most exquisite meats. Damocles thought himself very happy.'" (Cicero, 1877: 186)

It is a pleasure of wealth which makes Damocles so happy. However, this pleasure would transform into pain through decision of Dionysius:

'...In the midst of this apparatus, Dionysius ordered a bright sword to be let down from the ceiling, suspended by a single horse-hair, to hang over the head of that happy man. .... At last he entreated the tyrant to give him leave to go, for that now he had no desire to be happy. Does not Dionysius, then, seem to have declared there can be no happiness for one under constant apprehensions? But it was not now in his power to return to justice, and restore his citizens their rights and privileges...had he attempted to have returned to a right way of thinking, he must have endangered his life'(Cicero, 1877: 186)

Under the title "Sword of Damocles", a legend is referred to. According to this legend, Dionysus, the King of Syracuse, invites him to dinner to teach a lesson to Damocles, who argues that being a king is very comfortable and beautiful. He first intoxicates him with wealth and abundance but then sits him in a chair under a heavy sword tied to the ceiling with a thin twine. In other words, he shows him how difficult it is to be king and to be in power. In this study, this myth is used as a reference to the policy-making processes regarding emerging technologies in Turkey. Damocles represents the actors in the technologies in question; Dionysus represents the policy-makers, mainly the governments, who are seen as comfortable and absolute power holders because they hold power, who are responsible for solving all kinds of problems by intervening with the "policy" tool in their hands and eliminating the problem, and who are found guilty in unsolved problems. Dionysius, who is thought to have absolute power to find solutions to problems because he has power, as well as being in abundance and comfort at the same time, wanted to show Damocles that this is an illusion and that this abundance and power are a difficult responsibility that you have to sit under a sharp sword all the time. So who is the Damocles in the HEBRES Sector in Turkey? Who is the "actor" under the sword who thinks that the government has the power and can solve all the problems? Is this actor a "policy-maker", a "researcher", or a "company owner"? Our qualitative analysis examines analogies and interpretations to find out who is/are under the sword of Damocles (HEBRES Sectors) during the sectoral development under the S&T Policies. Here, we benefitted from sociological imagination and Technology Innovation System approaches together.

### 1.2. A Literature Snapshot on Technology Innovation System Approach for S&T Policy Making:

The energy sector is unique in its essential peculiarities, and policy-making must consider them for the policy design process. For the emergence and dissemination of renewable energy technologies, these peculiarities legitimize using technology-specific policies in the innovation system to improve the system as a whole (Jacobsson and Bergek, 2004;

Sanden and Azar, 2005; Jacobsson and Lauber, 2006; Jacobsson and Bergek, 2011). Long-term perspective, interrelatedness with the other energy sub-sectors, political nature, and the need for dynamic policy-making.

‘Long-term perspective’ is one of the crucial peculiarities of energy policy making. The Energy Sector is a complex and huge system, and the renewable energy sub-sector is just a part of the whole sector. We must consider the renewable energy sub-sector as a unit, a part of the energy sector, and other parts. Hence, for the emergence and dissemination processes of new renewable energy technologies, the renewable energy technology policy is designed with a long-term perspective in a meaningful energy context.

In this context, the renewable energy sector does not evolve as a compact structure, and the other energy sub-sectors are interrelated and interdependent. To design technology policies and to create incentives for investors of renewable energy technologies, the policy-maker must take into account the direct and indirect subsidies to incumbent technologies in the energy sector. This policy design process must encompass all possible relationships between other energy sub-sectors.

Moreover, the nature of policy design is another specificity. Policy-making is a highly political business and highly dependent on framework conditions. Hence, lobbying over policy goals and institutional framework design should be emphasized during the policy design. Especially for emerging renewable energy technologies, the environment and the circumstances are continuously changing due to continuous and dynamic technological changes. Hence, to analyze the process of technology change and to support this process, a dynamic and flexible approach is needed. In this context, Technological Innovation System Approach is the policy framework that evaluates all these peculiarities for which the policy is designed. Therefore, by considering all these, Technological Innovation System Approach is used to design technology policies in the renewable energy sub-sector in Turkey (Jacobsson and Bergek, 2011).

Moreover, the innovation system approach is also used as a theoretical framework for health sector analysis. According to Cassiolato and Soares (2015), innovations and technological change are increasingly recognized as central driving forces of the transformation of economic structures and development in the health sector, and Schumpeter’s concept of development contributed to this debate with two central ideas of the connection of technology to production; and the disruptive character of development. The first idea relates innovation with economic agents, leading to the generation of new products, new processes or the establishment of new markets. Cassiolato and Soares (2015) underline the health sector as one of the new emerging markets concerning the rate of health spending in overall GDP worldwide. In overall GDP, it was 17.9% in the United States in 2011, 12.0% in 11.6% in France and Germany, as in the case of most developed countries. On the other hand, emerging and developing countries like India, China and Russia are different.

Moreover, Cassiolato and Soares (2015) emphasize that in Latin America, the Innovation System approach is used as a tool of analysis in the industries of aerospace, biotechnology, automobile, software, textiles-apparel, agro-industry, tourism, footwear, music and other creative industries in the studies of Lopes and Lugones (1999), Vargas (2000), Segura (2000), Cassiolato et al. (2003), Matos and Britto (2011) (Cassiolato and Soares, 2015: 23). Also, the application of Innovation System Approach for the local health biotechnology sector in Europe, such as Santos and Marques (2012) study of the Health Cluster in Portugal, the study of Doloreux et al. (2003) on the Science Park to facilitate a medical technology cluster in Linköping, Sweden, and the study of Hypponen et al. (2005) on the virtues and difficulties to systematically innovate in health are the other examples of innovation system approach referred by Cassiolato and Soares (2015).

With the motivations given above for renewable energy and health sectors, in this study, we benefitted from the Technological Innovation System approach as the theoretical framework of our analysis for the S&T Policy-making in health biotechnology and renewable energy sectors (HEBRES). The Technological Innovation System Approach is the functional analysis of the technology and innovation development activities in a specific sector and research area. The main aim is to understand the overall performance of the technological innovation system by the diagnosis of the main problems in the emerging technology sector, then to find solutions by taking care of the needs of the actors and changing environment through designed policies (Bergek and Jacobsson, 2003; Bergek et al., 2008, Jacobsson and Bergek, 2004; Jacobsson et al., 2004; Hekkert et al., 2007).

## 2. Methods and Materials

In this study, we examined two separate and different sectors and made two independent and parallel empirical analyses: **Empirical Analysis 1** for Renewable Energy Sector and **Empirical Analysis 2** for Health Biotechnology Sector in Turkey. Then, we combined this empirical analysis by identifying the similarities and differences in S&T Policy-making dynamics.

In the Empirical Analysis 1, renewable energy representative was interviewed: As a part of an extensive data set of key experts from the energy sector, 17 in-depth interviews were conducted with private companies that worked in renewable electricity generation in Turkey between 2014 and 2016. The participants were mainly experts from national and international energy companies that are generating electricity from renewable sources or applied to generate and sell renewable electricity in large-scale licensed electricity generation facilities. The interview guide has questions on the interviewee's profile, the energy sector in Turkey, the obstacles and facilitators for technological improvements, the policy-making process and sectoral development.

In the Empirical Analysis 2, health biotechnology sector representatives were interviewed: 5 in-depth interviews were conducted with experts from In Vitro Fertilization (IVF) Centers during the period of 2014-2016 in the health biotechnology sector in Turkey. The participants were the key practitioners of health biotechnology policies in Turkey. Five interviews were conducted with the managers and specialists from different Assisted Reproduction Technologies Centers in Ankara, Turkey. These centres were chosen randomly, and a semi-structured interview guide was used in these interviews. The interview guide included profile questions about the centre, the allowed and restricted applications in the centre, their ideas about the policies, restrictions, and their interpretations and suggestions.

We benefitted from snowball and purposeful sampling for both data sets to reach the interviewees. The authors did each interview in person; detailed notes were taken; memos were prepared, and under the interviewee's approval, tape recording was made and transcribed during the data collection. For the analysis, the raw data was coded by line-by-line coding and the thematic analysis was conducted to derive the main themes of the discussions.

## 3. Data Analysis and Findings:

### 3.1. Empirical Analysis 1: Renewable Energy Sector

In empirical analysis 1, as a part of an extensive empirical data set of critical expert interviews from the renewable energy sector, 17 in-depth interviews were conducted with experts from national and international companies whose main activity is electricity generation from renewable sources. These companies are located in various cities in Turkey, namely Ankara, İstanbul, İzmir, Denizli and Kayseri. The time period of the research is 2014-2015, during the first phase of sectoral development of the renewable energy (mainly renewable electricity generation) sector in Turkey. The participants were the key experts in renewable electricity producer companies. Ten companies were active in large-scale electricity generation with commercial licenced renewable power plants. Four were small-scale producers with unlicenced renewable energy power plants and mainly the investors who built these plants for their own self-consumption needs. The remaining three interviewees were from companies that generate renewable electricity in large-scale licenced and small-scale unlicensed power plants. The participants are general managers, project engineers and heads of company units. We asked questions about the current structure and dynamics of the Turkish energy sector, the main problems, their suggestions for solutions, their perception of change towards the usage of renewable sources as a solution to the energy problem, and the policies in the renewable energy sector in Turkey. In this study, the main aim is to understand the primary motivations of renewable electricity generation, to learn fundamental problems in the sector and to understand the role of technology policies in the acceptance and diffusion of emerging renewable energy technologies from the perspective of the firm's perspective.

The highlighted results of the study are summarized as follows:

- The 'import dependency' is the strongest motivation behind Turkey's diffusion of renewable energy technologies. One of the interviewees from a Turkey-based (national) company which generates

electricity both with large-scale and small-scale renewable energy power plants underlined this import dependency problem by touching upon the relations with Russia and said, "We are highly dependent on imported natural gas, especially in wintertime. Import dependency, especially on Russia, may create another indirect threat to electricity supply security since natural gas is also intensively used for heating purposes in Turkey.<sup>1</sup> In case of an unexpected natural gas shortage, natural gas power plants may shut down and hence natural gas supply for electricity generation is also endangered."

- The 'lack of long-term planning' is the most important problem underlined mainly by the large-scale licenced electricity producers as a critical factor that increases the role of uncertainty in the decision-making process, specifically for new investment decisions in the Turkish renewable energy sector. This high risk coming with 'uncertainty' makes international companies hesitant to invest in new renewable energy power plants and technology development activities. For example, the interviewee from a multinational energy company (that describes itself as the "World's largest independent renewable energy company that has 23 GW total installed capacity all over the world in 40 years experience") told that "...our company wants to invest in Turkish solar energy sector and projects a considerable potential in the country. We are following the solar energy licence applications and the head of the region asked me (*the business development leader in Turkish Region*) about the investment projections in different market segments of small and large-scale production. Since I cannot provide a clear roadmap for the investment decision, the head pivoted to an investment decision in Turkey. It postponed the new investment until the company can clearly make projections in the Turkish market."
- The other problems stated by the interviewees from renewable energy firms are the need for more and the insufficiency of codes, rules and standards in the sector for quick adaptation to developing technologies and changing circumstances and asymmetric policy-making and evaluation processes in the renewable energy sector. These problems mainly refer to changing nature of the technology and the unpredictable nature of technology development in the sector that creates uncertainty in the actions of policy-makers that lead the actors to find some auxiliary solutions for their sectoral needs.
- From the perspective of renewable energy firms, the 'optimal energy generation bundle' (by which sources we produce the energy) is critical for policy-making. Such a bundle was told to be a balanced bundle that included various energy sources (rather than one dominant fuel) and at least 25% renewable power overall, according to the interviewee, who has a long-lasting experience in different energy sectors (including fossil fuels) and currently active in small scale renewable electricity generation, variety of energy sources in energy bundle provided to minimize the risk in energy supply. Moreover, sustainable energy feeding of the grid was one of the main motivations for robust energy bundles for large energy companies. Hence the local character of renewable energy technologies is critical. That is why energy companies strategically increase the share of renewable sources in energy bundles to guarantee the transfer of energy sources to power plants to decrease the risk of a blackout in the energy supply. When considering the renewable energy policies design, the energy bundle should be taken into account not just by the national energy security concerns but also considering the sustainable, dispatchable energy supply of electricity generation firms (who own the power plants.)
- Renewable energy is an emerging industry with enormous profit potential. This energy subject is multidimensional and has to be considered carefully for each country, considering the local dynamics. The policy-making process should also take these multidimensional aspects into account.
- According to the perception of renewable electricity generation firms, policy-makers unintentionally slow down the development of the renewable energy sector in Turkey with policies that have indirect

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<sup>3</sup> In 2013, during the data collection period, 59% of total natural gas consumption was used for heating purposes at home-based consumption (ETKB, 2013). Now in 2022, 46% of total natural gas consumption is used for the same purpose (EKTB, 2022). We can see a slight decrease, but still, it is large and creates supply security problems for heating and electricity generation purposes.

restrictions and limitations on the diffusion of the new technology (for ex., measurement prerequisite in solar energy licence applications). These policies were accepted as the control mechanism of government, however in one sense, that let actors find auxiliary solutions (for ex., in the case of solar energy licence applications, the investor built small-scale unlicensed power plants to sell the electricity to the grid, rather than to use for self-consumption.)

- The ‘dependency on physical conditions for renewable energy’ can be an opportunity rather than an obstacle for the Turkish Renewable Energy Sector. Due to the appropriate physical conditions in Turkey, de-centralized off-grid renewable energy systems, especially for the settlements far from the grid systems, are promising solutions for the losses in transmission and distribution of electricity and energy problems. Therefore three participants, who were one of the leading large-scale renewable electricity generation companies' representatives, small-scale electricity producers and the winner of the first solar electricity generation license applications, agreed that investment in renewable sources could be seen as a medium of regional economic development with its socioeconomic benefits. This is a strength of renewable energy technologies and can be beneficial for designing technology policies for the diffusion of these emerging technologies in a developing country.
- Nuclear power and renewable energy are not substitutes for each other for the solution of Turkey’s import dependency problem in energy supply, and they should not be perceived as alternatives to each other. Because their contexts are different and incommensurable, the design policies are different in direction. Therefore, while discussing different energy sources, the policy-maker must consider complementarity between various energy sources to design policies targeting optimal energy bundles rather than substituting each other.
- Preference for renewable sources instead of fossil fuels with environmental concerns necessitates a 'conscious choice of society' as a whole, and conscious and intentional acceptance of the society can achieve this preference. It is possible, but too much effort is needed, especially in countries like Turkey. Hence, legitimation needs more effort in the Turkish renewable energy case.
- There is a ‘transformation in the perception of the public sector's role in the energy sector’. At the very beginning of the establishment of the Turkish Republic, the state's role was central to the country's economic development. So was in the energy sector. The government entirely performed the energy investments. However, the state's role in the energy sector is changing. The public sector is retreating from the scene and is minimizing its role in energy investments. This role is transferred to the private sector. However, this is a transition period, and hence the government is trying to determine its role in the energy sector mainly to support the sector indirectly from backstage.

With the highlights of the empirical analysis of Turkish Renewable energy given above, we can say that the main peculiarities in the energy sector of “considering the long-term perspective, interrelated and interdependent nature of policy actors, context-dependent policy-making practice under given framework conditions and the need of dynamic and flexible approach for healthy diffusion of emerging renewable energy technologies” draw the borders of technology policy-making with innovation system perspective. The main finding of the empirical data leads us to dig into details of problem-solving technology policies for diffusion renewable energy policies.

### 3.2. Empirical Analysis 2: Health Biotechnology Sector

Medicine is a field in which technology has been widely used from time immemorial to the present day and contains different aspects of technology. While the available physical facilities make the achievements in the field of medicine visible through technology as a way of solving problems, the disembodied part of technology comes from some specializations, past experiences, and knowledge of past technological applications. It is known that medicine has used various technologies and developed different routines at different times in its journey so far.

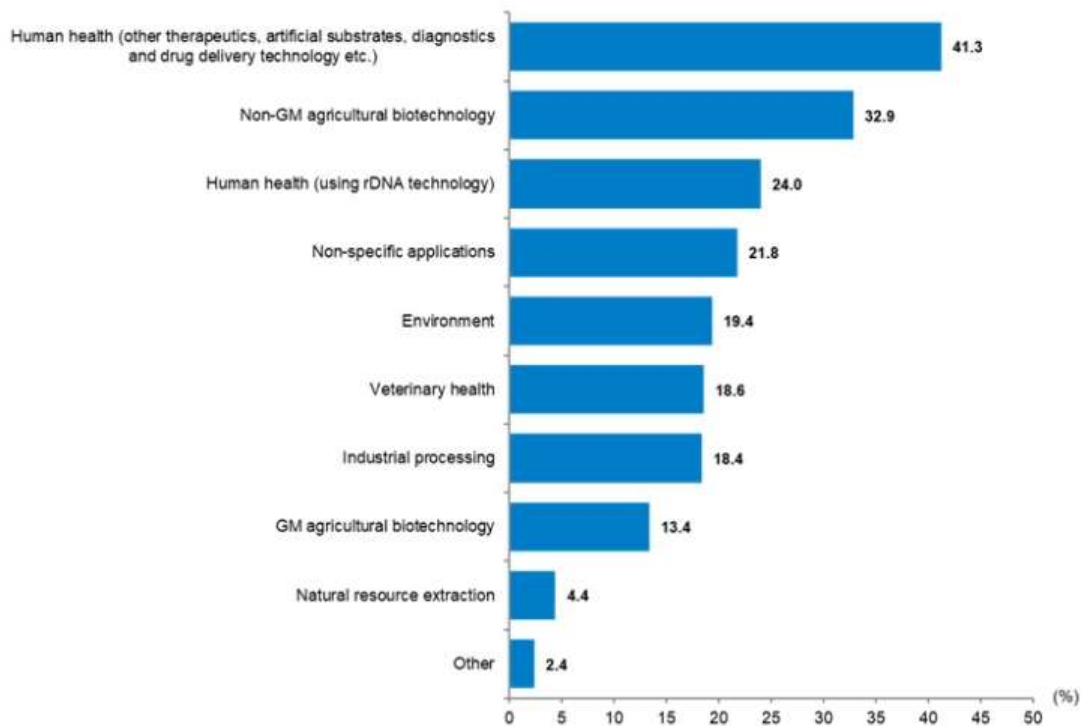
For Pickstone (2007: 504), “at the end of the mapping of new chemistry and the development of other analytical sciences up to today, the set of transformations that created ‘science’ in the modern sense but that also created the



modern roles of engineer, medical doctor, and artist as ‘the second scientific revolution’ around ‘1800’.” The changing roles of individuals and organizations and the relationship between professional practice have influenced these modern roles. As a result of this influence, various changes have emerged related to vocational roles and have affected the field of medicine as in other fields.

Turkey has been affected by this modern medical development fastly. According to the Biotechnology Statistics of TURKSTAT (2022) in Turkey, 499 enterprises carried out biotechnology activities in 2020. In other words, 499 enterprises used biotechnology in their goods or services and carried out biotechnology Research and Development (R&D) activities. The number of enterprises active in biotechnology was 363 in 2019. When the enterprises active in biotechnology using at least one biotechnology technique by size groups were examined, it was observed that 369 enterprises had 1-9 employees, 67 enterprises had 10-49 employees, 37 enterprises had 50-249 employees, and 26 enterprises had 250 or more employees in 2020. In 2020, enterprises active in biotechnology used mostly "DNA/RNA" techniques. The number of enterprises using the "DNA/RNA" technique was 261. This was followed by "process biotechnology techniques" used by 155 enterprises and "cell and tissue culture and engineering" techniques used by 139 enterprises.

**Figure 1: Proportions of enterprises active in biotechnology by biotechnology applications, 2020**



**Source:** TURKSTAT, 2022.

According to the objectives of biotechnology activities, 41.3% of 499 enterprises engaged in biotechnology used biotechnology for human health (other therapeutics, artificial substrates, diagnostics and drug delivery technology etc.), while 32.9% of them for non-GM agricultural biotechnology and 24.0% of them for human health (using rDNA technology) in 2020 (TURKSTAT, 2022).

In the empirical analysis, as a part of extensive empirical data of the critical health expert interviews, five in-depth interviews have been conducted with experts from IVF Centers between 2014 and 2015 in the health biotechnology sector in Turkey. The participants are the key practitioners of health biotechnology policies in Turkey.

Five interviews were conducted with the managers and specialists from different Assisted Reproduction Technologies Centers in Ankara, Turkey. These centers were chosen randomly, and a semi-structured interview guide

was used in these interviews. The interview guide included some questions about the centre, the allowed and restricted applications in the centre, their ideas about the policies, restrictions and their personal interpretations and suggestions.

Some of the results of the study:

- An emphasis on the roles of religion and culture in bringing such restrictions.
- An economical loss: ‘...Iran is on the front of Turkey in this issue, Royan Institute<sup>2</sup> has a crucial role in stem cell research. It is essential because it does not need any third person [donors]. It takes its source from the DNA of people themselves. This example was important because if there would not be any donors, religion could not find any evidence for its rejection.
- The limitations on social health insurance and its scope. Especially the limited number of pregnancies of In vitro-babies (only one baby): 'When you say that I support reproduction, then you should allow them to have 9 babies if they (people) want'.
- A problem in reproductive organ and tissue donation from third parties: '... Oocyte or sperm donation or surrogate motherhood are banned in Turkey, and even suggesting that alternative or another centre abroad [consultantship] are also banned, we are suggesting the patients have adoptions [adopting children who have already born].' However, he admitted that some patients had come back to him for other reasons and cited that adoption insensitively as 'Sir, do you remember that it could not be realized and we got it ...' near the adopted child. Hence he meant that people would prefer to have their children rather than overcome the social and behavioural problems of other people's children.
- In the political decisions, the Biotechnology Association<sup>3</sup>'s role should be adopted more because reproductive policies are critical. Reproductive medicine has a rapid development among all other fields in Turkey. Social regulations and price policies are also important in this issue.
- A specific problem is the condition of marriage. As it is known, only married couples can apply to IVF Centers to have children. Using third parties' organs and reproductive tissues is banned in Turkey. However, IVF Centers may be convinced by the patients. A man can introduce any woman as his wife and they can be regarded as if they had committed a crime together in the end.
- Directing people to another country or centre was also banned by Regulation 2010 ( Turkish Official Gazette, 6.03.2010). Before that date, they could conduct some applications, such as the sex selection of embryos, but they cannot do it anymore. It is mentioned that the reproductive demands of couples should be covered and affordable in Turkey. The IVF Centers are unable to warn their patients even about the unsafe and unhealthy conditions of some countries' ART centres.
- Social and ethical problems in using the genetic material of the donor or womb of surrogate mothers.
- A policy, a group or a religion should not prevent any people from their reproductive choices/rights.
- Benefiting from assisted reproductive technologies would socially contribute to the traditional family structure. People, especially from central Anatolia and the eastern region of Turkey, may have some sexual intercourse with their relatives or foreigners in order to have children. They adopted such behaviour since they were under intense social pressure from their families and social environments.
- Developments in mitochondrial transportation. This technology was generated and allowed in the UK. This development was regarded as a radical innovation that reduces the entire donor DNA use, but again, this new technology would need an oocyte supplier for that aim.

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<sup>4</sup> Royan Institute was established with an emphasis on Stem cell biology and Technology in Iran: <https://royanstemcell.ir/>

<sup>5</sup> For the website of the Biotechnology Association, visit: <https://www.biyoteknoloji.org.tr/>

Health biotechnology debates are mainly conducted around IVF processes. Despite the regulations and bans, the conversations and processes are being practised between the patient and the embryologist or gynaecologist. It is essential but difficult to manage and control the health biotechnology sector, as seen above since it directly relates to population, personal relations and preferences, privacy and ethics.

## CONCLUSION

Health biotechnology and Renewable Energy are two emerging research areas for Turkey. Science and Technology Policies are tools to eliminate the problems in the sector and differences in S&T capacities between developed and developing countries. However, these two sectors are growing as problematic research areas for S&T policy-making in Turkey. Government policies are rigorous in the health biotechnology sector and loose in the renewable energy sector. Despite this difference in policy-making, “unforeseen outcomes of political interventions and procedures” are expected in decision-making for the actors. This motive compels them to seek “illegal or auxiliary (so-called as 'off-the-record) solutions” to survive in national and international markets. These auxiliary solutions are first realized as the unintended consequences of intentionally designed S&T policies specifically for the diffusion of these emerging technologies. Due to the peculiarities of the two sectors dictate itself, these auxiliary solutions become policies to adapt to the changing conditions and respond to the sector's rising needs. Hence, in this study, we intended to answer the question of “What are the unforeseen outcomes of political interventions and procedures" namely "threats", which lead the actors to illegal or off-the-record ‘solutions’ in these different emerging sectors?”

The unforeseen outcomes of Turkish government policies towards the Renewable Energy sector are:

- Unlicensed electricity generation substitutes licensed electricity generation due to bureaucratic burden.
- This practice of unlicensed electricity generation is the off-the-record solution to diffuse renewable electricity in Turkey.
- The government oversees this kind of unlicensed producers to reach policy targets (to diffuse renewable electricity generation).

This creates an unforeseen growth path of renewable electricity generation in Turkey; unfortunately, these plants' future is unclear and uncertain.

The unforeseen outcomes of Turkish government policies towards the Health Biotechnology sector are:

- A general criticism towards the reproduction policies of the Turkish government exists.
- The participation of third parties in the insemination and IVF processes is shown as a threat for religious reasons.
- Instead, a legitimization of reproductive policies and decisions is highly needed.

Therefore the sword, a threat, is assumed in both cases. Moreover, there is a full awareness of firms about the inadequate policies of the Turkish government. Hence, firms behaved according to these threats. As a solution, while the firms in RES tolerate the outcomes of policies to generate renewable electricity, firms in HEB still have legal difficulties in overcoming the rigorous policies. Also, firms have to survive in both national and international markets. Their alternative ways should be considered and policies should be arranged according to social needs.

When one passes over the empirical analysis, s/he would see that the decision makers should give their policy decisions on the new emerging sectors such as HEBRES in Turkey via re-arranging of the subject, in doing so, they should try to invite imagination even in policy making. In this study, we get better insight by considering extremes by thinking of the opposite of the one we are directly concerned about. That leads us to think in more critical and alternative ways.

As a final statement, the Turkish government, namely Dionysius, has power over Damocles, namely HEBRES, firms and researchers in some respects. An interdisciplinary approach should determine the social and economic welfare of societies. Final decisions and actions regarding the new emerging sectors' applications, such as HEBRES, should

be given by the policy-makers adaptively in a dynamic manner by taking care of the main problems in the sectors and the needs of the actors.

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## REFERENCES

- CASSIOLATO, J. E and SOARES, M. (2015) Innovation Systems, Development and Health: an Introduction, in Book *Health innovation systems, equity and development*, Edition: 1 (Eds: José E. CASSIOLATO, Maria Clara C. SOARES), E-Papers, Rio de Janeiro.
- HEKKERT, M.P., NEGRO S. O., HARMSSEN R., and HEIMERIKS G.J. (2007) "Technology innovation system analysis: a manual for Analysts", Utrecht, The Netherlands: Utrecht University, Report for Joint Research Center, Energy Institute.
- JACOBSSON, S. and BERGEK, A. (2004), "Transforming the energy sector: The evolution of TIS in renewable energy technologies", *Industrial and Corporate Change*, 13(5), 815-849.
- JACOBSSON, S., LAUBER, V. (2006) "The politics and policy of energy system transformation—explaining the German diffusion of renewable energy technology", *Energy Policy*, 34, 256–276.
- JACOBSSON, S and BERGEK, A. (2011), "Innovation system analyses and sustainability transitions: Contributions and suggestions for research", *Environmental Innovation and Societal Transitions*, v.1, pp.41–57.
- PICKSTONE, J.V. (2007) "Working knowledge before and after circa 1800: Practices and disciplines in the history of science, technology and medicine," *Isis*, Vol.98/3, The University of Chicago Press on behalf of The History of Science Society, pp. 489-516.
- SANDEN, B. A. and AZAR C. (2005), "Near-term technology policies for long-term climate targets-economy wide versus technology-specific approaches", *Energy Policy*, 33, 1557–1576.

- URL 1: ETKB (T.C. Ministry of Energy and Natural Resources) (2013). National Equilibrium Tables, available at: <https://enerji.gov.tr/eigm-raporlari>.
- URL 2: ETKB (T.C. Ministry of Energy and Natural Resources) (2021). National Equilibrium Tables, available at: <https://enerji.gov.tr/eigm-raporlari>.
- URL 3: Turkish Official Gazette, Republic of Turkey Ministry of Health, Regulation on Assisted Reproductive Treatment Practices and Assisted Reproductive Treatment Centres, dated 6 March 2010 and numbered 27513, URL: <https://www.resmigazete.gov.tr/eskiler/2010/03/20100306-10.htm>.
- URL 4: TURKSTAT (2022) Biotechnology Statistics, Accessed on 1st December 2022, URL: <https://data.tuik.gov.tr/Bulten/Index?p=Biotechnology-Statistics-2020-37449>.